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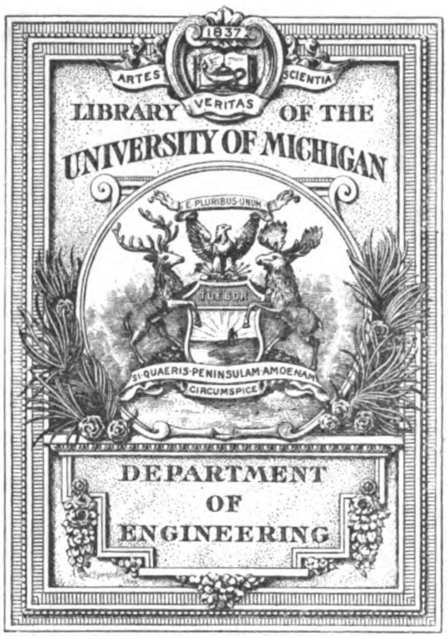

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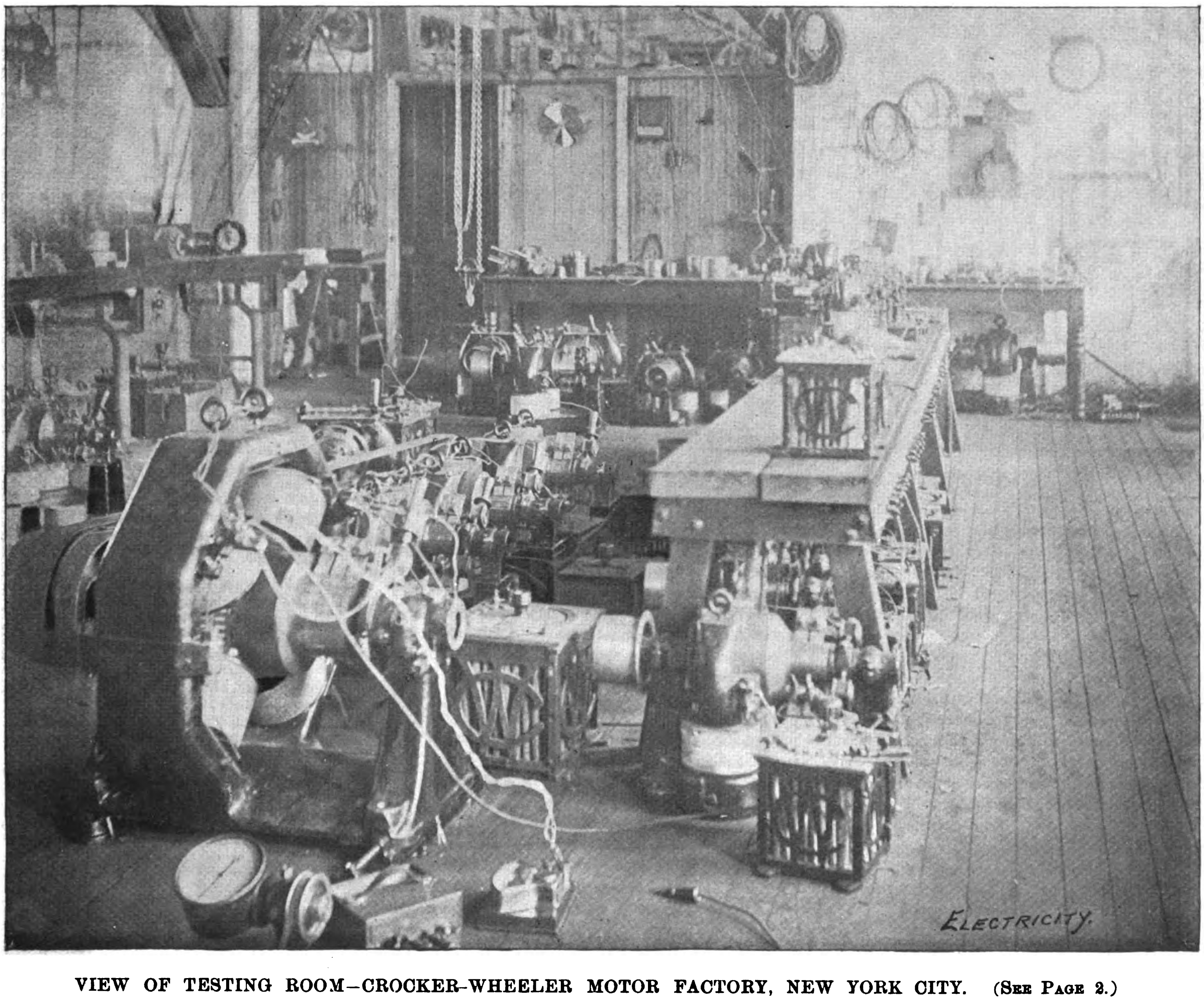


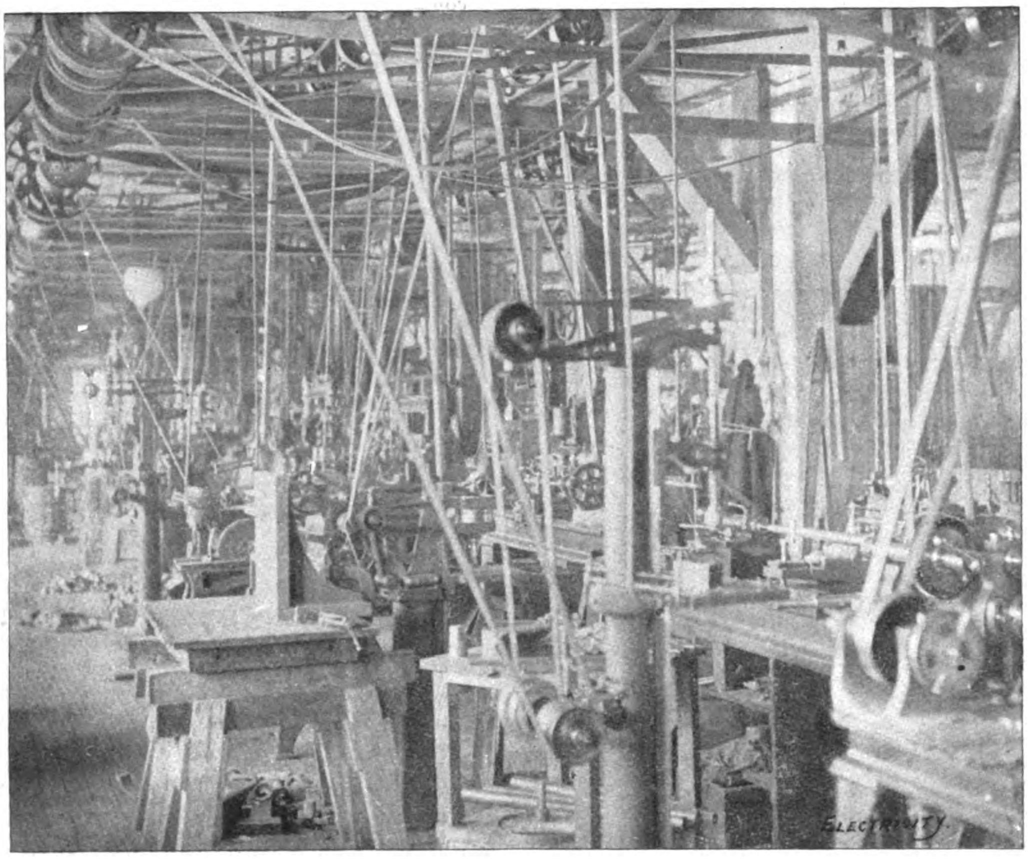
VIEW OF TESTING ROOM—CROCKER-WHEELER MOTOR FACTORY, NEW YORK CITY. (See Page 2.)

An Electric Motor Factory.

Works of the Crocker-Wheeler Company.

One of the most prosperous and enterprising electrical manufacturing concerns among the many which are to be found in New York is the Crocker-Wheeler Motor Company, whose present factory is situated on the corner of Fourteenth street and Tenth avenue. We say *present* factory advisedly, as this concern has now, for the second time, outgrown its factory capacity and is forced to seek larger quarters in order to meet the demands for its machinery, which have increased beyond the capacity of its present plant. The situation of the new plant has not yet been decided upon, but a change of location is definitely announced for the coming spring.

Notwithstanding the growing number of electrical concerns supplying small sized motors and accessories, the Crocker-Wheeler Company has doubled its business during the past year, and it was recently found necessary to increase the capital stock from $200,000 to $400,000. A feature of the new factory will be the conspicuous absence of belting and shafting throughout the entire works. The plan to be adopted is to transmit the power to each machine by wires which will connect to a motor on the machine and drive it direct. This method will be followed in the case of every machine where it is found possible, and will result in a considerable saving of power which would be otherwise required to constantly run lines of shafting and counter-shafts to each machine, as well as a large saving in the cost and maintenance of belts, counter-shafts, pulleys, oiling, etc.



Machine Shop—Crocker-Wheeler Motor Factory.

There are three hundred hands employed in the factory at present, but after removal the number will be considerably increased. The principal part of the works is situated on the second floor of the building in Fourteenth street, although the basement is used as a storeroom, and the fourth floor is utilized exclusively for a winding room for armatures of one-sixth horse power machines and under.

On the second floor, which is a long, narrow room covering the entire space of the building, is situated the machine shop. This shop contains all the machinery used in the manufacture of motors and is confined to about half of the entire floor, a central partition running the length of the room separating the testing room, armature and field winding room, where the larger sizes of machines are wound, and an erecting shop. Our frontispiece shows a view in the testing room, through which all the motors manufactured must undergo the ordeal of a thorough test before being put upon the market, and here every facility is to be found for accurately testing the motors down to any degree of precision.

It was formerly the case, and is still generally understood, that the Crocker-Wheeler machines are manufactured in sizes up to five horse power only. This is, however, no longer the case, as the company is now prepared to manufacture machines of any capacity up to thirty horse power, and after increasing its facilities for handling heavy machines will be prepared to furnish motors of any size desired. They will continue to make their small motors and the different machine combinations on which their reputation has been built.

The machines of the various sizes up to five horse power are almost too well known to need description. There is one point however in connection with them which is worthy of notice. It will be remembered that drop forgings are used entirely in all the machines up to five horse power, and these motors have been the means in no small degree of improving and extending the possibilities in the manufacture of drop forgings. It is but a few years ago that the forgings for the larger sizes of these motors were considered impossible to make, and for some time the sizes of these machines were limited to the sizes of the forgings possible to obtain. This company may therefore be considered as one of the leading factors in the promotion of drop forgings. The growing tendency in the direction of multipolar machines, especially in the case of those of larger sizes, has been appreciated by this company and has resulted in a type of motor which will be the one adopted for all sizes above five horse power. A machine of this type, in this case a fifteen horse power motor, is shown in the foreground of our frontispiece. This, unlike the small sizes made by this company, has a cast iron frame with four internally projecting pole pieces on which the field coils are wound.

The frame is divided through the centre horizontally, enabling the upper casting with its two pole pieces to be lifted off without otherwise disturbing the machine. The starting boxes used with these machines are also shown in the illustration. These are of the old style resistances arranged in spiral coils and placed in an open cast iron frame permitting ample ventilation. In addition to these the company furnishes the Carpenter enamel rheostats when desired, which consist of a set of resistance wires or plates coated with an insulating enamel permitting them to be placed in a very compact space where the matter of size is a consideration. The machines of the Crocker-Wheeler Company are all of remarkably small size for their capacity owing to the use of drop forgings for the smaller sizes and a multipolar type for the larger ones. The armatures are remarkably well designed for obtaining low speeds and reducing the magnetic resistance of the air gap. The cases are built up of insulated laminated discs, with teeth which are stamped out of sheet iron. The spaces in which the windings are contained being small at the circumference and wider at the bottom of the slot permit the core of the armature to run very close to the faces of the pole pieces and, in a great measure, prevent the winding from being thrown out by centrifugal action against the pole pieces. This method of armature construction greatly reduces the amount of winding on the fields. as the air gap between the armature core and the pole faces requires many more ampere turns than all the rest of the magnetic circuit in order to obtain the required saturation.

In the winding room the machines for winding the field spools are all provided with counters which register the number of turns at every revolution of the spool. It is thus possible to have the windings absolutely equal for each section, and perfect uniformity is obtained without the possibility of errors by the workmen.

These machines are otherwise noticeably well built, and their design is to be commended from a mechanical as well as an electrical standpoint. As an example of the refinements which have been included may be mentioned the use of self-oiling bearings on all motors down to the one-sixth horse power size.

The stock room equipment is a most extensive one. Besides containing material in the line of tools sufficient to stock a good sized hardware store, it contains a miscellaneous assortment of silk, rubber, shellac, paper, and in fact everything that enters into the make-up of an electric motor.

A method of application of motors to machines, not hitherto extensively adopted, consists in mounting a motor on each machine which drives it directly without the intervention of belts, and which is the plan described above, to be used as far as possible in the new factory.

Some of the machines in the present works are equipped in this way, and the lack of any apparent means of driving them presents a rather novel appearance.

Drills, shapers, circular shears, etc., are operated in this way, besides which are to be seen a number of automatically-controlled machines, such as pumps, organ bellows, etc., which are adjusted to vary in speed according to the service to be performed and to stop running at any predetermined stage of the work.

The Beacon Factory Not Closed Yet.

Boston, January 16.—Judge Colt, in the United States Circuit Court, to-day granted the Beacon Pump and Electrical Co. an extension of a week in which to prepare further evidence, in the action for an injunction brought by the General Electric interests. The case comes up for final hearing, Monday, January 3.

World's Electrical Congress.

Report of the Sub-Committee of American Institute of Electrical Engineers on Provisional Programme for the International Electrical Congress of 1893.

To the General Congress Committee of the American Institute of Electrical Engineers:

GENTLEMEN: The Sub-Committee on Provisional Programme respectfully submits to you the following report:

DUTIES.

The Sub-Committee understands its duties to be as follows:

To suggest what work it is desirable to have done at the coming International Electrical Congress to be held in Chicago in 1893.

To suggest a programme for carrying out this work in the most satisfactory manner to all parties, and with the least loss of time.

RECOMMENDATIONS.

Regarding the work to be done, your Committee's recommendations are as follows:

RATIFICATIONS.

(1.) *Ratification of the adoption of units, terms, symbols and definitions by previous International Electrical Congresses.*

This is a mere matter of form and an act of courtesy to the preceding Congresses. Your Committee understands that this was done at both the Paris Congress of 1889 and the Frankfort Congress of 1891.

NEW UNITS.

(2.) *Defining and adopting practical units for measuring and designating the measurements of the following quantities: Magneto-motive force; magnetic flux; magnetic intensity; magnetic reluctance; electric conductivity; illumination.*

It will be noticed that this refers only to the question of what the magnitude of the units shall be, or, in other words, what multiples or submultiples of the absolute units they are to be.

Your Committee is aware that objections are raised by some to the establishment of units not already in universal use. Past experience, however, has shown that the proper time to establish units is *before* their need is universally felt, in order to avoid the introduction by different persons or nations of units of different values, a contingency which will be very likely to arise if not anticipated by concerted action.

Your Committee recommends the following:

The value of the practical unit of magneto-motive force to be one-tenth of the absolute unit, that is, equal to $\frac{1}{4\pi}$ ampere turn.

The value of the practical unit of magnetic flux to be 10^8 absolute units or lines.

The value of the practical unit of magnetic intensity to be 10^8 absolute units, that is, 10^8 lines per square centimetre.

The value of the practical unit of reluctance to be 10^{-9} absolute units.

The value of the practical unit of electrical conductivity to be 10^{-9} absolute units, that is, to the reciprocal of the ohm. This makes it equal to the unit proposed some time ago and known to some extent by the name of "mho." It should be given this value in order that it correspond with the already adopted units.

The value of the practical unit of illumination to be a bougie-decimale at the distance of one metre. The bougie-decimale is the unit of light or candle power already established and is practically equal to one English standard candle; by making the distance a metre, the practical unit will be approximately equal to one-tenth of a carcel-metre, one tenth of a foot-candle (or "lux") or to one metre-candle or metre-kerze, all three of which units are already in use to some extent.

It has been announced that a proposition will be made at this Congress to change the values of some of the practical units which have been adopted by previous Congresses and are already in universal use. Among these are the ampere and the farad. It is urgently recommended by your Committee that such changes should not be favored, since they would necessarily be followed by great confusion and would of necessity have to be accompanied by some change in these well established names in order to distinguish these new units from those now existing.

NAMES OF UNITS.

(3.) *Adopting names for the following practical units: Magneto-motive force; magnetic flux; magnetic intensity; magnetic reluctance; inductance; electrical conductivity; illumination.*

The following names are suggested for these units:

For the practical unit of magneto-motive force, the name "gilbert."

For the practical unit for magnetic flux, the name "weber." This term was formerly applied to a unit of current, but its use in this sense was so limited and it has been abandoned for so long a time that no confusion would be likely to arise; the context alone would always be sufficient to prevent any possibility of misunderstanding. The name "weber" is preferred on account of the intimate relation between this unit and that of magnetic intensity for which the name "gauss" is suggested.

For the practical unit of magnetic intensity, the name "gauss." This name has already come into use to such an extent that objections to it will not be likely to arise.

For the practical unit of magnetic reluctance, the name "oersted."

For the practical unit of inductance, the name "henry." This name has already come into use quite extensively and it would therefore be very undesirable to change it. The value of this unit has already been fixed as equal to 10^9 absolute units or nearly to the length of an earth's quadrant. The definition "quadrant" is sometimes employed as the name itself, but its use as a name is evidently objectionable, as it already has several other meanings, which might readily lead to confusion.

For the practical unit of electrical conductivity, equal to the reciprocal of the ohm, the name "mho." This name has been in use for some time and is already well known. It is thought better to recommend it than to select and introduce a new name.

For the practical unit of illumination defined above, the name "bougie-metre."

It has been suggested to name the units "kilowatt hour" and "ampere hour." Your Committee, however, recommends that inasmuch as these terms explain themselves, and are no longer than some others in use, to give them special names would burden a system of nomenclature unnecessarily. The principal objections to the term "Board of Trade Unit," which is in use in England for the former, are, that it could never become international, that it is longer by one syllable than the term "kilowatt hour," and that there are now, or may soon be, units of other denominations adopted by the same Board of Trade from which this one will have to be distinguished by an additional affix or prefix.

CONCRETE STANDARDS.

(4.) *Defining and adopting modes of embodying the following principal units of measurement in concrete standards capable of being readily reproduced, and adopting names for them or for the theoretical units, by which they can be distinguished from each other: Ampere, ohm, volt, watt, standard candle.*

The following definitions of these units are recommended:

An ampere shall be that unvarying current which, when passed through a solution of nitrate of silver in water, in accordance with the specifications recommended in the recent report to the British Board of Trade, deposits silver at the rate of 0.001118 of a gramme per second.

An ohm shall be the resistance offered by a column of mercury at the temperature of melting ice 14.4521 grammes in mass, of a constant cross-sectional area, and of a length of 106.3 centimetres. It is recommended that material standards of this value, constructed in solid metal, should be preserved under the care of the several Governments as standards of comparison, and that they should from time to time be verified by comparison with the mercury standard defined above; also that for the purpose of replacing the standard, if lost, destroyed, or damaged, and for ordinary use, a limited number of copies should be constructed which should be periodically compared with the standard ohm.

A volt shall be the product of this ampere and this ohm.

A watt shall be the product of the square of this ampere and this ohm.

The other units, such as the coulomb, the farad and the joule, shall be taken as derivatives in terms of this ampere and this ohm.

In order to create as little confusion as possible by the introduction of this set of units which are to become the universal standards, and in order to distinguish them readily from the true theoretical, or abstract units defined in terms of the absolute units, it is recommended to call the former simply "amperes," "ohms," "volts," etc., or more specifically "standard amperes," "standard ohms," etc., and to call the theoretical units "true amperes," "true ohms," etc. The latter term has already come into use in this sense.

The unit of resistance known as the B. A. unit shall be taken as equal to 0.9866 of this ohm.

The electro-motive force of a Clark cell at 15° C., prepared in accordance with the specification recommended in the recent report to the British Board of Trade, shall be taken as not different from 1.434 of these volts by more than one part in one thousand. The coefficient of temperature shall be taken as..................................?

The standard candle shall be taken as equal to the light from a lamp like that known as the Hefner-Alteneck standard amylacetate lamp, which is to be defined by its dimensions and the height of the flame, the dimensions being such that the light shall be equal to that of the "bougie-decimale," the practical unit adopted at the Paris Congress of 1889, which is equal to one-twentieth of the absolute platinum standard adopted in 1884.

It has also been suggested that a universal wire gauge be defined and adopted. Desirable as this may at first seem, your Committee recommends that no action be taken by the Congress in this matter, as it is not likely that any one scale would ever be universally adopted by manufacturers, even if defined and adopted by a Congress. The universal introduction of the metric system and the designation of wires by their diameters in millimetres is thought to be the only satisfactory solution of this question for international work.

NOTATION AND SYMBOLS.

(5.) *Adopting an international system of notation and conventional symbols, for designating different quantities.*

The system suggested to the last Congress by Mr. E. Hospitalier, of Paris, is recommended by your Committee, although doubtless some amendments may be found desirable.

DEFINITIONS.

(6.) *Defining the following terms:—Impressed* *electromotive force, inductivity, inductance, reluctivity, Matthiessen's standard, north and south pole.*

The following definitions are suggested:

The impressed electromotive force is the ratio of the total activity in an electrically conducting circuit to its instantaneous current strength.

The inductivity at any point in an isotropic medium is the ratio, added to unity, of 4 π times the intensity of magnetization there existing to the magnetizing flux-density. Inductivity is synonymous with "permeability." The electro-magnetic dimensional formula is $L^0 M^0 T^0$; the conventional symbol is μ.

Inductance.—(*a*) Self-inductance is the ratio of the total magnetic induction linked with and established by an electric current to the uniform strength of the same. The inductance of a conducting circuit is constant when its environing medium has constant inductivity. (*b*) The mutual inductance of one electric circuit upon another is the ratio of the total magnetic induction linked with the second, due to a uniform current in the first, to the strength of that current. The mutual inductance between two electric circuits is reciprocally equal when the environing medium has constant inductivity. The electro-magnetic dimensional formula is $L^1 M^0 T^0$. The absolute unit is one centimetre; the practical unit, one henry.

The reluctivity of a medium at any point is the volume differential of the reluctance thereat. Simple definition: Reluctivity is the reluctance per unit volume. The electro-magnetic dimensional formula is $L^0 M^0 T^0$. The absolute unit is one C. G. S. unit of reluctance per cubic centimetre; the proposed practical unit is the same, or about one oersted per cubic earth quadrant.

The resistance of copper known as Matthiessen's standard shall be defined as follows: The resistance of a soft copper wire one metre long, weighing one gramme, is 0.14365 B. A. units at 0° C. This definition is recommended by the Committee of the American Institute of Electrical Engineers on Matthiessen's Standard. The reasons for selecting it are given in that report.

The north pole of a magnet to be defined as being that which seeks the geographic north pole, and the south pole that which seeks the geographic south pole. This is the generally accepted definition, but it is thought desirable to formally define it.

EXPRESSIONS.

(7). *Defining and adopting expressions:—For alternating currents of more than one phase; for describing phenomena of alternating currents and of electro-magnetic waves.*

It is recommended to adopt the following expressions: "Simple" alternating current for the usual alternating currents in which there is practically but a single phase; "di-phase" alternating currents for two alternating currents whose phases differ in time by 90 or 270 deg.; "tri-phase" alternating currents for three alternating currents whose phases differ in time by 60 or 120 deg.; "polyphase" alternating currents for such as have more than three phases.

For expressions describing phenomena of alternating currents and electro-magnetic waves, your Committee solicits suggestions.

UNIVERSAL USE.

(8.) *Recommending the more universal use:*

Of the term "voltage" as synonymous with "difference of electrical potential" or P. D. *in place of the terms "potential," "tension," or "pressure," the use of which in this sense it is recommended to abandon.*

Of the term "transformer" instead of "converter";

Of the term "dynamotor" for a continuous current transformer;

Of the term "continuous current" instead of "direct current";

Of the term "kilowatt" instead of "horse power";

Of the metric system of weights and measures, and suggesting means by which its introduction will be facilitated.

PROGRAMME.

Regarding the programme for carrying out this work in the most satisfactory manner to all parties, and with the least loss of time, your Committee's recommendations and suggestions are as follows:

PREPARATORY DISCUSSIONS.

It cannot be too strongly urged that an International Congress is the place to close but not to open a discussion on questions about which international agreement is to be had; it is therefore urgently recommended that action be taken at once to open the discussion of such matters now, in order that expressions of opinions, and, if possible, agreements, may be arrived at prior to the meeting of the Congress. To this end your Committee recommends that the suggestions embodied in this report, or as many of them as you may see fit to designate, be printed and sent to all the leading electrical and physical societies and journals in this country and abroad, with a request that they aid this work by making them public, by freely discussing them, and by sending copies of such discussions and any further suggestions to the General Congress Committee of this Institute, care of the Secretary, 12 West Thirty-first street, New York City. That a sub-committee of the Institute prepare from time to time a classified summary of such discussions to be sent to the leading electric and physical journals for publication here and abroad, and that it present a final summary of this international discussion at the Congress. This discussion ought to be closed by July 1, 1893.

It is recommended also that this Institute invite other societies to co-operate with it by appointing special committees to discuss and report to their respective societies on these international questions and to publish their conclusions in the electrical journals of their country.

It has been suggested that various committees be appointed to prepare reports on the international questions on which agreement is desired, and to submit these at the meeting of the Congress. Your Committee, however, believes that to postpone the discussion until the Congress is in session would lead to no satisfactory results, as was shown at the last Congress of 1891, in Frankfort. It therefore urges that the discussion take place through the medium of the journals *prior* to the meeting of the Congress, and that the only report submitted to the Congress be a summary of such discussions.

MEETINGS.

Regarding the meetings of the Congress, your Committee recommends that, as in the Paris Congress of 1889, the meetings be divided into (a) *General Meetings*, one at the opening and one at the closing of the Congress, which are to be devoted to the consideration of general questions and those on which agreements are desired, and to the reading of papers of a general character; (b) *Sectional Meetings* for the reading of all other papers. The following division into sections is recommended.

1. Electro-physics, units, measurements and all electrical matters of a purely scientific nature.
2. Dynamos, motors, transformers, etc.
3. Systems, central stations, installations, lamps, etc.
4. Electric telegraphy, telephony and signalling.
5. Electric railways.
6. Electro-chemistry, batteries, electro-metallurgy.
7. Electro-physiology and electro-therapeutics.
8. Legal questions.

PAPERS.

It is suggested that specific invitations be extended by the Congress Auxiliary to prominent electrical engineers and physicists to prepare papers on specified subjects to be read and discussed at the Congress meetings. Also, that a general invitation be extended for other papers, which are to be submitted not later than July 15, 1893, to a Committee on Papers appointed by the Chairman of the Congress Auxiliary; that this committee shall examine and accept or return the latter, and at its discretion shall print any or all of those accepted as well as those solicited, in form for circulation at least one week prior to the meeting at which they are to be read; that the papers shall be read in full, in abstract or by title, as that committee shall direct.

The following subjects of papers are offered as a suggestion to the Congress Auxiliary merely as a basis and not as a complete list:

The criterion of sensitiveness of galvanometers or on the theory of their construction.

The working of national or municipal laboratories for testing meters and instruments.

The practical results and economy of the employment of accumulators in central station systems of supply.

On the relation between weight of copper and iron in dynamos and their output.

Nomenclature and notation of magnetic circuit; or on standard and units of magnetism.

Magnetism.

On the economic use of transformers under various conditions of supply.

Electricity meters from a European standpoint.

Electricity meters from a British standpoint.

Electricity meters from an American standpoint.

Choice of materials for standards of electrical resistance.

Nomenclature of phenomena of electro-magnetic waves.

Standards for electrical measurement.

Alternating current transformers from an American standpoint.

High frequency and high potential phenomena.

Dynamo construction.

Your Committee suggests that papers should be solicited by the General Congress Committee of this Institute on the work of the early electricians of this and foreign countries considered from a modern standpoint, and their importance in the development of the science of electricity, including descriptions and illustrations of models and apparatus used.

TRANSACTIONS.

Your Committee suggests that the proper authorities be requested to have a stenographic report made of the proceedings and discussions at all of the meetings of the Electrical Congress, and that this report, including such of the papers and discussions as a committee appointed for the purpose shall direct, shall be printed and published in book form; that each member of the Congress be entitled to one copy of this report on the payment of $1 (one dollar) and non-members on the payment of $5 (five dollars).

MEMBERSHIP.

It is suggested that the membership of the Congress be divided into delegated members and members, and that the dues for each shall be $5 (five dollars); that only delegated members and members be admitted to the meetings and be permitted to take part in the discussions; that any one shall be entitled to become a member; that delegated members shall be appointed by Governments, physical and electrical societies, and shall be approved by an international committee whose decision shall be final; that questions on which international agreement is desired be decided by the delegated members, whose decisions shall be submitted to the whole Congress for approval or rejection in part or in whole, but not for alteration.

It is recommended that the United States Gov ernment be requested to extend a formal invitation to foreign Governments and societies to send delegates to this Congress.

ACKNOWLEDGMENTS.

In the present report, your Committee has embodied recommendations from the reports of the Institute's Committee on Matthiessen's Standard, and on Magnetic Units, from the recent reports of the British Board of Trade Committee, and from the suggestions of Dr. Silvanus P. Thompson to Dr. Elisha Gray, in reference to the Congress.

Respectfully submitted,
CARL HERING, Chairman.
WM. A. ANTHONY.
A. E. KENNELLY.
New York, December 28, 1892.

The Deflection and Control of Galvanometers.

BY E. TREMLETT CARTER.*

The observation of the conditions of electrical stress which produce and limit the amount of deflection in any measuring instrument is an interesting and profitable one; and it is proposed in this paper to make a short study of the sources of the energy which produces the deflection in magnetic and thermal galvanometers, whether for measuring current or voltage. It is well known that two forces are concerned in the deflection; one, the electrical or magnetic force of the quantity measured, which is caused by the coil or heated wire; and the other the controlling force, which is variously produced by magnetic, gravitational, or other elastic forces. In most instruments the controlling force has to bring the pointer back to zero when the current ceases; but there is an exception to this rule in the Cardew voltmeter type, in which the deflection is *produced* by the controlling spring and *cancelled* by the contracting wire. In any case, however, there is some transfer of energy when the deflection is being produced or cancelled; and the source and destination of this energy form a very interesting inquiry. In an ideal instrument the whole of the energy which produces the deflection would be given back when the pointer returned to zero. But, in practice, owing to the imperfect elasticity of the deflection—through friction—the energy is only partially restored. The frictional resistances are opposed both at the forward and at the return motion of the pointer, causing a waste of energy on each occasion.

The energy which is temporarily expended when the deflection is being made must not be confused with that constant expenditure which takes place the whole time the instrument is in circuit. The two have no necessary relationship. The mere C^2R energy does nothing useful—neither in a magnetic nor in a thermal instrument. It may at first sight appear that the C^2R function does some useful work in a thermal galvanometer; that, in fact, it supplies the heat by means of which the deflection is produced. But this supposition would be erroneous. The energy which does the work of the deflection is actually put into the instrument when it is manufactured, namely, at the moment the tension of the controlling spring is brought to the required amount. The *resilience* of the spring is a continual store of energy which is partially and temporarily drawn upon whenever a deflection takes place. This is restored to the spring in full amount when the heated wire cools and contracts. If we trace the passage of this energy from the instant it leaves the spring to the instant it gets back again, we shall follow a thermodynamic study of peculiar beauty. It is well known that all substances which expand on the addition of heat have their specific heats apparently raised by being subjected to increased external pressure, and lowered by being placed under tensile stress. The reason is that in the former case the expanding body does external work against the compressive force, while in the latter case the stress expends some energy in heating the expanding body. On this account, if a thin wire is heated by the passage of an electric current it will take less energy from the current, and will take less time in rising to its limiting temperature if it is under tension than if it is slack. Some of the stored heat of the wire is due to the current, but some of it is due to the expenditure of resilient energy under the relaxation of elastic stress of the spring which holds the wire tight. When the current ceases and the deflection is returning to zero, the conditions are reversed. The contracting wire expends heat on the tension spring, restoring its lost resilient energy; and, in the ideal instrument, the amount of heat which will thus be converted into work will equal the energy originally taken from the spring. Thus it will be seen that the true C^2R function has nothing to do with the source of energy which causes the deflection. If the stress-strain diagram of the hot wire of such an ideal instrument be plotted, the curves representing a complete cycle will inclose no area; but in an ordinary instrument this would not be the case. In such the curve of deflection would lie nearer to the axis of stress than the curve of restoration to zero; and the area enclosed would represent loss of energy on account of friction, pretty much as the area of the Ewing-cycle represents hysteresis losses.

In an electro-magnetic galvanometer the source of energy of the deflection is the electric circuit, but not through the medium of the dissipation function. The medium of exchange of energy is an electromotive force which is set up in the circuit when the needle moves. In a forward deflection there is a back electromotive force, which takes some energy from the circuit; while in the return of the deflection to zero there is a helping or forward electromotive force which restores this energy to the circuit from whence it had been taken. During the deflection this energy exists potentially in the controlling mechanism. Thus, if there is a bar-magnet control, the energy is stored magnetically in the ether; if there is a spring control, the energy exists as resilience of the spring; while if there is gravity control, the energy exists as a stress—*where?* Would that we could say where! *Is* it the ether?

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[*] *The Electrician.*

Paris 1881 and Chicago 1893.

BY G. EMIL HESSE.

The Exposition in Paris, 1881, was a memorable one in many respects. From that time we count the commencement of one of the most remarkable inventions in electricity—the electric railway. Dr. Werner Siemens built one small road in Berlin in 1879, but there was no real life until 1881.

The United States was very quick to see the great advantages of electric propulsion; the rapidly growing cities, with the many suburbs, were peculiarly well suited for the trolley, and the 5,000 miles of electrically equipped roads of to-day tell a better story than any pen is able to describe. There has been very small progress in Europe during the same period; this is not on account of conservatism, but for various other reasons of which the disfigurement of the town is the principal. There is, therefore, a very large field for an electric railway system without the objectionable poles and overhead wire.

Paris in 1881 saw the first practical electric railway. What will Chicago show in 1893? If she should exhibit an underground electric road that worked in every way satisfactory, Europe would utilize this invention as sure as this country adopted the Paris discovery. That it also would be used in the large cities of this country follows as a matter of course.

There was another question decided upon in 1881, viz., a practical unit for measuring current, resistance, etc. The United States is very enterprising and generally prepared to adopt improvements of various kinds, but it shows a most surprising stubbornness when it comes to a change of existing measures, weights and thermometer. Even the scientific and engineering bodies use the old systems, here and there mixed up in beautiful harmony with the new, which in my opinion is very annoying.

What is the reason of this, and why not break with the old absolutely, and to the benefit of everybody? Most of the European countries have introduced the metric system, with of course the exception of Russia and England, most of the Central and South American Republics, Japan and many other less civilized countries.

We nevertheless in this country stick to the ancient English system, where one acre is equal to 48,560 square feet, a figure that nobody remembers; one pound equal sometimes to 16 and sometimes to 12 ounces, etc. Why is it that the future greatest civilized nation in the world is so slow in this respect? The developments of the resources of the country are so rapid, that they, together with the political questions, absorb every thought of the nation, and I think that is the reason why nothing is left for other important things.

Now that representatives from every part of the world will again meet in Chicago, why not discuss the matter thoroughly and decide then and there that the metric system and the centigrade shall be the only recognized measures in the future for this country, at least for scientific calculations, and that every effort be used to get Congress to pass a law to that effect. The result of the Exposition would then be a lasting one and worthy of the memory that it is about to celebrate.

The daily newspapers discuss all sorts of questions of more or less importance. We have monetary conferences, Behring Sea arbitrations, speculations as to this and that political job, etc., but not a word about the 43,560 square feet to the acre.

The technical press of the country ought to take the question up with vigor, and not rest until it is introduced. A continual dropping will wear away the hardest rock, and conservatism and disinterestedness have to give way if continually hammered on.

The St. Louis Convention.

Transportation Arrangements.

The various passenger associations have granted an excursion rate of a fare and a third to delegates attending the Convention of the National Electric Light Association to be held in St. Louis, February 28, March 1 and 2, 1893. To secure this rate it will be absolutely necessary for persons purchasing tickets to state to the agent from whom the purchase is made that they contemplate attending said meeting, and to procure from said agent a certificate, which, immediately upon their arrival in St. Louis, should be left in the secretary's office, addressed as below, to C. O. Baker, Jr., who will see that it is properly vised and returned to the owner.

Arrangements are now being made for a special train from New York to St. Louis, which will exceed in the way of equipment and appointments anything that has ever been in service between these two points. To bring this matter to a successful issue, it is very important that the number of passengers who wish to avail themselves of this train should be known at the earliest possible moment. Therefore, it is very desirable, and will facilitate transportation matters greatly, if all delegates who contemplate using this train will make application for space at once to Mr. C. O. Baker, Jr., Master of Transportation, 136 Liberty street, New York.

ELECTRICITY

The Popular Electrical Journal.

GEORGE R. METCALFE, - - - EDITOR.
R. H. WILLOUGHBY, - - ASSOCIATE EDITOR.

W. M. ALLISON, - - BUSINESS MANAGER.

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Our columns are open for the discussion of any question in which the interests of the Electrical Industry are at stake. News notes, descriptions of new devices with drawings or photographs, are at all times desired.

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As ELECTRICITY reaches all classes interested in electrical work, its value as an advertising medium can be readily appreciated. Rates will be sent on application.

Changes for advertisements should reach the office not later than the Saturday preceding the date of publication.

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"Electricity," under its present ownership, has never solicited the advertising patronage of the General Electric Company.

The Trust's Onward March.

Our news columns report the closing of the Sunbeam lamp factory in Chicago by a restraining order granted last Saturday in an action brought, not directly by the General Electric Company, but by the Chicago Edison Company, pending the final hearing on Saturday next.

Our predictions are thus verified, and ELECTRICITY is the only paper which had the news in advance.

If there was one company in the field which might reasonably have been expected to make an amicable royalty arrangement, that company was the Sunbeam. It was a fair assumption that Mr. J. B. Wallace, who has claimed Mr. Coffin as his personal friend, and whose close relationship to the Messrs. Terry is well known, would be able to exert so strong an influence in favor of such an arrangement that it would be brought about. It is possible, therefore, that the Chicago Edison Company demanded immediate action, and that the General Electric Company had no alternative. The fact that the Edison Illuminating Company of New York demanded some days since that the General Electric Company proceed immediately against all trespassers on their contract rights in this city lends color to this view. The New York licensees threatened to take the law into their own hands unless their demands were met.

But our view of the case is that the bringing of the suit in the name of the local Chicago company was only a smart trick on the part of Mr. Fish, who apprehended that an action brought by the Trust direct would not be successful.

However, it is best for all concerned that the Sunbeam Company was selected at this time. There is no longer any doubt whatever as to the policy of the Trust. While they have not had the courage to make an official announcement of their policy or plans, actions speak louder than words, and no one is now in the dark.

It is better as it is.

All that remains for other manufacturers is to bring out their new lamps which do not infringe the Edison patent, and there will be nothing more than a temporary interruption to the business. We are advised that the Sunbeam Company and some others will have such lamps ready to place on the market in short order.

Nothing better could have happened to justify the course of ELECTRICITY. The waiting policy advocated by the *Electrical Engineer* has already proved futile. Bankruptcy is not a pleasant thing to wait for.

ELECTRICITY says "Fight!" And do not wait to be attacked. The man who waits till his hands are bound is an easy victim. Fight! and fight now!

We cannot conceal our pleasure at the present turn of affairs. It has been a common criticism on our course that we were too soon—a year at least in advance of the times; that the Trust was not injuring any one. Chicago concerns, particularly, have seemed to think that the Trust had no power to harm them, even if it had the desire. Perhaps they will revise their opinions.

There is not in Chicago or in the United States an electrical manufacturing concern or a supply house that will not sooner or later feel the coil of the serpent.

IF INDEPENDENT CONCERNS WOULD ESCAPE EXTINCTION, IMMEDIATE ACTION IS NECESSARY.

The Trust invites the battle—who are the cowards?

* * *

The Fake's Progress.

The activity of the Press Bureau of the Chicago-St. Louis Through-by-Lightning scheme leads to the conclusion that the chief aim of the enterprise—the raking in of dollars—is not being attained rapidly enough. The rural papers, always glad to get "scare" matter (illustrations preferred) when it costs nothing, are treating the boomers handsomely, and their readers almost believe that the road will be in full operation by next All Fools' Day. If transportation tickets are placed on the market, and we suppose they will be shortly, there is bound to be a profitable advance sale among the grangers of Arkansaw and Texas.

Meantime, Dr. Adams preserves discreet silence as to the technical details of his motive power arrangements. No electrical engineer of any standing in this country believes there is any merit whatever in the scheme, or that the end will be anything more than a humiliating fiasco, throwing discredit and suspicion upon the whole range of new and legitimate electrical enterprises. And it is with this latter point that we are specially concerned. While there is no doubt that in the hands of competent engineers the speed might be attained, the introduction and booming of the thing from the first has not disclosed the name of any of our leading engineers as being identified with it. It is claimed, we believe, that the matter has been laid before such engineers, and has met with their approval. But the *leading electrical engineers of the world*, those who are recognized authorities, are not legion, and no one of these has announced his approval; in fact they all deny that it has been submitted to them.

The attainments and reputation of Prof. Nipher are not underestimated by us, but we look upon his connection with the scheme more as a misfortune to himself than otherwise.

We do not believe that there is, or has been, any definite plan, beyond the sale of stock. They will sell all they can, and trust to luck for the outcome.

Mr. Henry Villard is well known as a most sanguine investor in new enterprises. He has an almost boundless faith in electrical possibilities, and has frequently been called visionary. But we are enabled to state authoritatively that when Dr. Adams laid his scheme before Mr. Villard, several months ago, Mr. Villard said: "Dr. Adams, I do not feel at all complimented that you should assume to bring any such scheme to me." And that subsequently Mr. Villard was "not in" when the urbane Doctor called.

ELECTRICITY will lend a helping hand to all worthy electrical enterprises. But if a hundredth part of Dr. Adams's claims is correct, he needs no help. Let him but show proof that he has got a system to run 100 miles an hour safely, economically and satisfactorily, and he will not need to advertise his stock—capital would scramble to get in on the ground floor. We can give him no assistance in perfecting his motor, and we will not help him to sell stock, until he offers reasonable proof that the whole thing is not a swindle.

Twenty miles of road, we are informed, have been built—all but the track. This affords ample opportunity for a display of the wonderful machine, and there ought to be no delay in the exhibition. ELECTRICITY can be counted on to charter a special car—not exactly for the first trip—but as soon as the Accident Insurance Companies will take the risk on passengers.

In The Fake's Progress up to date marvellous ability of a certain order has been exhibited; and the man who gets up the prospectuses could command a munificent salary as the advance agent of Bailey's show.

The electrical papers on this side of the water, with the single exception of ELECTRICITY, have been guilty of short-sightedness, if nothing worse, in their treatment of this matter from its first announcement. Nothing better was to be expected from our fawning contemporary, the *Electrical World*, which has perhaps received a good-sized block of stock in exchange for advertising and puffing space. But from the *Electrical Engineer* we looked for better things.

The English papers have been led to believe that the scheme was really considered favorably by conservative men here. When the whole job reaches its inevitable end, and the stockholders lose their money, American electrical investments will all be discredited abroad, and no small portion of the blame will rest upon the American electrical papers which refrained, from whatever motive, from telling the truth.

We desire, with pardonable pride, to call attention to the remarks made in these columns (Vol. II., No. 21,) just after Dr. Adams, in his address before the American Institute of Electrical Engineers in this city, drew a square on the board, saying, "*This represents my motor.*" The editorial was headed "Rapid Transit by ——":

"There were many things in his lecture that could not fail to attract the attention of the least observant. One of these was the exceedingly happy way in which every detail of his plan was favored by nature and otherwise. One listening to him could not help being reminded of the fairy tales of his youth, where the fortunate traveler has but to call up his good fairy whenever obstacles occur to have them smoothed away. A straight line was desired—and a straight line was surveyed for two hundred and forty-eight miles, and nothing was found in the way to turn it aside; no churches, no graveyards, no cities, no rivers. It was originally intended to have but a single central station, but immediately that two were decided upon, locations unsurpassed sprang immediately into existence—not only that, but ready equipped, at somebody else's expense, for use. An entrance was desired into Chicago. Ordinarily the right of way for this would have cost millions of dollars, but the good genius again arises and provides it free of charge and partly equipped at that.

"High potentials were required for transmission and lower ones for the motors. This suggested the use of the alternating current, but since the motors must be capable of starting from rest with a load, multiphase currents would be required, but these necessitated two or more conductors while but one could be used. Behold, again the fairy appears, and a multiphase motor operated by a single phase current is produced at the projector's beck.

"The financial aspect of the scheme as presented by the projector could scarcely be more rosy. But, we take it, few will accept his statements without a little salt. According to his estimate there will be thirty million visitors at the World's Fair—does he mean visitors or admissions?—and of these 10 per cent. will ride over his road to St. Louis and back for $5.00. The road will cost six millions to complete, and in six months' time it will pay for itself two and a half times over from the custom of those who ride on it from curiosity solely. Of course, there will be additional receipts from other sources, which ought to round the receipts up to eighteen millions. Considering that 'the power will cost them nothing,' we wonder that the projectors are willing to part with their stock.

"We believe the feat of running from St. Louis to Chicago on a straight track at 100 miles an hour is perfectly feasible, but regret to say we are not convinced by Dr. Adams's plans."

About the only favoring circumstance which remains for Dr. Adams to claim for his heaven-blest enterprise is, that if electricity fails the natural grade is such that trains may run by gravity in either direction.

* * *

AMONG the many Trust rumors last week was one that the National Electric Manufacturing Company of Eau Claire had concluded that any further fight against the Trust was useless. There can be no doubt as to the source of rumors of this nature. They are put forth in the vain attempt to frighten outside manufacturers. The National Company is doing a prosperous business, and is in the field to stay. The formation of the Trust has actually improved, rather than injured, the business of this company.

* * *

IF there ever has been, or ever will be, a time when an independent paper is essential in the electrical field, that time is now! ELECTRICITY is that paper, and the only one.

* * *

THE present Legislature at Albany will no doubt give cordial support to Gov. Flower in his efforts to secure the introduction of the trolley or some other electric system as the motive power on the State canals. An opportunity is here offered to inventors which should be taken up at once. And may the best plan win.

* * *

THE pirate lamp factory at Lynn is still running full time, and lamps are being sold daily in the territory of Edison Illuminating Companies. We suggest that the programme be changed, and that the Lynn factory be attacked immediately.

* * *

A PROMINENT electrician of this city, who has just returned from Pittsburg, had ample opportunity to inspect the new Westinghouse lamp, and freely expresses his opinion that the lamp is an entire success.

IT SEEMS to us that if the National Electric Light Association is to fulfil its mission, it cannot do otherwise than arrange for a discussion at the St. Louis meeting of the one topic of supreme interest, "Will the proposed monopoly of the General Electric Company result in the greatest good to the greatest number? And if it will not result in the greatest good to the greatest number, is it nevertheless inevitable?"

A public discussion of this topic cannot be long postponed. And if it does not come at St. Louis, it will follow soon afterwards in a convention of a different make-up.

We are in receipt of many requests from leading central station men and manufacturers, urging us to advocate an independent meeting at St. Louis.

Such a course may be necessary, but it is our opinion that the Executive Committee of the National Association ought to have the first opportunity. If they fail to provide for such a discussion, an independent meeting will be in order.

The voice of the independents cannot be smothered.

* * *

THE Chicago and St. Louis Electric Railroad Company, which figures out cock-sure net earnings of $2,025,000 for its first year's business, is playing a scurvy trick on American manufacturers in endeavoring to get the right to import its outfit free of duty. And the General Electric Company should have more important business for its able counsel just now than opposing any such damphool proceeding.

There is no tariff on goods from the seaport of *Esgiebtnicht* in the land of *Wiessnichtwo;* and this is the *exact* location of Dr. Adams's outfit.

* * *

We present our compliments to our contemporary with more name than honor, *Electrical Progress and Development*, for its article on the Security Safe Deposit Company's burglar alarm system. Anything stolen from ELECTRICITY is sure to be good reading, and our illustrations are works of art.

We Stir Them Up.

Comments of Detroit Papers on the Lighting Situation.

The Journal.

The controversy over the letting of the public lighting contract has attracted the attention of the electrical journals throughout the country, and the result is that Detroit is getting some left-handed advertising.

Controller Black has received marked copies of ELECTRICITY. In one of its articles it says:

"Radical measures on the part of the city are necessary if there is to be any actual competition. The people of Detroit are so accustomed to being humbugged that they have been ready to believe the report started by the agents of the Trust that the Standard Company was also in the deal. A little investigation would prove the falsity of the report."

Another article in the same paper hits the Controller pretty hard, inasmuch as he is one of the old electric light magnates of the city. It says:

"There seems to be dense ignorance of electrical matters among the officials of the Trust-ridden city."

The New York idea, of course, does Controller Black injustice, as he has so far led the van in the fight for cheaper and better public lighting.

Controller Black said yesterday that no further steps will be taken in the lighting matter until after the new council is organized.

Mayor Pingree continues to receive calls from prominent citizens and tax payers who urge him to stand firm for a municipal lighting plant.

[ELECTRICITY has intended no injustice to Controller Black or to the city of Detroit. Both Mayor Pingree and Controller Black have been reported in the daily press as being of the opinion that the Trust controlled all efficient systems of arc lighting. We have endeavored to enlighten not only the city of Detroit but all the rest of the world on this point. And we are pleased to see that our efforts are bearing fruit.]

The Press.

ELECTRICITY, the anti-Trust electrical organ, published in New York, has a number of articles on the situation in Detroit. The paper says that Detroit's officials are not well informed on electrical matters if they imagine that the Standard or Western companies, of Chicago, are not entirely competent to carry out any sort of contract with the city.

The paper also states that R. T. McDonald, one of the chief moguls of the Trust, considers Detroit the ideal place for the operation of the Trust's schemes. The two sets of towers, both owned by the Trust, the act passed by the last Legislature and a number of other conditions make Detroit a heaven for the mammoth electrical Trust.

The Journal.

ELECTRICITY says that Detroit is considered by the electric companies as only "pudding" for them. People here, it says, "are so accustomed to being humbugged" that they have already two sets of towers and plants belonging to the Trust, and the last Legislature passed an act which in effect forbade them from owning an electric apparatus of their own. In fact Detroit seems to be looked upon by the Trust as the "Hungry Joes" look upon a feeble old man from the country with a wallet full of greenbacks.

The Octopus Reaches Chicago.

CHICAGO, Jan. 14.—A restraining order was granted to-day against the Sunbeam Incandescent Lamp Company and the Illinois Lamp Company in an action brought by the Chicago Edison Company. Chicago is therefore brought to a realizing sense of the situation.

The closing of the Sunbeam factory will be only temporary, as they will have a new lamp on the market within thirty days which will not infringe the Edison patents.

The Chicago Edison Company also advertise in the daily papers that they will enforce their rights, and that they have the exclusive right to sell incandescent lamps in that city.

Dr. Adams's Suit.

The suit of the Adams Electric Company against the Lindell Railway Company, which has been in progress before a Commissioner in St. Louis since December 1, is drawing to a close. The testimony has been voluminous, Dr. Adams's answer to one question filling 300 printed pages.

This suit, it will be remembered, is only a test case, the question at issue covering the fundamental patents on present methods of motor suspension on electrical street cars.

A large array of able legal counsel is engaged, including Marcellus Bailey, of Washington (who drew the patents), for the plaintiffs, and Eaton & Lewis, of this city, for the defendants.

Electrical men in this section consider the entire proceedings as farcical so far as any practical results are concerned.

The Electric Club Gives up the Ghost.

The Electric Club of this city, whose financial affairs have been going from bad to worse, has concluded to dissolve. Mr. George M. Phelps, of the *Electrical Engineer*, is the receiver, and Stephen H. Olin has been appointed referee to hear objections, if any, on April 20 next, at his office, No. 32 Nassau street.

Moralizing would be useless. Cross-roads villages will still maintain prosperous electric clubs, to the common good of all their members, but the metropolis of the country cannot maintain one.

Prof. Thomson to Make a Special Exhibit.

BOSTON, January 16.—Professor Elihu Thomson is reported as having arranged to make an exhibit at the World's Fair of his many beautiful and useful electrical inventions, altogether distinct from and in addition to the extensive display that is to be made by the General Electric Company, with which he is identified as electrician-in-chief. The brilliant inventor has done so much to advance the electrical science that such a display is bound to form one of the most attractive features in the department of electricity.

Canadian Electrical Association.

The annual convention of this association will be held at Toronto, January 25-26. Following is the programme :

WEDNESDAY, JANUARY 25.

2 P. M.—President's Address; Secretary-Treasurer's Report ; Reports of Committees.

Paper by Mr. George Black, of Hamilton, on "Electrical Measurements."

Paper by Mr. W. A. Tower, Toronto, on "Underground Construction."

An invitation is extended to the members of the Association to visit and inspect the Toronto Electric Light Company's new station.

8 P. M.—Dinner at McConkey's.

THURSDAY, JANUARY 26.

10 A. M.—Discussion on proposed Amendments to the Constitution.

Paper by Mr. J. M. Campbell, of Kingston, on "Free Wiring."

Paper by Mr. R. G. Black, of Hamilton, on "The Incandescent Lamp."

Paper by Prof. Rosebrugh, School of Practical Science, Toronto, on "Speed Control."

Paper by Mr. Breithaupt, of Berlin, Ont., on "Probabilities as to the Success of Distribution of Power at Considerable Distances by High Tension Currents of Electricity."

The members are invited to visit and inspect the Bell Telephone Company's new Exchange.

Electricity for the Canals.

Governor Flower Confident that the Idea is Practical.

In an interview in the daily press last week Governor Flower expressed himself more at length in regard to the plan of adopting electricity for the motive power on the State canals. The Governor said :

"I believe that the running of canal boats by some form of electric motor is as certain to come, and come soon, as I am that I am sitting here in the State executive chamber as the Governor of the Empire State. Why, it is easy enough, and not so costly as many suppose. I had an engineer experienced in electrical matters give me some estimates, and I am satisfied that the State can equip the Erie Canal from Buffalo to Albany with an electric power plant by which we can furnish boatmen the necessary power to propel their boats at a cost to them of only about sixty cents a day per boat. The cost of this plant and equipment of power stations, poles, and two trolley wires for up and down boats, I do not think would be much over a million dollars. How do I figure it out? Simply by this: The power house here in Albany cost $160,000, and it furnishes power to run electric cars of six or seven tons each over thirty miles of track. Now, a power house can be constructed for anywhere from $50,000 to $100,000, just as you please to equip it. For the plant on the Erie we should need thirteen or fourteen power houses or stations, situated about thirty miles apart. At a cost of $50,000 each the State could erect fourteen between Buffalo and Albany at a cost from $700,000 to $750,000. The balance of a million-dollar appropriation, or about $300,000, would suffice for the erection of trolley poles and wires. Such a plant would, as I said, furnish power to canal boats at a cost of about sixty cents a day. Now, as I understand it, the canal men have to pay at least $3 a day, while they have to feed and keep five or six mules, which furnish the motive power at present ; so that the paying of sixty cents a day to the State for power would be economy for the boatmen. It would cost each boatman, I am told, about $150 or $200 to equip his boat with the necessary dynamo, or whatever apparatus is needed to operate a small screw propeller, but this cost would not be as much as to equip it with mule power. The State would save by the operation, I think, because a large proportion of the repairs to the canal yearly are made on the tow path, which would not have to be kept up. Oh, it's bound to come ; if not by the trolley, by some other system of applying the electric power to canal transportation, and when it does come it will put the canals in a position to compete with the railroads, and prove their salvation."

Don't Want to Pay Duty.

The promoters of the Chicago-St. Louis Electric Road appeared before the Senate Committee on Commerce, on the 12th, and endeavored to show cause why the Government should permit them to import necessary construction material free of duty. Wellington Adams, John Muir and Representative Seth Cobb, of St. Louis, represented the interests of the company, while the General Electric Company was represented by Eugene H. Lewis, of New York, as counsel. The committee took the matter under consideration.

Harvard's Electric Club.

The Harvard Electric Club, founded in '88, has recently been reorganized, and the old constitution has been amended. The following officers were elected : President, P. W. Davis; vice-president, G. B. Pierce; secretary and treasurer, F. E. Frothingham; librarian, E. Clark; executive committee, the above officers and J. C. D. Hitch, T. H. Soren and J. F. Vaughn. The meetings are to be held bi-weekly; prominent electricians will address the club, and members will read papers before it.

Valuable Stock at Auction.

Great excitement occurred among the brokers in the Real Estate Exchange on January 10, when Messrs. R. V. Harnett & Company offered 20,500 shares of the United States Porte Electric Company's stock at auction. The first bid was $10 for the lot. This was raised successively to $100, $1,000, $2,500 and up to $500,000. There it jumped up $250,000 at each bid, until finally $1,800,000 was realized—on paper.

BOOK NOTICES.

STANDARD TABLES FOR ELECTRIC WIREMEN, with underwriters' rules, instructions and other data. By CHARLES H. DAVIS. Third edition. THE W. J. JOHNSTON COMPANY, LTD., New York. Price $1.00.

This edition of Davis's Wiring Tables has been thoroughly revised and edited by W. D. Weaver. The tables have been recalculated on a uniform basis of 55 watt lamps, and a number of new tables have been added. The method of determining the sizes of conductors, formulas for the horse power of engines, and tables for the limiting sizes for wiring are published for the first time in the present form. A revised copy of Ayer's Instructions for Wiremen has also been reproduced, as well as the rules for wiring adopted by the National Electric Light Association.

TIPS TO INVENTORS. By ROBERT GRIMSHAW, PH.D., M.E. THE PRACTICAL PUBLISHING COMPANY, 21 Park Row, New York. Price $1.00.

This book consists largely of a republication of articles published by the author in the New York *World* and the *Practical Mechanic*, and contains a number of hints as to the directions in which the field for invention is open. It will be forwarded to any address, post paid, on receipt of one dollar, but has not been offered to the book trade.

The *Wall Street News* reports that the sales of the General Electric Company for the first nine days of the present month equalled those of the entire month of January, 1892, and that the Westinghouse Electric Company is known to be thus far $2,000,000 behind its orders.

Boston Notes.

Mr. Paul G. Fiedler, of the Boston Braid Company, was in New York last week on a business trip.

The fierce and destructive conflagration in the wool and leather districts of Boston which broke out last Tuesday morning, and which the fire department is still trying to completely drown out at this writing, has proved a trying experience for all parties concerned. It occurred at a point where there are more overhead wires than at any other part of the city. The entire electric system—telephone, telegraph, light and railway, have been completely demoralized for the time being. What wires were not fused by the excessive heat were either broken by the falling debris or had to be cut to give the firemen a fair show. Owing to the sharp frost that has prevailed all the week, the spray and water froze in such masses on the trolley feeder wires, weighing them down so seriously that even the eight inch steel poles supporting the wires were bent in such fashion that they are having to be removed, and entirely new construction will have to be put up ere the car and other service can be resumed. It is only the truth to state that the entire overhead system of wires has come in for a large share of criticism in consequence of this big fire with its attendant excitement, losses and accidents.

Work is to commence at once on a large building wherein electric cars are to be constructed at Millbury, Mass. A company with a capital of $150,000 has been incorporated, and it is expected that nearly 200 men will be employed.

At the first regular meeting in the New Year held by the Thomson Scientific Club, Lynn, last Thursday evening. Professor Elihu Thomson gave an address on "The Induction Coil," in the course of which the subject of high frequency currents was entertainingly and instructively dwelt upon. Allusion was made to the remarkable experiments in which currents of high voltage were discharged through five feet of air, Professor Thomson expressing his confidence in being able to construct a machine that would discharge a current through a space of no less than fifty feet of space. An attractive course of lectures is being arranged for. Subjects and speakers we hope to publish at an early date.

The new central light and power station in the shoe town of Haverhill, Mass., was started up a week ago. It is one of the best built and equipped stations in Massachusetts. The plant consists of two Harris compound engines of 350 and 250 H. P. capacity respectively; one T.-H. alternating machine of 2,000 light capacity and a Brush alternating dynamo of 1,000 lights; one generator of 100 H. P.; one Brush arc dynamo. The entire work has been erected under the personal supervision and from plans prepared by Mr. Charles H. Herrick, Boston, a gentleman who enjoys an enviable reputation for his skill and ability throughout the electrical field in New England.

Some of the handsome electric fixtures to be seen in Boston have recently been fixed in the new Hotel Reynolds, this city. The ladies' dining room, which is fitted throughout in Louis XVI. style, is generally admitted to be the most beautiful dining room in this country. The electric fittings alone cost over $1,800.00.

New Bedford and Fall River, Mass., are to be connected at an early date by an electric railway which is projected by a wealthy corporation. It is likely to be used for both freight and passenger service.

Chicago Notes.

J. B. Wallace, of the Electrical Supply Company (Ansonia, Conn.) was in Chicago last week, on his annual visit to the headquarters of his company.

H. T. Paiste, of the Paiste Switch Company, was in the city last week visiting his many business friends.

At the last regular meeting of the Chicago Electrical Association the following officers were elected for the ensuing year: President, Albert Scheible; F. S. Hicock, vice-president; C. A. Pratt, librarian; M. B. Speirs, secretary; L. G. Bassett, treasurer; H. G. Dimick, auditor; directors, C. A. Brown, Fred DeLand, E. G. Hovey.

The Englewood and Chicago Electric Street Railway Company was incorporated last week to build an electric street car line from Chicago to the suburb of Englewood. The road will be extended to all the small suburban towns located in a southerly direction from the city.

It is reported that Charles H. Morse, of this city, has purchased the Eclipse Clutch Works and the Williams Engine Works, of Beloit, Wis. It is understood that Mr. Morse will consolidate the two companies and move the plant to Chicago.

General News.

What is Going on in the Electrical World.

St. Louis, Mo.—The mayor has approved the Manchester Electric Railroad bill.

Cheshire, Mass.—There is serious talk here of starting an electric light plant to furnish light for the town.

Columbus, Tex.—The citizens of Columbus are responding liberally to the call for an electric light plant.

East Orange, N. J.—The township committee have decided to procure an electric light plant and do away with gas.

Bay City, Mich.—The Union Street Railway Company are equipping their road for electricity and will dispose of their horses.

Gainesville, Fla.—From Gainesville *Leader*: "Electric lights are what the people of Gainesville demand and will insist upon."

Oakesdale, Wash.—The council has passed an ordinance giving to the Oakesdale Electric Light Company a franchise for thirty years.

Shelbyville, Ky.—The subject of electric lights is a chief topic here, and the people are thinking it is about time they were introduced.

Windsor, Can.—The Sandwich, Amherstburg and Windsor Electric Road has been sold to W. Ryckman, M. P., and others, of Hamilton, Can.

Windsor, Conn.—The people of Windsor are anxious to have electrical railway communication with Hartford and are actively moving in the matter.

York City, Pa.—The Westinghouse Electric Light Company's plant here is nearly completed, the building and its equipments being all of the best class.

Chenoa, Ill.—The citizens after holding a meeting to discuss the matter, voted that the city council should at once contract for lighting the city by electricity.

Menasha, Wis.—The council here is wrestling with the question whether the city would better establish an electric lighting plant of its own or continue the contract system.

Philadelphia.—The People's Passenger Railway Company, according to a statement of President Carson of the company, intends to introduce the trolley system on all its lines.

Reading, Pa.—The electrical department of the Philadelphia and Reading Railroad Company are preparing electric light plants for Coxeton, in the coal regions, and Port Reading, N. J.

Lebanon, Pa.—The Lebanon and Annsville Electric Street Railway Company has just declared a dividend of 6 per cent. although the road has been in operation only sixteen months.

Seabright, N. J.—A number of business men, believing they can get light cheaper than it is furnished by the Long Branch Company, are talking of setting up an electric light plant here.

Indianapolis.—In addition to the building of the Virginia Avenue line the Citizens' Street Railroad Company intend to construct an electric line out Indiana avenue to the Cerealine Works.

Fremont, Ohio.—The proposed electric railway seems in a fair way of becoming a reality, S. Brinkerhoff having asked the council for a franchise, and the members of the council being in favor of the project.

Mobile, Ala.—The bondholders of the street-railway are waking up to the necessity of equipping the road with electric motive power.—The electric cars have begun running here and are giving satisfaction.

Seattle, Wash.—Seattle has nearly ninety miles of street railways—forty-seven miles of single and the remainder double track; twenty-two miles are cable, sixty-five miles electric. There is not a horse car in the city.

Wheeling, W. Va.—The franchise of the Martinsburg Electric Light and Power Company has been accepted by the incorporators of that company, and as soon as arrangements can be made the new company will go to work.

Bridgeton, N. J.—Application has been made to council by the Thomson-Houston Electric Motor Company and by other electric concerns for authority to construct electric railway lines in and about Bridegton and Millville.

Montgomery, Ala.—The Montgomery Terminal and Street Railway Company has resolved to equip its entire system of street and suburban roads with electricity, dropping the mule. Bids for first class equipments are to be called for immediately.

Norwalk, Ohio.—The Sandusky, Milan and Huron Electric Railway Company has been granted a franchise to construct an electric street railway on East Main street from the east line of Norwalk City to East Norwalk. The line is to be completed by July 1, 1893.

Lockport, N. Y.—The long-contested suit between a local electric smelting and aluminum company and a similar concern in Pittsburg was decided yesterday in favor of the Pittsburg company, which practically gives it a monopoly of the business in America. The fight was over patents.

Columbus, Ohio.—It is said that the Thomson-Houston Company is negotiating for the purchase of the plant of the Jeffrey Manufacturing Company. By making this purchase the Thomson-Houston Company would remove its strongest competitor in the manufacture of electric mining machinery.

Youngstown, Ohio.—A special committee of council, appointed to investigate the electric lighting question with a view of ascertaining the advisability of the city erecting and maintaining its own plant, will visit a number of cities for the purpose of getting all available information on the subject.

Hamden, Ohio.—The electric railway that is to connect our town with Wellston has taken a new impetus. Harvey Wells, the originator of the scheme, has just returned from the East and reports that he has secured the co-operation of capitalists there, and that work will begin as soon as the weather will permit.

Flatbush, L. I., N. Y.—The Kings County Electric Railway Company has obtained the consent of the town board and the local authorities to permit it to build and operate a street railway between Brooklyn and Flatbush, running through Rogers avenue in the latter place, to the town line between Flatbush and Flatlands.

Portland, Me.—A harbor dredge now in the harbor is said to be the first dredge on the Atlantic coast to use electric light in its operations at night.—By the application of vaseline to all the trolley wires of the electric railroad in Portland they have, it is said, been kept so clear of ice and snow that no difficulty from the former has arisen.

Natchez, Miss.—The Natchez Street Railway Company has been granted a franchise by the board of aldermen to construct and operate an electric railway system in this city, the franchise continuing until 1912, but the line to be built and in operation on or before the 1st of January, 1896. Morris Moses is general manager of the company.

Hoboken, N. J.—The new electric plant of the New York and New Jersey Electric Company is now in readiness, so far as electric power is concerned, to run cars to North Hudson. A line of cars will be established. The electric lighting of Hoboken will also be served from this plant, which is one of the most costly and complete in the State.

Lancaster, Pa.—The electric railways of Lancaster during the year 1891 carried 1,074,086 passengers, and during the year 1892 the fares numbered 1,684,921, an increase of 610,835. A local paper says: "The enterprise of the company in fitting up parks and affording pleasure resorts for the public is in a large degree responsible for the increase of over half a million passengers in a year's time."

Kent, Ohio.—A petition signed by several prominent citizens has been presented to the council asking for the right of way over various streets of the town for an electric railway. A like petition has been presented to the county commissioners for the right to erect a line over the roads leading to the various lakes which dot the county.

Wilmington, Del.—A report is in circulation here that some Boston capitalists have been looking over the ground and have about decided to build an electric road from Wilmington to Brandywine Springs. If they succeed in purchasing the grounds there, they will convert them into a public park, with such attractions as will make them a popular resort.

Denver, Colo.—The Platte Valley Electric Railway Company has petitioned the county commissioners for right of way for an electric road between Denver and Brighton—fourteen miles—and will probably obtain the grant.—A certificate has been filed by the Amethyst Electric Power and Light Company that its capital stock of $200,000 is fully paid up.

Buffalo, N. Y.—A test of the Sachs Fire Alarm Telegraph System was successfully made here recently. An expert electrician who witnessed the test says "the science of the apparatus is correct and its operation perfect."—The Buffalo Electrical Association held its sixth annual meeting on the 9th and elected officers. The membership is stated to be 306, an increase for the past year of 145.

Fair Haven, Conn.—The people here are demanding quicker transit and are urging the Fair Haven and Westville Street Railway Company to adopt electricity on its lines. They are also desirous that a new electric line be run from the Quinnipiac drawbridge through East Chapel street connecting with the Fair Haven and Westville road at the corner of East street, and another spur from East Chapel the entire length of Ferry street.

Grand Rapids, Mich.—A scheme is in progress here to use the water power at Lowell for the generation of electricity to be transmitted to this city. The Peninsular Electric Company will continue doing business on the present basis, and a new company will be organized with substantially the same stockholders to take charge of the long distance enterprise. The company will have a capital of a quarter of a million dollars at least, and possibly more.

Cincinnati.—H. P. Bradford, of Little Rock, Ark., has been appointed manager of the Mt. Auburn electric road. Mr. Bradford had been manager of the electric lines in Little Rock for a long period, and was so successful that the roads of that city are considered among the best in the country.—The Siemens & Halske Electric Company deny all knowledge of the survey for an electric railroad from this city to Springfield, by the way of Dayton, and say that they do not build roads, but manufacture supplies.

Haverhill, Mass.—It is reported here that the stock of the Haverhill, Merrimac and Amesbury Electric Railroad is to be pooled with that of half a dozen other electric roads in New England. Among the roads which will be affected are those in New London and Norwich, Conn., the South Shore line at Plymouth, Mass., and the Bangor, Me., system. The consolidated companies will, it is stated, form one of the largest companies in the business, and it is understood that one purpose is to antagonize the Thomson-Houston syndicate.

New Orleans.—The New Orleans and Carrollton electric railroad is nearly completed, and a number of the cars have already arrived in the city. It is expected that the trip from Canal street to Carrollton will be made by the new cars in twenty minutes. In reply to a question by an inquisitive reporter as to the danger of running electric cars in a large city as compared with the mule system, Mr. Haile, the superintendent of the Carrollton road, remarked that he thought "there was more to be dreaded from the tail end of a mule than from any trolley car."

Norristown, Pa.—A trolley road from Norristown to Wissahickon, within the Philadelphia city limits, seems to be reasonably assured if the plans of the projectors do not go awry. The Citizens' and Norristown Railways, of Norristown, have been practically sold to a syndicate in which the Shepp Brothers, of Philadelphia, are deeply interested. The Roxborough and Barren Hill Railway, extending from Wissahickon, in Philadelphia, to Barren Hill in Montgomery County, was recently purchased by a stock company, and now it is proposed to connect the two lines.

Nashville, Tenn.—The Union Bank and Trust Company has had a chime of bells put up in the bank building that are rung by electricity. The chimes at the first quarter strike two bells, at the second quarter four bells, at the third quarter six, and at the hour a selection from some opera or some well-known melody follows the time strokes. A different air is played every hour for the six days of the week, making seventy-two in all. A large regulating electric clock governs the movement and operation of these chimes, and will also operate an electric time dial to be placed in the front window of the bank.

Detroit, Mich.—The franchise granted to E. W. Cottrell for an electric line from the city limits on Grand River avenue through the township has been assigned by Mr. Cottrell to George H. Russell, W. C. McMillan, M. S. Smith and himself under the corporate name of the Detroit and Greenfield Electric Railway Company. The company will begin the construction of its line early in the spring.—The Detroit Electrical Works propose an issue of $500.000 preferred stock by conversion of that amount of authorized common stock into preferred, to be sold at par with a bonus of 50 per cent. of common stock.

Jersey City, N. J.—Chancellor McGill, acting on the application of the receiver of the United Traction Company, whose main works are at Marion, for leave to sell the Newark plant, has ordered the plant to be sold at public or private sale, subject to the mortgages and confirmation of the sale by the court. The plant was established to furnish electric power to manufacturers and others. The petition of the receiver sets forth, among other things, that the property was covered by two mortgages aggregating the sum of $700,000. — The Montgomery street electric cars have already become popular and are filled almost every trip. The horse cars have all been taken off.

Kansas City, Mo.—The *Star* is in favor of municipal lighting, and says "the only men who oppose the city having its own lights are the stockholders in the electric light companies or their tools."—A letter from A. J. O'Reilly, supervisor of city lighting at St. Louis, in regard to electric lighting in that city, was laid before the board of public works of this city lately. Mr. O'Reilly says: "The city of St. Louis does not own an electric light plant. The streets are lighted by 2,273 arc lights, of 2,000 nominal candle power, from sunset to sunrise, at a cost of $74.95 per year; and 1,792 incandescent lights of thirty candle power, at a cost of $17.50 and $26 per year. The Heisler and Westinghouse incandescent systems are used." Kansas City, it seems, pays $43.55 a year per lamp more than St. Louis.

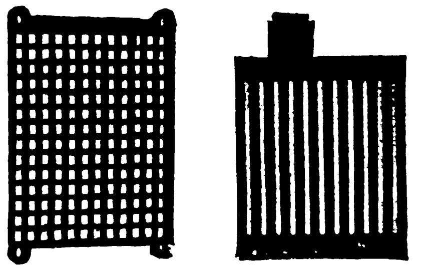
Baltimore.—The electric locomotives to be used in hauling the trains on the Belt Railroad will be six in number, of 400 horse-power each, and each will weigh thirty tons. Three of them will be coupled together, giving 1,200 horse-power, and it is in this form they are expected to be most used, although they can be easily separated, and one motor of 400 horse power can be used when necessary to move light local trains. The generators to be used will be of 700 horse-power. Thirty miles an hour is the speed guaranteed for passenger trains moved by the motors in the tunnel for trains of 500 tons weight, and fifteen miles an hour is the guaranteed speed for freight trains. The plant for the movement of trains is being built at Schenectady, N. Y. — The *Herald* in calling attentention to the enormous development of rapid transit in Washington and Baltimore and contiguous territory within a few years says: "Trolley lines have been projected along the Potomac into Western Maryland. A street railway from Washington to Bay Ridge and down the Potomac into Southern Maryland are also possibilities of the future. Only this week was the Lonaconing and Cumberland Electric Railway Company incorporated with a capital stock of $250.000 to build a railway from Cumberland to Westernport, a distance of twenty miles."

A Storage Battery Car.

On Wednesday a party of electricians, at the invitation of Messrs. McDougal & Woolcott, made a trip over the Ninth avenue railroad from the car stables at Fifty-third street to the end of the route and back to the stables. The car in which the party made this trip was equipped with the McDougal motor and Acme storage batteries, and its performance was such as to elicit the highest encomiums from all who participated in the trial trip.

The Acme cell weighs twenty-seven pounds against forty pounds for a cell of the same dimensions using lead grids.

These grids are of a non-conducting material which is not attacked by the acid and which is sufficiently elastic to yield to the expansion of the active material without buckling, warping or breaking. On the other hand the active material is retained with sufficient firmness in contact with the conducting plate of lead which is situated in the middle of the complete plate. There is an equal amount of active material on each side of this lead conducting-plate, thus insuring an equal distribution of current



Ribs on the non-conducting grids meet through slots in the conducting plate, and are cemented together, uniting the whole into one solid plate. The openings for the reception of active material are smaller on the outside to aid in the retention of their contents. The exposed surface of active material is about forty inches on each plate, or about 200 square inches for the five positives. The maximum steady discharge on the hill was 130 amperes, or about sixty-five amperes per square inch.

Patrick Kennedy and Charles J. Diss, the inventors of the battery, and W. M. McDougal, the inventor of the motor, expressed themselves as being well pleased with yesterday's trial trip. They claim that the car will be able to travel at the rate of twenty miles an hour; that the capacity of discharge of the Acme battery is the highest yet attained. They also said that the supporting plates in the batteries could not be affected by acid, thus prolonging the life of the cell considerably.

The Diamond Transformer.

It is only within a comparatively short time that transformers have been manufactured apart from generating apparatus, or since both articles were made by the same companies. Practical experience, however, suggested so many economies that might be effected by improved types of transformers that about two years ago factories outside of parent companies were established for the exclusive manufacture of transformers and kindred articles. Realizing, as these factories did, the necessity for producing transformers of marked superiority over the older types, they succeeded in producing a grade of transformers considerably in advance of those that had theretofore been in general use, and by this means not only established a market for their own products but also stimulated the parent companies to active exertion towards improving their own transformers.

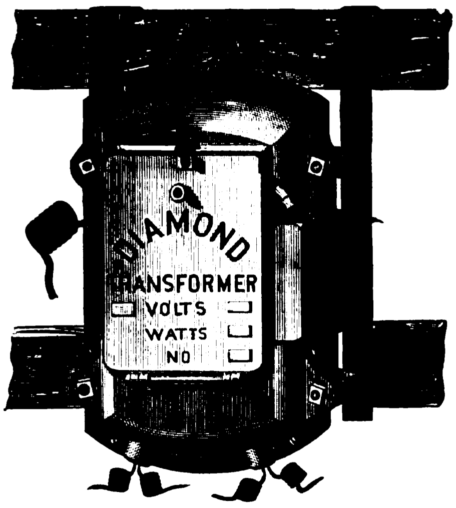


FIG. 1.

The Diamond transformer is the latest type which has been placed upon the market and embodies all that experience has obtained from the good qualities of other converters, while it succeeds in evading all of their defects.

A transformer to be popular in these days with the superintendents of central stations and with linemen must be convenient and unattended with any abnormal difficulties in placing of upon poles or buildings.

Fig. 1. illustrates the transformer as it appears when attached to the cross arm. It will be seen that this converter is easily adjusted and held in secure position by the hooks engaging with the cross arms. The ring in the top is for hoisting upon a pole by means of a block and tackle. Should it be necessary, however, to attach this converter to brick walls, the hooks may be easily removed and the converter secured to the wall by means of the four lugs seen in the cut. The Diamond transformer is also made three-point, and is easily and quickly convertible from 50 to 100 volts on the secondary wires without the use of a more or less clumsy and inconvenient switch.

Fig. 2 shows the transformer with fuse box exposed to view. The primary and secondary connections are readily seen, and it will also be noticed that when the door is closed each fuse is in a separate compartment, so that in case one should blow out it would have no effect upon the other by excessive heating. The porcelain box and fuse blocks are highly glazed, and it is claimed that there is no danger of their absorbing moisture. The convenience of this style of fuse box will, we believe, be apparent. The fuse blocks are attached to the door itself. If follows that when the door is opened the connection is completely broken, and a lineman may replace fuses upon a live wire with perfect safety, at the same time having the fuse blocks entirely exposed to view. The fuse blocks themselves may be detached by means of a little gnarled thumbpiece, seen by the side of the detached block. These fuse blocks are interchangeable for all sizes of transformers, so that a central station by keeping a few of them on hand may always be assured of a fuse block in case one upon the line should be broken by lightning or otherwise.

It has been a source of inconvenience and expense to central stations heretofore to return burned out converters to their respective factories to be repaired or replaced. The delay has often caused serious inconvenience and it has resulted in many cases in the stations making ineffectual attempts to repair the converters themselves.

Fig. 3 illustrates one of the most important claims of the Diamond converter to the appreciation of practical central station men. It will be seen that the secondary coils are in two parts, the primary coil being securely imbedded between the two, thus affording a common center of magnetism. After the primary coil is in position, the secondary coils are adjusted and firmly bolted together, completing a perfect magnetic circuit. Should, however, a primary coil be burned out by lightning or otherwise, it is only necessary to have another coil sent by express, when the central station man can readily place it in position himself, thus obviating all the delay and expense which was a necessary part of the old methods.

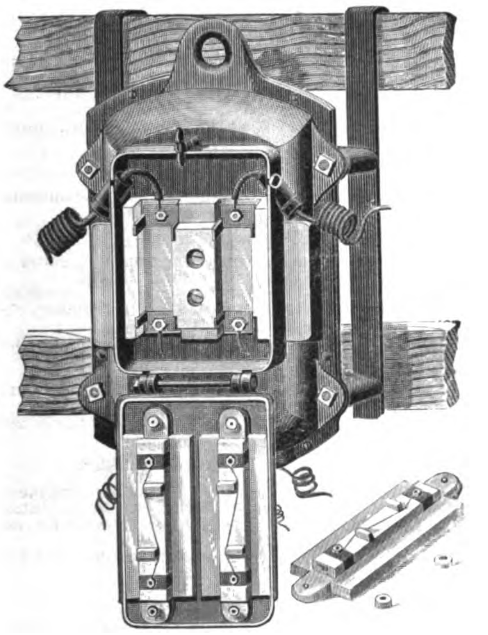


FIG. 2.

The Diamond converter is of very high efficiency, low leakage current and excellent regulation. It is made as light in weight as is consistent with the best practices, and is well ventilated through the top and bottom of the case so that a free passage of air will aid in keeping the coils at a low temperature This converter has so many points of excellence that it will, we believe, meet with ready appreciation among all practical central station men.

Taylor, Goodhue & Ames, 827 Monadnock Block, Chicago, have taken the exclusive agency for the sale of this converter and have in course of preparation a pamphlet treating quite extensively of its merits

The Waterhouse Arc Lamps.

The firm of Waterhouse, Gamble & Company, of Hartford (New York office 45 Broadway), are meeting with excellent success in the sale of their various types of arc lamps. Mr. Gamble is widely known as a successful business man, and the name of Waterhouse is one of the oldest in the electrical trade. Mr. W. T. Partridge, of the firm, is in charge of the New York office.

Mr. Waterhouse has been a fertile inventor, and the line of lamps handled is varied and covers everything needed.

Their specialties just now are Ornamental Lamps of extra finish and artistic design; Railroad Circuit Lamps to run on currents of variable E. M. F., controlled by an automatic current regulating device; and a Fifteen Hour Lamp for 5-8 inch single carbon, guaranteed to burn from thirteen to fifteen hours under all conditions.

The special points of merit claimed for the Waterhouse Lamp are the following:

1. There *are no insulating washers* used in their construction, the insulations being confined to four solid pieces of cement, thus doing away with short circuiting and the other annoying features heretofore so common in other kinds of arc lamps.

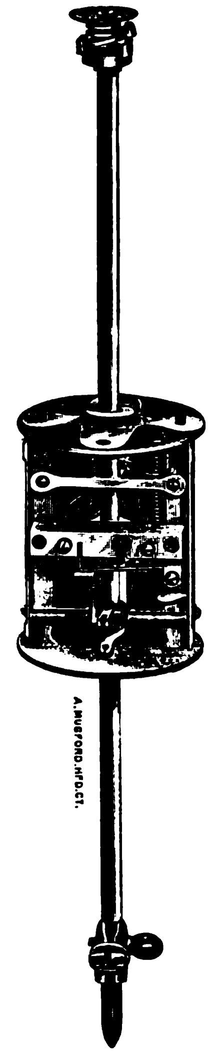

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FIG. 1.

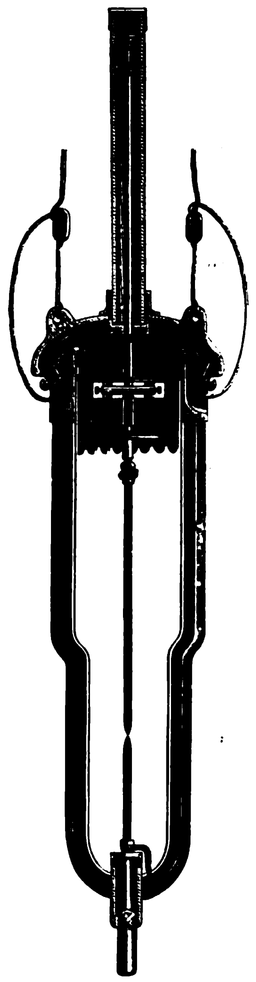


FIG. 2.

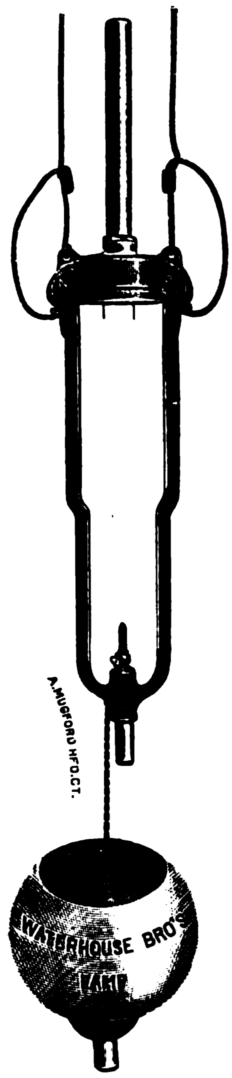
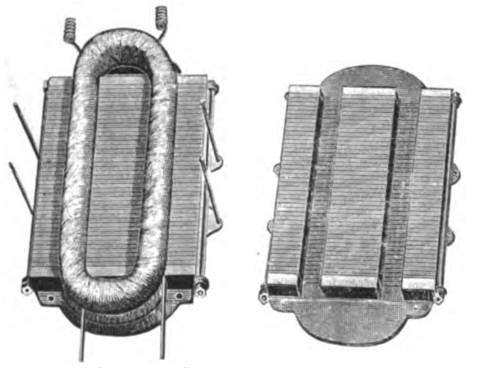


FIG. 3.

2. The magnets are double, strong, and adjusted in their position so perfect alignment is secured.

3. The armature hangs and has its pull on the clutch in an exactly perpendicular line, so that all side friction or necessity of transmitting motion through pivots is avoided, thereby securing a sensitiveness as near perfect as can be reached.



DIAMOND TRANSFORMER. FIG. 3.

4. The clutch is made durable, and by the assistance of the atmospheric clamping device shown at the top of Fig. 2, a steadier and finer feed is secured than is to be found in other lamps on the market, making them particularly desirable on incandescent circuits. The durability of the plunger used in this device is beyond question, it being made of soft, pliable material that prevents the possibility of sticking or hanging and is practically free from wear or deterioration, as has been proven by a test to 750,000 strokes, equivalent to trimming a lamp once a day for over 2,000 years.

5. The Globe Holder is a great improvement over all forms, being dust-tight for inside and well drained for outside use, and enabling the attendant to clean out the globe without unscrewing it.

Fig. 1 shows cage made of a single casting containing all working parts of the lamp and showing atmospheric clamp on top of carbon rod.

Fig. 2 shows all insulations (four pieces) in black.

Fig. 3 shows lamp frame for either incandescent or arc, with chimney and globe holder attachments, works removed. The two wires extending down from underside of top are the electrical connections

Any good uncoated carbons can be used with these lamps if lamps on incandescent circuits receive 110 volts or more per pair. If less than 110 volts, cored carbons for top and solid for bottom will be required.

An English company has been formed to associate with Waterhouse, Gamble & Company, and Mr. Addison G. Waterhouse, has recently sailed for Liverpool to assist in starting a plant on the other side. The machinery is already purchased, and the tools, which have been made at Hartford, will be shipped this month.

The Varley Magnet Winding.

The method of winding magnets in vogue to-day is the same, with the exception of some minor details, as when the industry was first created. A recent invention of Mr. Richard Varley, Jr., is quite a departure from the old-time methods of winding, as well as the design of the machinery used in the manufacture of electro-magnets.

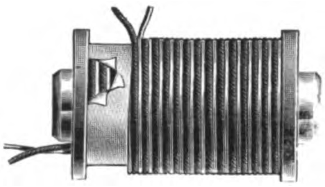


FIG. 1.

Owing to the fact that insulated magnet wire of small size costs in the neighborhood of twice as much as bare wire of the same size, it will be seen that by the use of the duplex system, as it is called by Mr. Varley, its inventor, a considerable saving in the cost of manufacture is effected by this system in this item alone.

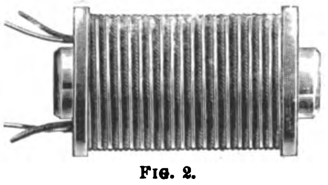


FIG. 2.

The definition of an electro-magnet has been given as "a soft iron wire surrounded by many turns of insulated wire," and while the illustrations show that this definition is not literally adhered to in the case of the Varley magnet, the conditions which are implied are attained by a cheaper method.

Fig. 1 shows the Varley magnet partly constructe and the general method of construction. Two wires are wound simultaneously by means of a special machine, one of these being a bare wire, the covering of the insulated wire serving the purpose of insulating the two parallel strands. The different layers of wire are separated by means of a layer of paper which serves to insulate them.

Fig. 2 shows a complete spool as turned out by this machine. There are four ends exposed which may be connected so as to put the windings either in series, parallel or differential connection as desired.

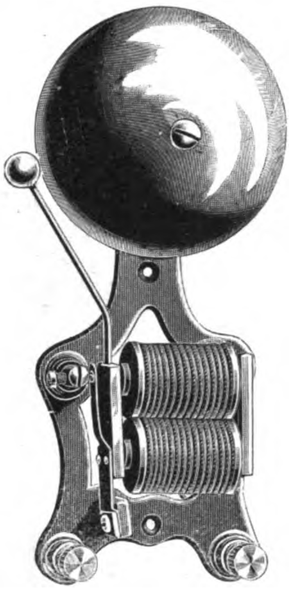


FIG. 3.

Fig. 3 shows an electric bell fitted with the "duplex" magnets.

The chief object of the manufacturer to-day is to cheapen the cost of construction, and the Varley magnet reduces this cost to the lowest point. The saving of space which results from the use of this electro-magnet also adds to its effisiency by reducing the amount of copper wire used as well as the size of the spool. In this respect the Varley winding will be of great service, as considerably more wire can be used in the same space than is possible with all-insulated wire, and in the cases of apparatus using small currents the insulation resistance need not be extremely high.

Cincinnati's Leading Supply House.

Houliston & Company, 161 Plum street, Cincinnati, are doing a thriving business in the sale of supplies and various specialties. They are agents for several of the "good things," chief among which being the Mather dynamos and motors, Perkins lamps, Carpenter heaters, and Eureka tempered copper. Everything needed for a lighting plant can be bought of Houliston & Company, and perfect satisfaction is guaranteed to their customers.

COMMERCIAL PARAGRAPHS.

The Card Motor and Dynamo Company of Cincinnati are doing a flourishing business, and will move into more commodius quarters early in the spring. They purchased a factory site some time ago, and work on the building is progressing rapidly. Mr. Wilshire is demonstrating the fact that he knows his business.

The Phosphor-Bronze Smelting Company of Philadelphia, who were the original manufacturers of this line in America, maintain their position at the head of the column. Their "Elephant Brand" is as popular as ever.

Mr. George W. Beatey, who has constructed quite a number of electric roads in New England and formerly handled Westinghouse apparatus, now occupies an extensive suite of offices in the Hathaway Building, 620 Atlantic avenue, Boston, and represents the Dewey Electric Heater Company, also the Detroit Electrical Works. He has at the present time quite a number of important contracts in hand, and with his wide reputation and extensive facilities, he is in a fair way for continuing to do a large business. He is one of those who have a fortunate way of getting ahead and is adding to his excellent reputation right along.

The Consolidated Electric Manufacturing Company, of Boston, has recently issued a neat little illustrated catalogue in cloth and gold, which will be found invaluable to all in the elecctrical business. The multitudinous devices this company manufactures and handles are described and prices given, so that prospective purchasers can make no mistake when placing their orders. Under the enterprising management of Mr. C. E. Bibber, this company is rapidly getting to the front and is about to place on the market certain apparatus that is bound to secure popular favor. The little New Year's souvenir, consisting of a celluloid whist marker, circulated by this company is in extraordinary demand.

Mr. H. C. Hawks, well known throughout New England as a first class constructing electrical engineer, has sold out his business to the Hawks Electric Company, which occupies a handsome suite of offices in New England Building, Sumner street, Boston, where a full line of supplies and specialties will be carried. Mr. Hawks has been retained as treasurer and general manager of the company, and the many important contracts now in hand will be carried out under his personal supervision.

The prosperous Electric Gas Lighting Company has just removed into a large factory on Dover street, Boston, where with greatly increased facilities it will still further extend its now colossal business in the manufacture of every kind of domestic electrical apparatus. This company occupies a foremost position in the country in this branch of the electrical business.

The Mather Electric Company, Manchester, Conn., and Boston, has recently issued a handsome little pamphlet entitled "Practical Thoughts by Practical Men," in which, among other interesting matters, are given the opinions of many eminent men and companies on the merits of the well-known Mather system of electric lighting. The voluminous list of purchasers and users of this system furnishes convincing proof of its efficiency and popularity. The company has had to enlarge its factory to keep pace with the demand for its apparatus.

The Electrolier Manufacturing Company of Pittsfield, Mass., will soon be in the market with a full line of fans, bells, automatic adjusters for electric lamps, etc.

The Giant Motor Company of Portland, Me., is about to erect a very large manufacturing plant, being four two-story iron buildings, each 150x75. The Berlin Iron Bridge Company has the contract for the work. The Giant Company has bright prospects.

The Jenney Motor Company of Indianapolis has just put in a fine electric power and lighting plant for the Williams & Powell Brass Works Company of Cincinnati. The plant is a model one, and has attracted considerable attention.

The Belknap Motor Company of Portland, Me., has just installed a 150 light dynamo in the factory of the Portland Stone Ware Company. This company has built up a very satisfactory local trade, and is now working over a wider territory.

INCORPORATIONS.

The Durango Light and Power Company, Durango, Colo. Capital stock, $200,000. Directors Clinton Reed, Sam P. Rose, William C. Henry, E. R. French and H. V. Johnson. The design of the company is to operate a gas and electric light plant in Durango.

The Spartanburg, S. C., Electric Light and Power Company, having made application to the Secretary of State for power to increase its capital stock from $30,000 to $75,000, has been empowered to do so.

The Columbus and Harrisburg Electric Street-Railway Company, Columbus, Ohio. Capital stock, $1,500. Incorporators: Joseph M. Briggs, Adam G. Grant, Gideon D. Martin, John S. Young, J. H. Chenoweth, Levi Hite and George M. Stark.

The following certificates have been filed with the Secretary of State at Lansing, Mich.: Edison Illuminating Company, Detroit, capital increased $300,000 to $350,000; Excelsior Electric Company, Port Huron, capital increased to $150,000.

The Electrolier Manufacturing Company, Newark, N. J. Capital stock, $100,000. Incorporators: Benjamin E. Chapin, Newark; Henry D. Sisson, Charles H. Robinson and Mortimer H. Haynes, Pittsfield, Mass; and Henry [illegible] Sisson and Edward F. Blodgett, Mill River, Mass.

The Waterhouse Electric Company, Hartford, Conn. Capital stock, $20,000. Incorporators: Addison G. Waterhouse, Frank G. Waterhouse and George L. G. Waterhouse, all of Hartford. The company was organized for the manufacture and repair of all kinds of electrical apparatus and machinery, to buy, sell and deal in the same, promote electrical inventions and to conduct experiments therefor.

The New Haven Electric Company has increased its capital from $300,000 to $400,000, and the number of shares from 3,000 to 4,000 of $100 each.

The Brooklyn Traction Company, Brooklyn, N. Y. Capital stock, $10,000. Directors: E. D. Phillips, Albert Strauss, Henry S. Glasier, E. J. Kavanagh, of New York City, and P. F. Vaughan and J. H. Lockman, of Brooklyn. The company was formed for the purpose of constructing street railways and equipping them with electricity and other power. The principal office of the company will be in Brooklyn.

The Englewood and Chicago Electric Street Railway Company has just been organized and incorporated with a capital stock of $1,000,000. The road will be twenty-five miles in length. James P. Mallette, of the real-estate firm of Eggleston, Mallette & Brownell, Chicago, was the prime mover in the organization of the company.

The Pittsburg Gas and Electric Fixture Manufacturing Company, Pittsburg, Pa. Capital stock, $10,000. Directors: John M. Thompson, Edmund Mudge, David F. McKee, Robert B. Ivony.

The Central Colorado Electric Supply and Manufacturing Company, Pueblo. Capital stock, $100,000. Directors: Moses Franklin, E. H. MacDermott, Boone Hartson, Roger MacDermott, Thomson Neelson and H. W. Preston.

The Superior Electric Company, at Chicago. Capital stock, $300,000. Incorporators: Fred H. Hamlin, David H. Wilson and James L. Clark.

The Electric Battery Company, at Chicago. Capital stock, $10,000. Incorporators: Frank L. Malmstedt, Martin R. W. Russell, E. Theron, C. G. Hendberg and Victor Bronson.

The Independent Electric Company, Chicago. Capital stock, $25,000. Incorporators: William F. Hall, S. G. Hicks and N. D. Levin.

The Electrical Publishing Company, Chicago, have certified to a change of name to Electrical Engineering Publishing Company.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JANUARY 10, 1893

ELECTRIC RAILWAYS AND APPLIANCES.

489,481. Electric-Railway Trolley. Ernest H. Jenkins, Winfield, Md. Filed July 20, 1892.

489,563. Electric Railway. Daniel E. Kimball, Topeka, Kan. Filed Jan. 11, 1892.

489,573. Conductor System for Electric Railways. George W. Von Siemens, Berlin, Germany, assignor to Siemens & Halske same place. Filed Feb. 3, 1892.

489,597. Multiphase Railway System. Francis B. Badt, Chicago, Ill. Filed Feb. 19, 1892.

489,764. Underground Electric Railway. James B. Sheldon, Daniel J. Murnane and George L. VanBeek, St. Louis, Mo. Filed June 22, 1891.

489,835. Closed-Conduit Electric Railway. Charles A. Stark, Duluth, Minn. Filed March 23, 1892.

489,883. Electric-Car Truck. Thomas Tripp, Avon, Mass., assignor, by mesne assignments, to William G. Means, Boston, Mass., and Aretas Blood, Manchester, N. H. Filed June 30, 1892.

DYNAMOS AND MOTORS.

489,505. Journal-Bearing for Dynamo-Electric Machines. William L. Silvey, Lima, Ohio. Filed May 18, 1889.

489,687. Means for Controlling Electric Motors. John F. Ott and Arthur E. Kennelly, Orange, N. J., assignor to the Edison General Electric Company, New York, N. Y. Filed May 7, 1891.

489,709. Variable-Speed Electric Motor. Carl Hering, Philadelphia, Pa. Filed April 30, 1892.

ELECTRIC LIGHTS AND APPLIANCES.

489,526. Electric Lighting System. Harry M. Doubleday, Pittsburg, Pa. Filed April 21, 1892.

489,598. Electric-Lighting System. Francis B. Badt, Chicago, Ill. Filed Oct. 22, 1892.

489,616. Electric Gas-Lighting Apparatus. Aaron M. Sloss, Kansas City, Mo. Filed March 24, 1892.

489,682. Lamp-Socket. Amandus Metzger, Schenectady, assignor to the Edison General Electric Company, New York, N. Y. Filed April 26, 1892.

489,739. Socket-Switch for Incandescent Electric Lamps. Louis Henry and Louis N. Dalysson, Newark, N. J. Filed Oct. 10, 1892.

489,815. Hanger for Electric Lamps. Charles S. Hume, Detroit, Mich. Filed June 2, 1892.

489,861. Bracket for Electric-Light Wires. George H. Bennett, Cincinnati, Ohio. Filed Nov. 16, 1891.

TELEPHONE AND TELEGRAPH APPARATUS.

489,571. Spring Jack Switch for Telephone Exchanges. Charles E. Scribner and William R. Patterson, Chicago, Ill., assignors to the Western Electric Company, same place. Filed Jan. 21, 1892.

489,603. Attachment for Telephones. James L. Davidson, Pittsburg, Pa. Filed Oct. 8, 1892.

BATTERIES.

489,522. Galvanic Battery. William C. Cahall, Philadelphia, Pa. Filed Oct. 29, 1891.

489,559. Galvanic Battery. George L. Foote, Brooklyn, N. Y. Filed Sept. 13, 1892.

489,668. Electric Battery. Clarence H. Bryan, Chicago, Ill. Filed May 3, 1892.

489,832. Galvanic Battery. William R. Reud, New York, N. Y. Filed June 28, 1892.

MISCELLANEOUS.

489,464. Electro Steam Valve Attachment. James H. Crosby, Somerville, Mass., assignor to the Gamewell Fire Alarm Telegraph Company, New York, N.Y. Filed Sept. 1, 1890.

489,515. Automatic Feed and Return Mechanism for Phonographs. [illegible] Anthony, Cincinnati, Ohio, assignor of three-fifths to James L. [illegible], same place. Filed Nov. 20, 1890.

489,551. Electrical Diaphragm. Charles N. Waite, Newton, Mass. Filed March 16, 1892.

489,553. Electrical Switch. George Baehr, Brooklyn, N.Y., assignor to Samuel O'Connor, same place. Filed March 26, 1892.

489,570. Spring-Jack Switch. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Dec. 27, 1880.

489,625. Electrically Controlled Ventilator. Sebastian G. Brinkman, New York, N. Y. Filed March 8, 1892.

489,629. Railway Signal. William F. Z. Desant, New York, N. Y., assignor to the Desant Electric Company, same place. Filed April 25, 1892.

489,653. Electric Gas Lighter. Thomas W. Lane, Boston, Mass., assignor to the Electric Gas Lighting Company, Portland, Me. Filed Jan. 25, 1892.

489,704. Electrotype. William T. Barnum, New Haven, Conn. Filed Nov. 23, 1891.

489,736. Railway Signal. John E. Geary, Syracuse, N. Y. Filed Dec. 29, 1891.

489,902. Electric Prison Cell and Guard. William S. Hull, Sheffield, Ala., assignor of one-half to Charles H. Sparks, St. Louis, Mo. Filed Sept. 22, 1891.

This Journal begins volumes on Jan

ELECTRICITY.

VOL. IV. NEW YORK. JANUARY 18, 1893. CHICAGO. No. 1.

ELECTRICAL and MINING ENGINEER,
WESTERN AGENT OF THE
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MEASURING - APPARATUS,
—COMPRISING—
Ammeters, Voltmeters, Galvanometers, Resistance Coils, Condensers, Electrometers, Photometers, etc., etc. If interested send for our descriptive catalogue No. I-66.
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BROOKLYN, N. Y., July 19, 1892.
HENRY A. REED, SEC'Y BISHOP GUTTA-PERCHA CO.
Dear Sir: We can candidly vouch for the superior quality of the Bishop insulation, as it has withstood the weather, falling wires, etc., during our two and a half years' service without accident or trouble of any nature on our aerial lines or in our house wiring. The severe storm of the winter of 1890-'91, which obliged all other plants to "shut down," caused no injury to our alternating circuits. Yours respectfully,
JAMES FERGUSON, *Sup't.*

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Recognized as foremost in the market
is made by
THE ELECTRIC CONSTRUCTION . .
. . . AND SUPPLY COMPANY,
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Lancaster City & West End R.R. Co.,
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Write as follows: "We must change some of our cars, so as to use your 'Lyon' brake handle. Fill enclosed order as soon as possible."
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355 Congress Street,
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Put in a low voltage incandescent plant; use the incandescent lamps for offices, etc., but wherever you have large spaces to light use the

"WARD" Arc Lamp.

Safe, reliable and economical. The only satisfactory lamp made for such circuits. Many thousand in use.

We manufacture single and double carbon, street railway, photo-engraving, theatrical and search lamps.

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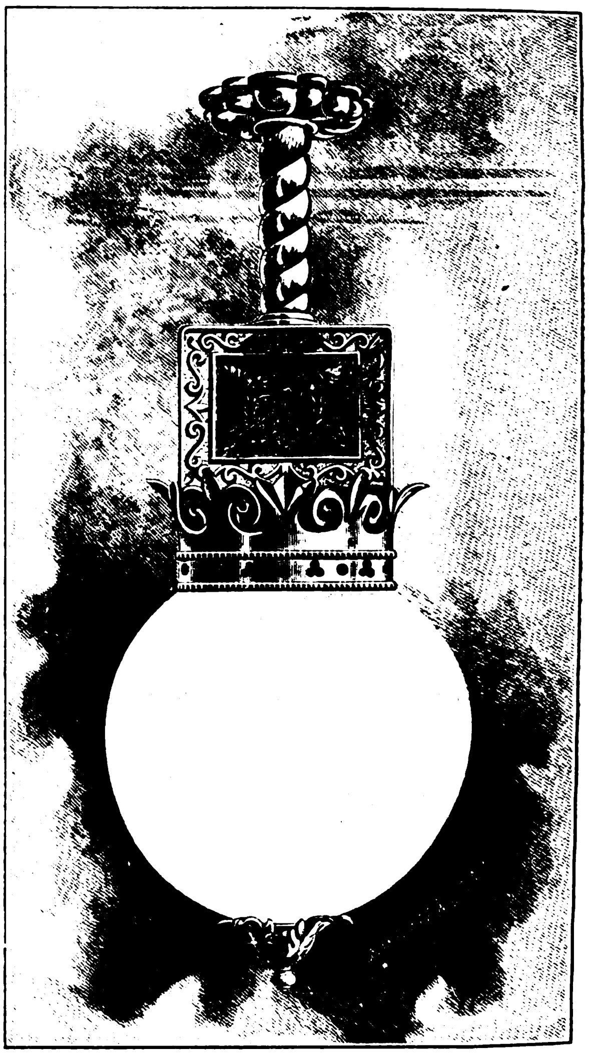

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RAISES THE RECORD OF TRANSFORMER EFFICIENCY TO

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A full account of this performance can be obtained by writing to us for a copy of the report by Prof. Ryan, of Cornell University, of a test of one of our 350-light TRANSFORMERS.

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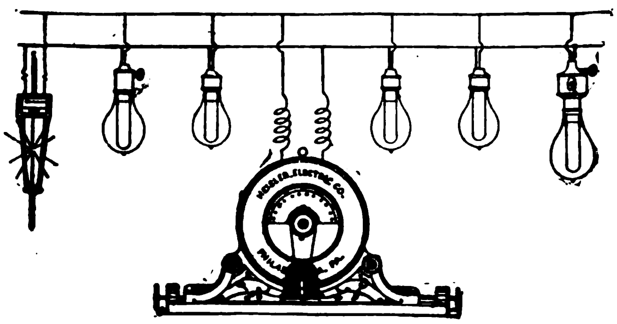

EQUIPPED WITH REGULATING LAMP SOCKET.

With this system it is possible to regulate each individual light at any desired degree of brilliancy, resulting in a saving in current as well as prolonging the life of the lamp.

This system is efficient and reliable, and specially adapted for isolated plants for the lighting of Hotels, Educational Institutions, Hospitals, Municipal and Office Buildings, Private Residences, etc.

The apparatus is simple, compact and economical, having no complicated appurtenances, self-gulating, and can be installed as conveniently as the ordinary direct current type of apparatus.

If desired, arc lights and motors can be operated upon the circuits.

Estimates furnished of complete installation of isolated plants. Satisfaction fully guaranteed.

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WHEN you want a Lamp made on business principles, and are tired out with "Chin Music" as to the "Wonts** you write to the CHICAGO INCANDESCENT LAMP COMPANY, 75 North Clinton Street, Chicago, Illinois, and ask for the PRAY'S Lamp ? ? ? ? ? ?

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One No. 7 30-Light Brush Arc Dynamo with Dial.

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PREMIUM ANNOUNCEMENT, 1893!

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TO THE USERS OF INCANDESCENT LAMPS.

The shipment of our new stopper lamps will begin early in January.

In making this announcement, and in quoting prices, we take pleasure in giving particulars which will indicate some of the many advantages the users of our apparatus will enjoy.

FIRST—The new lamps are made in separable parts, so that the carbon burners may be replaced, and the glass parts used repeatedly; and their bases being molded of uniform size to fit a specially designed socket, the lamps are neater in appearance than the all glass-globe form.

SECOND—The carbon burners will be preserved by an attenuated atmosphere of nitrogen, and their candle power maintained more nearly constant than heretofore by means of a recent important discovery.

THIRD—Special sockets of neat design will be employed for these lamps, and special fittings will be supplied at five cents each, which will adapt any of the forms of sockets now in use to receive the new lamps, thereby bringing about exact uniformity in lamp bases.

FOURTH—By reason of the manufacture of the lamps by special machinery and improved methods, by the use of nitrogen for preserving the carbons, and by means of pumping and charging apparatus recently perfected, WE HAVE BEEN ABLE TO SO REDUCE THE COST OF MANUFACTURE AS TO FIX OUR PRICES FOR 8, 10 AND 16 CANDLE POWER LAMPS AT

30 CENTS EACH,

subject to a discount of 10 per cent to our central station customers,

and to others from 2 1-2 per cent. upward, according to quantity,

with an allowance of 10 cents for every burned out lamp returned unbroken

to any one of our factories, making the net cost OF RENEWALS FOR THE 8, 10 AND 16 CANDLE POWER LAMPS 17 CENTS to our central station customers. For 20 and 25 candle power lamps the prices will be 35 cents each, subject to the same discount and allowance for burned out lamps.

By long and careful tests, and by the use of a large number of these lamps in our works, we have demonstrated that the new lamp will have greater advantages for users than the Edison lamp or any of those heretofore upon the market.

The importance of the improvements in manufacture by which we have been enabled to offer these lamps at so low a price will be appreciated by all users who are aware of the constant deterioration in the carbon burners, and of the fact that the real commercial efficiency of a lamp is its average efficiency. With a constant amount of electric current the ordinary 16 candle power lamps rapidly fall below 10 candle power from deterioration of the carbon, when they must be renewed; and it results from this that the users, with cheaper lamps, will get from

15 TO 20 PER CENT MORE LIGHT

from a given expenditure of electricity by a more frequent renewal of lamps than is now customary. Thus the low cost of the lamps may be made to add to the revenue of a lighting station in one of two ways, viz., either by giving a greater lighting capacity at the present cost of lamp renewals, or by actual saving in the cost of lamps with renewals made at the present period of renewal.

The problem of manufacturing a sufficient number of lamps to supply the entire demands expected from the users of electric light is a difficult one to meet quickly. We are preparing to turn out from

15,000 TO 20,000 LAMPS DAILY,

and in addition to this to renew the carbons in returned burned out lamps to any extent that may be required. During the month of January we expect to be able to take care of all of our customers who must have the new lamps, and rapidly thereafter to fill all the orders with which we may be favored.

We are also contemplating the erection, as the business develops, of "renewal stations" in all large cities, such as New York, Boston, Philadelphia, Chicago, Cincinnati and St. Louis,

thereby reducing the cost of shipment and return of lamps for renewals and still further reducing the net cost of the lamps to our customers.

WESTINGHOUSE ELECTRIC AND MANUFACTURING CO.,

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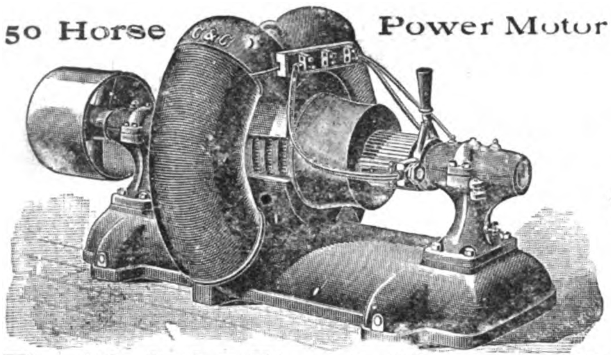

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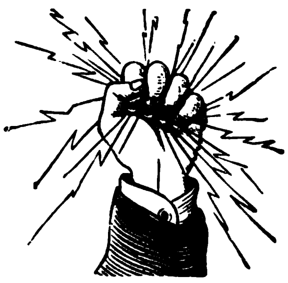

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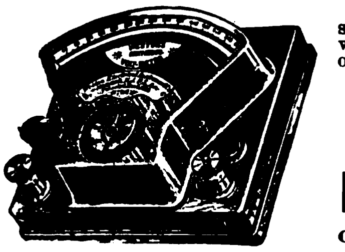

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ARE IN THE MARKET FOR BIDS ON A 100 TO 125 LIGHT PLANT
for their factory, to be put in at once.
Write them for specifications.

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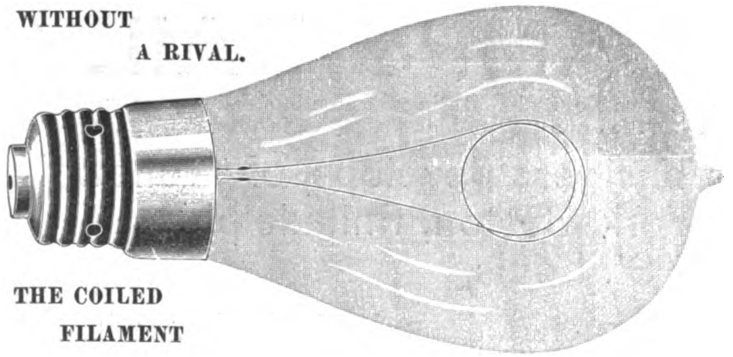

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EFFICIENCY. BEAUTY. LIFE. | TRY JUST ONE LOT AND YOU WILL HAVE NO OTHER.
Voltage 90 to 125.
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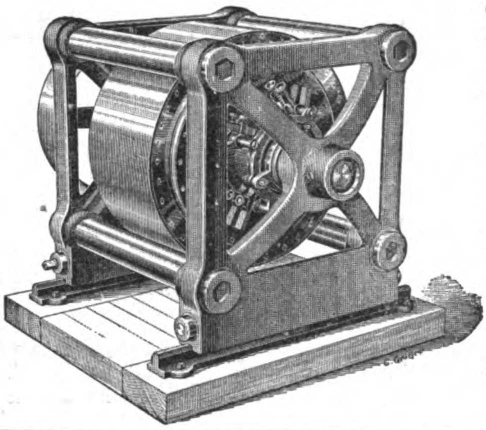

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HIGH GRADE INCANDESCENT LAMP,
10 to 32 C. P. 45 to 125 Volts.
To fit any Socket.
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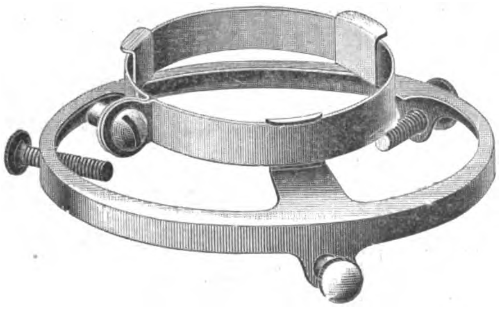

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No Weak Points,
No Joints to Work Loose.

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SPECIAL PRICES FOR FIVE GROSS OR OVER.

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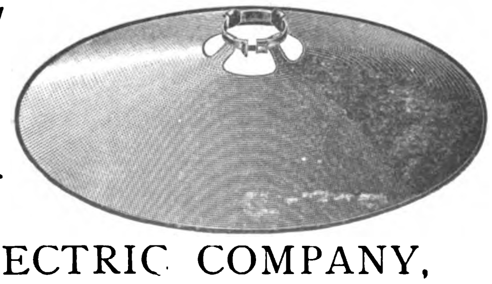

A Universal Shade and Holder,
Can be applied to any Make of Lamp.
IN USE EVERYWHERE.
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INSULATION GUARANTEED WHEREVER USED, AERIAL, UNDERGROUND OR SUBMARINE.

In a letter from the Inspector of the Boston Fire Underwriters' Union, under date of March 29, 1886, he says: "A thoroughly reliable and desirable Wire in every respect."

THE rubber used in insulating our wires and cables is especially chemically prepared, and is guaranteed to be waterproof, and will not deteriorate, oxidize or crack, and will remain flexible in extreme cold weather, and is not affected by heat. The insulation is protected from mechanical injury by one or more braids, and the whole slicked with Clark's Patent Compound and special extra finish, which we have now adopted for all our solid wires as an extra weather proof protection, and also preventing chafing and abrasion, which is water, acid, and to a very great extent fire-proof. Our insulation will prove durable when all others fail. We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph and Electric Light from stock. Cables made to order. We are now prepared to furnish our Clark Wire with a white outside finish for ceiling cleat work as well as our standard color.

CLARK JOINT GUM should be used for making water-proof joints. This is put up in half-pound boxes, in strips about one foot long and five-eighths inches wide, and when wrapped about a joint and pressed firmly it makes a solid mass. FOR RAILWAY and MOTOR use, we make all sizes of stranded and flexible cables with Clark insulation.

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And our net prices are as low, if not lower than any other first-class Insulated Wire. We shall be pleased to mail Catalogues with terms and discounts for quantities.

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HENRY A. CLARK, Treasurer and General Manager. **HERBERT H. EUSTIS**, President and Electrician.

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Is not being extensively used by Physicians because we are trying to keep it quiet, but the fact of its proving an almost infallible cure for CONSUMPTION—(of other so-called insulating compounds)—is bound to become known, and then look out for the rush. Our advice is to get in your orders early.

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in your ideas on

Primary Batteries,

expressed in your editorial of

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We think as you do, and always have.

We do not lay claim to any special solution, but have devoted our time to perfecting the Battery itself without regard to the solutions contained therein.

We do not recommend our Battery for lamps of more than 6 C. P. or motors of more than 1-8 H. P., nor do we claim that they can be run for two or three cents a day.

We have

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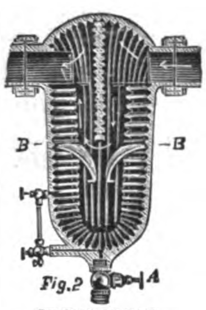

Fig.2
HORIZONTAL.

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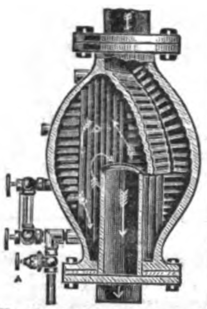
THE SUPERIOR OF ALL



Vertical where course of steam is downward.

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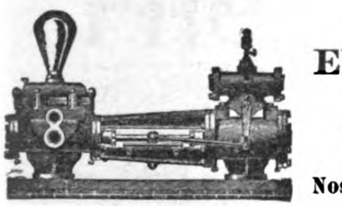

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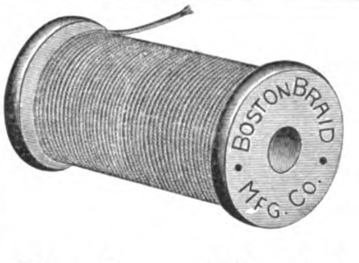
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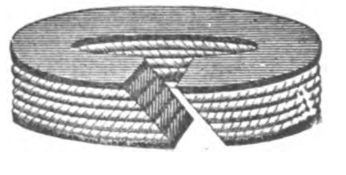

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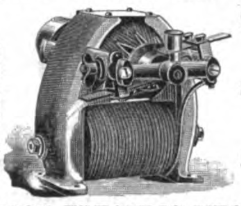

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NORTH MAIN STREET.

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Respectfully yours,
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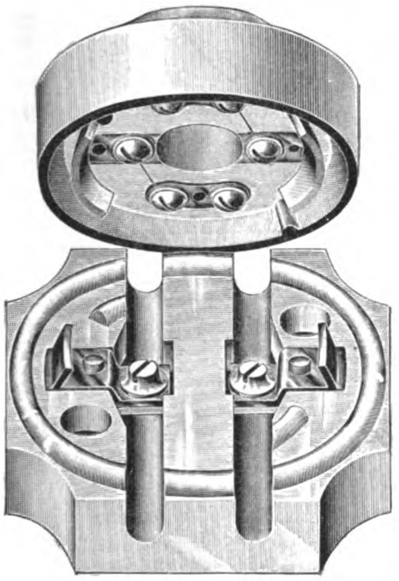

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Our Lamp Socket for T.-H. and Westinghouse bases is unsurpassed.

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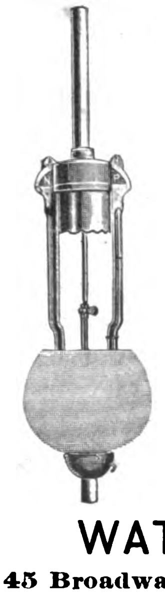

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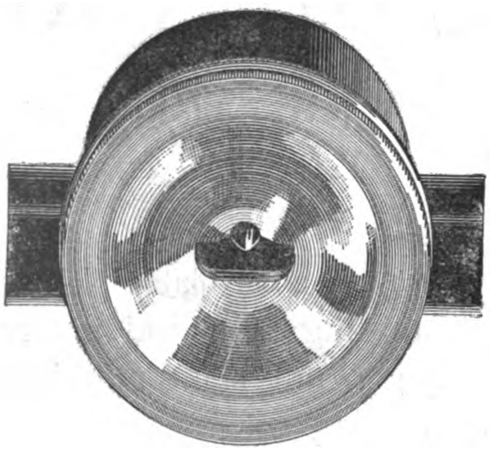

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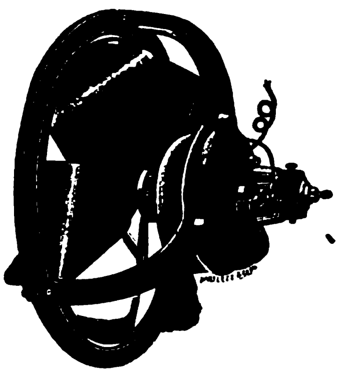

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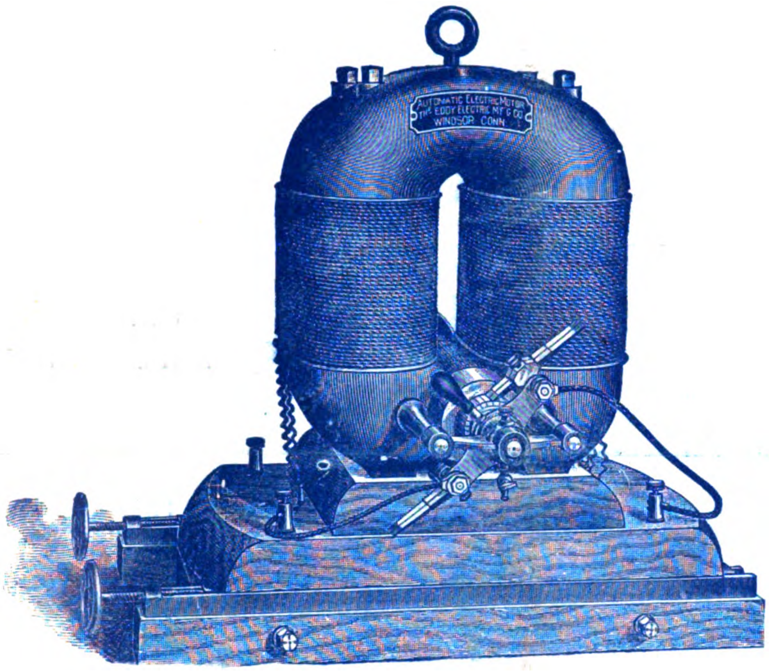

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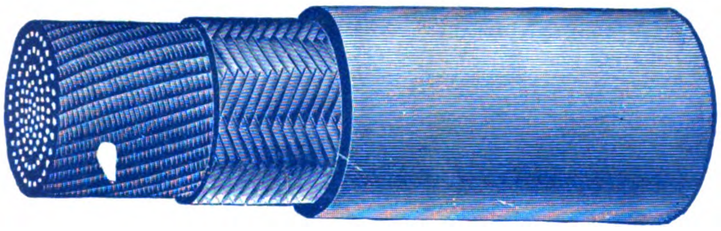

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ESPECIALLY SOLICIT ORDERS FOR SOFT AND EXTRA SOFT PLAIN BLUE FINISH OR ANNEALED OR PICKLED
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American District Telegraph Apparatus,
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Insulated Wires, Line Supplies,
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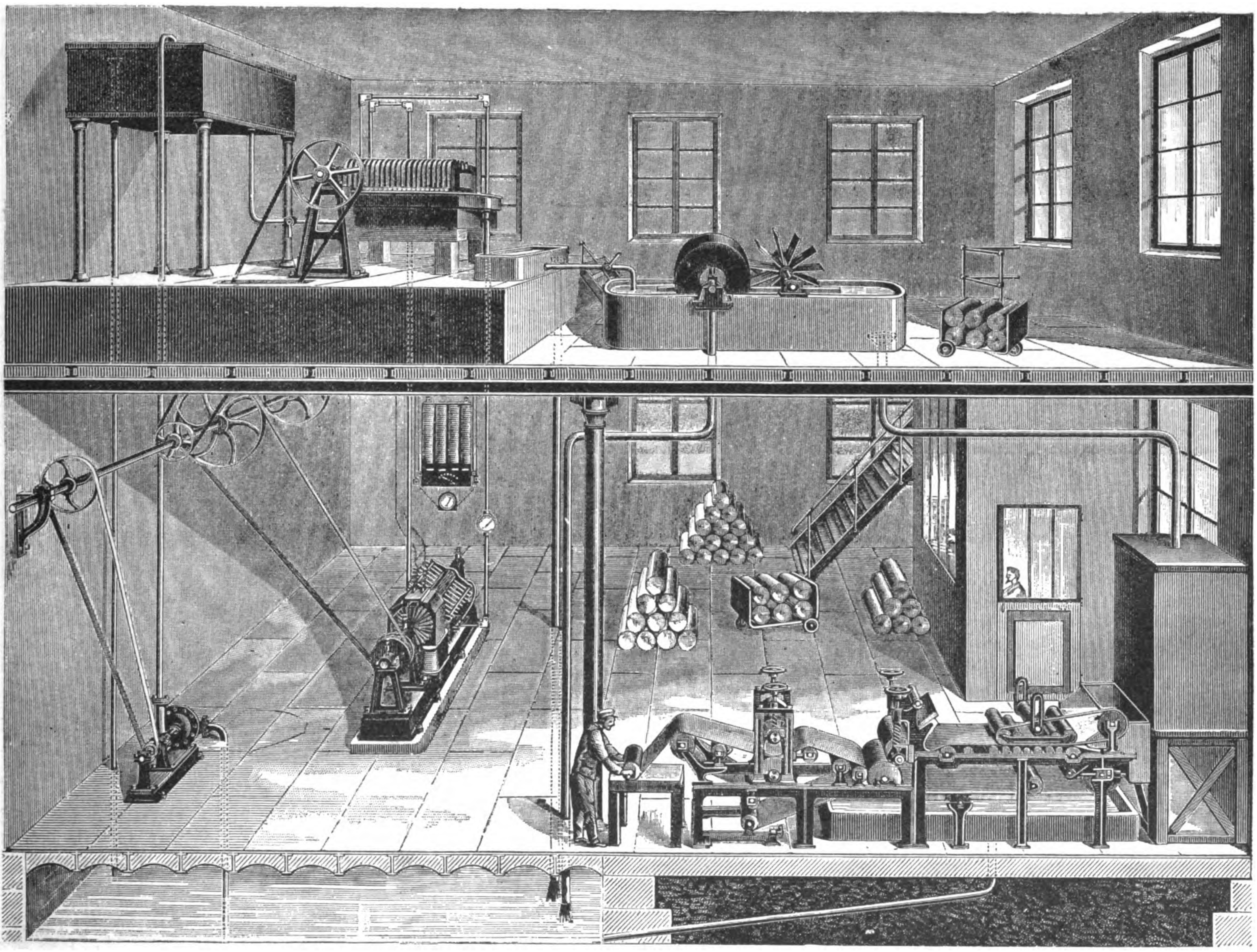
ELECTRICITY.

VOL. IV. NEW YORK. JANUARY 25, 1893. CHICAGO. No. 2



GENERAL VIEW OF PAPER PULP BLEACHING PLANT. (SEE PAGE 14.

Electro-Chemical Bleaching.*

At its meeting of May 8, 1892, Mr. Hermite gave the Society an explanation of his new process for bleaching vegetable materials by means of electricity. Your committee on chemical arts, recognizing the importance of Mr. Hermite's work has appointed a committee of two members to inspect the works of Montgolfier & Company, where this process is in operation, in order to study in detail this new method and make its report to the Society. I have the honor to present the following report embracing the results of the committee's investigation :

The principal bleaching agents for vegetable fibres are the chlorides of lime or of sodium, which are formed by the action of free chlorine on lime or sodium. In order to obtain a continuous flow of these chlorides without recourse to the use of free chlorine, it has been customary to decompose an aqueous solution of sodium chloride by an electric current with the idea of producing directly a solution capable of replacing with advantage those generally employed. These attempts, however, have not succeeded in producing practical results.

Mr. Hermite resumed experiments in this direction in 1883, after having carefully studied the reactions which occur in decomposing chloride of sodium by electricity; and after becoming convinced that the use of this salt alone was impracticable, he was led to examine the processes of decomposition of the various alkaline chlorides and alkaline earths and finally chose chloride of magnesium, a salt found in abundance and besides being quite inexpensive offers the following advantages : it is neutral, the solution properly diluted offers only a slight resistance to the current, the heat generated by its chemical union is slight, and its decomposition by the current is consequently easy. In the free state it does not produce any deterioration of the fibres, and it is well known that vegetable fibres are less affected by the action of magnesium hypochlorite than by any of the other alkaline hypochlorites or alkaline earths. In his experiments to determine the conditions under which the chloride of magnesium could be utilized, Mr. Hermite found that it could not be used alone, as in its decomposition an oxychloride was formed which coated the electrodes, and thus hindered the passage of the current. In order to avoid this, Mr. Hermite made use of a dilute solution of chloride of magnesium mixed with another saline solution.

The following was found to give the best results :

Water	1000
Sodium chloride	50
Magnesium chloride	3

When this bath is decomposed by the current only the chloride of magnesium and the water appear to be acted upon by the current and there is formed at the positive pole a compound capable of energetic bleaching action, while at the negative pole gelatinous magnesium is deposited which, on account of the small quantity of chloride of magnesium present in the solution, is prevented from forming an oxychloride.

As the magnesium deposited at the negative pole does not remain in the liquid long enough to combine with the compound of oxygen and chlorine liberated at the positive pole, Mr. Hermite adds to the solution a certain quantity of magnesium hydrate produced by precipitation of magnesium by caustic soda. There is no trouble on account of the presence of free soda which is produced by the decomposition of chloride of sodium as this reacts immediately on the chloride of magnesium.

Besides, the solution always contains some combined magnesium, which is shown by the deposit that is precipitated at any moment by an alkaline solution.

The standardizing of the bleaching liquid is done in the same way as for the commercial hypochlorites, by means of a standard solution of arsenious acid. The baths employed by Mr. Hermite contain from ½ gram to 2 grams at the maximum of chlorine per litre.

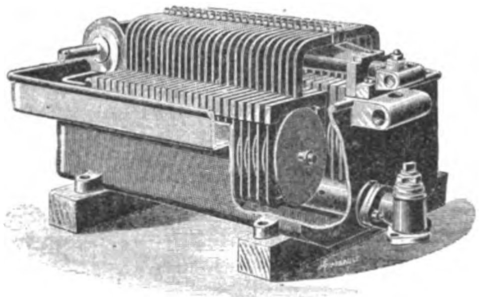


FIG. 1.

According to the inventor, the liquid should contain a hypochlorite entirely neutral, and it is to this condition that he attributes the remarkable properties of this product, which bleaches the most delicate fibres without otherwise affecting them, and even materials which we could not think of treating with the commercial hypochlorites.

The apparatus employed by Mr. Hermite for this process is illustrated in Fig. 1. A rectangular galvanized iron tank is provided with a channel around its upper edge, and a perforated tube provided with a zinc faucet runs along the bottom of this tank in the direction of its length. The solution is taken from an elevated reservoir into one end of this tube, and after filling the tank overflows into the channel and is led off by a pipe opening into it. A continuous circulation of the solution is thus maintained through the tank.

On each side, and a little above this perforated tube, are two shafts which revolve slowly and which as well as the tank are connected to the negative pole of the generator. On these shafts a number of zinc discs are mounted as shown, which together form the negative electrode.

The positive electrodes consist of plates of platinum gauze mounted on ebonite frames (Fig. 2). These plates are connected to a copper bar on top of the tank by means of insulated lead strips. The plates have also a slot, as shown, through which the shafts containing the zinc discs pass without making contact, leaving the positive and negative plates situated alternately along the shaft. The current enters at the copper bar, passes from the platinum plates through the solution to the zinc discs, and completes the circuit through the iron tank.

In order to maintain the zinc discs in position, flexible blades of ebonite are placed on the positive plates which press against the discs, and as the latter revolve continually the blades detach any deposits forming on the zinc. The arrangement is such that positive plates may be separately removed and repaired without interrupting the progress of the work, and the tank may be easily cleaned by means of a lateral opening with which it is provided.

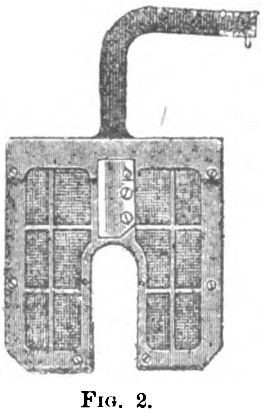


FIG. 2.

When several of these machines are used they are connected in series. At Haye-Descartes a current of 1,200 amperes at an E.M.F. of five volts is used. Measuring instruments are placed in the circuit which enable the work of the apparatus and the power consumed to be calculated at any moment. The operation of the machine is very simple ; the wear on the electrodes is practically nothing, and every month the tanks are thoroughly washed.

In order to give a more complete idea of the use of Mr. Hermite's apparatus, a description is given of the manner in which it is employed for bleaching paper pulp. Fig. 3 shows the arrangement of the plant.

The solution passes from the reservoir A into the electrolyzing tank B, and from that into the bleaching battery C, which is provided with a washing drum D that draws off the liquid after its action on the pulp into a lower reservoir of cement or galvanized sheet iron E from which it is pumped into the reservoir A. The solution is thus kept in continual circulation through the system. The pulp in the bleaching battery is lowered into tank G, from which it passes under a press. The liquid pressed out falls into the lower reservoir E, and is raised to A by the pump J.

As the quantity of pulp put into the bleaching battery in a given time is estimated so as to absorb only the chlorine compound which the machine will produce in the same time, the standard of the composition of the circulating bath remains almost constant. This effects the bleaching very rapidly and very completely.

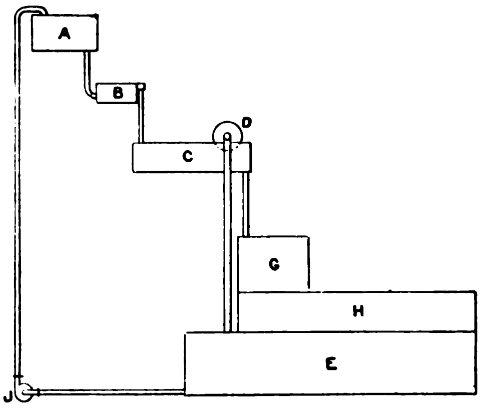


FIG. 3.

The liquid which has been exhausted in the bleaching process on the pulp contains among its products of decomposition some hydrochloric acid which with the magnesium hydrate in suspension in the bath restores the magnesium chloride.

Mr. Hermite estimates that for 100 kg. of dry pulp there is lost about 150 kg. of liquid which remains in the pulp and cannot be recovered ; this corresponds to a loss of 7.5 kg. of sodium chloride and 0.75 kg. of magnesium chloride. The economy which results from this process of bleaching varies with the location of the paper factories and the cost of motive power. It is from 40 to 70 per cent. The following figures are furnished by Mr. Hermite :

An electrolyzing machine of the Hermite system produces in twenty-four hours the equivalent of 100 kg. of dry chloride of lime using a maximum of 10 H. P. Chloride of lime is worth 20 to 22 francs per 100 kg. in France, delivered at the factories. Consider now the cost of the equivalent of this 100 kg. of chloride of lime in the cases where water power or steam is employed.

In factories using water power the cost is 5.22 francs—including the purchase of the electrical supplies, but not taking account of the labor, which is the same as with the use of chloride of lime—being approximately a saving of 80 per cent. These figures are based on the actual operation of the system for two years.

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* Report of the Committee of Chemical Arts of the Society for the Promotion of National Industry, by Mr. De Luynes. Translated from *L'Industrie Electrique*.

In factories where steam power is employed the net cost will be 10.02 francs, being 50 per cent. saving. This latter estimate may be reduced in localities where coal is very dear, but according to Mr. Hermite it will always reach 40 per cent.

It is under these conditions that your delegates have seen the operation of the Hermite system, for which the motive power is supplied by turbines situated on the Creuse River. The batteries are composed of two groups of five cells each which produce annually the equivalent of 300,000 kg. of chloride of lime.

The importance of these results which open a new path to the industry of bleaching, and the careful use which Mr. Hermite has made of this scientific method to add another solution to the problem of bleaching vegetable matter, are worthy of the Society's greatest interest.

Your Committee of Chemical Arts propose to thank Mr. Hermite for his interesting communication, to offer him congratulations on his success and to insert this report in the *Bulletin*, with drawings of the apparatus.

A view of the installation for bleaching paper pulp is given in the frontispiece.

On the upper story is seen a reservoir connecting with an electrolyzing tank, and the solution on leaving the latter falls into a cement vat, and from that into the bleaching battery, in which has previously been put a suitable amount of the pulp to be bleached.

This pulp after being bleached is carried by a pipe, which passes under the floor of the first story, to the press, while the solution contained in the battery is taken by the washing drum and carried to the tank below, shown at the left of the basement.

The pulp is collected after leaving the press while the solution pressed out is carried to the lower tank, which also receives the various additions necessary for the work.

The centrifugal pump, represented at the left in the basement, raises the solution to the upper reservoir, thus keeping up a continual circulation of the solution.

The dynamo at the right of the pump furnishes the necessary current, and behind it on the wall is arranged the regulating apparatus.

Electrical Recording Meters.

BY CARYL D. HASKINS.*

I propose to briefly describe and discuss the leading elements which, singly or combined, have gone to make up the typical meters presented to the public up to the present time. I find myself limited to generalities, and the mathematical theory, and strictly technical considerations have necessarily been neglected that the field might be approximately covered.

The earliest meter patent was granted in 1872 to Mr. S. Gardner of New York City, and the principle of a magnetic or electro magnetic release for a simple clock movement is preserved in two or three so-called time-counters to-day and is doubtless very useful for many purposes; as for example in the Spaulding clock for registering the hours of use of a motor, or other similar devices for registering the hours of use of arc circuits. These devices I shall neglect; they are not meters within the true sense of the word, and their simplicity is obvious.

The earliest successful meters, if we consider classes rather than individual instruments, were the chemical meters, closely followed by thermo-meters.

The chemical meter is obviously capable of giving most accurate results: in fact, with proper manipulation, it is very doubtful whether any measuring device which has up to to-day been designed could more correctly sum up passing power. It is in the manipulation and care which such meters require that their fault lies—if fault there be.

An electro-plating bath in its meter form as generally used does not, however, give a dial indication, and the consumers ask for a dial indication almost invariably, unless they have already become thoroughly familiarized with Edison meters as used by many large Edison stations.

Many very ingenious and some quite successful attempts have been made to actuate a train of gears by the electro-deposition of an electrolytic bath. Thus, we have two electrodes suspended at the opposite ends of a walking-beam, as shown in Fig. 1. This walking-beam is in various ways connected with a pole changer, and as but a small portion of the current being measured passes through the true meter (for of course almost all chemical meters are shunted) the pole-changer is not perhaps a very serious objection.

The action of such a meter as this is obvious; we have a deposit from one electrode onto the other, until the second electrode becomes the heavier, when the beam tips and the recording device is set one notch ahead, the pole-changer is thrown over and the deposit takes place in an opposite direction, the former plus electrode becoming the minus, and so on. This device deposits and reposits the same zinc, or rather electrode material. Again, we have a modification of the same device in the form of a wheel bearing a number of electrodes, and on the same principle setting up continuous rotation.

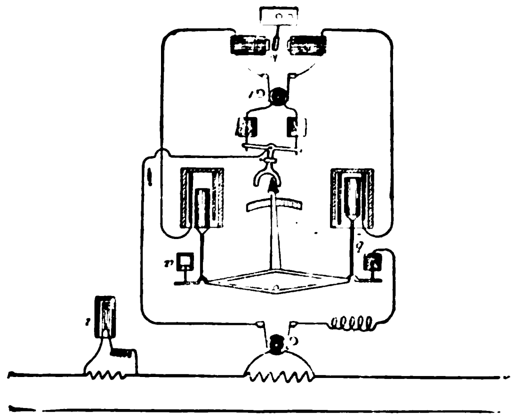
FIG. 4.

It should be noted that in this first digression from the chemical meter we at once meet with the prime factor of difficulty in all motor meter construction—that of friction, which, if uncompensated, must invariably introduce more or less serious error.

Another form of self-registering electrolytic meter has a cathode plate suspended from a spring balance, an ordinary sensitive spring weighing machine, and the heavier the cathode grows so much greater is the registration of the spring indicator. This device is perhaps preferable to the reciprocating movement just described, but is limited in the capacity of the spring, and probably lacks sensitiveness to small amounts, being dependent of course solely upon the nicety of construction in the spring-balance.

Mercury has at times been employed in the construction of electrolytic meters, and with at least moderate success, for with a mercury anode and a cathode of the same or other material, a record easily measured may be obtained, and such a meter may even be made self-registering in a graduated tube or by half a dozen other more or less simple means. Such are the more typical electrolytic meters.

Another form of chemical meter formerly quite popular among inventors depended for its registration upon the decomposition of water, generally acidulated water, and sometimes upon the decomposition of more volatile substances. This class of meter may very properly be divided under two heads:

First, those meters simply dependent upon the measurement of the gas developed by the decomposition of water through any gas registering device. In fact, we may say that such meters are mere decomposing baths connected to a gas meter. There are some devices of merit which may be classed under this head, but the principle is probably not commercial, for we have nothing very successful of this kind in use to-day.

One of the more ingenious meters of this kind provides a diagonally placed rotating wheel with pockets; the decomposition takes place directly under each pocket progressively, and as the air pocket fills with gas the wheel rotates sufficiently to free this gas at the surface of the fluid, bringing another pocket into place. Others have a rising and falling diaphragm like the popular gas meter, and still others a delicately poised air fan over a minute aperture. This last device is obviously most inefficient.

The second group of meters under this classification bring us to the thermo-meters, a typical group containing a few meters of more or less pronounced merit.

Those thermo-meters depending upon volatization of a fluid generally have two or more sealed bulbs partly filled with some volatile fluid, as for example, naphtha or ether. When two such bulbs are used, they have generally been mounted on a walking-beam mechanism combined with a pole-changer, each bulb containing some kind of a rheostat or heat developing device dependent for its heat on the current passing through the meter, the two bulbs communicating with one another. The rheostat in but one bulb is in circuit. The heat developed in the rheostat in circuit volatilizes more or less rapidly the fluid contained in this bulb, according to the current passing through it. The gas developed either passes in gaseous form into the second bulb and condenses, or else, as is more common, forces the fluid remaining by the simple increase of pressure into bulb No. 2, which at once becomes heavier and causes its end of the beam to fall. This throws the pole-changer, and the rheostat in the second bulb is thrown into action, repeating the operation as just described. To be successful, such a device must be very sensitive, and to be sensitive, the construction must be of a more or less expensive character and so delicate as to be to a greater or less degree prohibitive. Like the walking-beam meters just described, instruments of this class have been designed with a number of bulbs mounted on a rotating wheel; the same actuating principle holding true for all such devices.

Another ingenious form of thermo-meter, no longer in any sense a chemical meter, is an instrument dependent for its action upon the heat in a confined but circulating atmosphere. Thus a rheostat dependent for its heat upon the amount of current passing is so arranged as to heat a body of air, which, by the peculiar construction of its receptacle, at once commences to circulate more or less rapidly, dependent upon the heat. It is obvious that if a delicate air fan, a screw propeller in fact, be suspended over such a circulation of air, its speed would increase with the speed and volume of circulation, and one of the most ingenious and most interesting meters that it has ever been my good fortune to see is the Forbes meter, constructed on this plan. But here friction is the most serious consideration, the torque obtained in this manner being necessarily small.

While the Forbes meter cannot perhaps be properly considered as a motor meter in the true sense of the word, it still must be classed as such in a certain sense, and I think it may safely be accepted as an axiom that to be successful in practical operation a motor meter of any kind must be of high torque, for it is only by the combination of high torque and compensated friction that accurate results can be obtained on light loads. I might say that almost any one can build a meter which will record fairly accurately on heavy loads; the difficulty is to build a sensitive and accurate meter for very light loads down to one lamp.

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*Abstract of a paper read at the Seventy-third Meeting of the American Institute of Electrical Engineers, New York, January 17, 1893.

Some Mechanical and Electrical Analogies.

BY DR. F. BEDELL AND DR. A. C. CREHORE.

No phenomena are so readily comprehended as those which may be compared directly with facts that are familiar, and no reasoning is so quickly grasped as reasoning "by analogy." The analogies between certain mechanical and electrical relations are so striking that when either relations are understood the others follow, and from the laws of mechanics we can readily write those of electricity. The process is a reversible one and the electrician can with equal ease step over into the realms of dynamics. To enable one to reason accurately in this manner and to reach definite results with absolute certainty, it is necessary to give with exactness the fundamental relations of mechanics and electricity. The accompanying tables are, therefore, given showing the analogies between linear motion, motion of rotation and the electric current. Starting a current of electricity in a circuit is analagous to imparting motion to a body and requires an impressed force. This force must overcome the resistance (electrical resistance corresponding to that of friction) and the inertia of the mass or current. In the case of the electric current this inertia is called "self-induction." A revolving fly-wheel may well represent the flow of electricity, its velocity corresponding to the current, its moment of inertia to the coefficient of self-induction and the friction to ohmic resistance.

A study of the tables will make these analogies more clear. It is to be noted that the fly-wheel or moving mass in slowing down gives back its kinetic energy and the wheel is carried on, after the impressed force is removed, until this is entirely consumed in overcoming friction. Similarly, when the current diminishes upon the removal of the impressed electromotive force, the energy stored in the magnetic field is restored to the circuit and the current keeps flowing until the energy is entirely used up in overcoming the ohmic resistance.

These analogies cannot be considered as rigorous proof. The truth of the relations here given for the electric current has been fully established and may be found in the introductory chapter to our work on alternating currents. Other striking analogies will suggest themselves, but space will not permit calling attention to any but the most fundamental ones given above.

TABLE I.—LINEAR MOTION.

Notation.

1. time $= t$.

2. distance $= s$.

3. linear velocity $= v = \frac{ds}{dt}$. $ds = vdt$.

4. linear acceleration $= a = \frac{dv}{dt} = \frac{d^2s}{dt^2}$.

5. mass $= M$.

6. momentum $= Mv$.

Frictional Resistance.

7. frictional resistance $= R$.

8. force to overcome resistance $= F_R = Rv$.

9. energy expended in overcoming resistance in the time dt $\Big\} = dW_R = F_R ds Rv^2dt$.

Inertia.

10. force to overcome inertia $\Big\} = F' = Ma = M\frac{dv}{dt}$.

11. kinetic energy acquired in the time dt $\Big\} = dW' = F'ds = Mv\frac{dv}{dt}dt$.

12. kinetic energy $= W' = \int_0^v Mv\frac{dv}{dt}dt = \frac{1}{2}Mv^2$.

Inertia plus resistance.

13. total force applied $= F = F_R + F' = Rv + M\frac{dv}{dt}$.

14. total energy supplied in the time dt $\Big\} = dW = dW_R + dW'$;

or, $Fds = F_Rds + F'ds$;

or, $Fvdt = Rv^2dt + Mv\frac{dv}{dt}dt$.

TABLE II.—ROTARY MOTION.

Notation.

1. time $= t$.

2. angle $= \Phi$.

3. angular velocity $= \omega = \frac{d\Phi}{dt}$. $d\Phi = \omega dt$.

4. angular acceleration $= \alpha = \frac{d\omega}{dt} = \frac{d^2\Phi}{dt^2}$.

5 moment of inertia $= I$.

6. angular momentum $= I\omega$.

Frictional Resistance.

7 frictional resistance $= R$.

8. torque to overcome resistance $= T_R = R\omega$.

9. energy expended in overcoming resistance in the time dt $\Big\} = dW_R = T_R d\Phi = R\omega^2dt$.

Inertia.

10. torque to overcome inertia $= T' = I\alpha = I\frac{d\omega}{dt}$.

11. kinetic energy acquired in the time dt $\Big\} = dW' = T'd\Phi = I\omega\frac{d\omega}{dt}dt$.

12. kinetic energy $= W' = \int_0^\omega I\omega\frac{d\omega}{dt}dt = \frac{1}{2}I\omega^2$.

Inertia plus resistance.

13. total torque applied $\Big\} = T = T_R + T' = R\omega + I\frac{d\omega}{dt}$.

14. total energy supplied in the time dt $\Big\} = dW = dW_R + dW'$;

or, $Td\Phi = T_Rd\Phi + T'd\Phi$;

or, $T\omega dt = R\omega^2dt + I\omega\frac{d\omega}{dt}dt$.

TABLE III.—ELECTRIC CURRENT.

Notation.

1. time $= t$.

2. quantity $= q$.

3. current $= i = \frac{dq}{dt}$. $dq = idt$.

4. current acceleration $= \beta = \frac{di}{dt}$.

5. coefficient of self-induction $= L$.

6. electro-magnetic momentum $= Li$.

Ohmic resistance.

7. ohmic resistance $= R$.

8. electromotive force to overcome resistance $\Big\} = e_R = Ri$.

9. energy expended in overcoming resistance in the time dt $\Big\} = dW_R = e_R dq = Ri^2dt$.

Self-induction.

10. electromotive force to overcome self-induction $\Big\} = e' + L\beta + L\frac{di}{dt}$.

11. energy acquired by the magnetic field in the time dt $\Big\} = dW' = e'dq + Li\frac{di}{dt}dt$.

12. energy of magnetic field $\Big\} = W' = \int_0^i Li\frac{di}{dt}dt = \frac{1}{2}Li^2$.

Resistance plus self-induction.

13. total electromotive force applied $\Big\} = e = e_R + e' = Ri + L\frac{di}{dt}$.

14. total energy supplied in the time dt $\Big\} = dW = dW_R + dW'$;

or, $edq = e_Rdq + e'dq$;

or, $eidt = Ri^2dt + Li\frac{di}{dt}dt$.

Meeting of the Advisory Council of the Chicago Electrical Congress.

A meeting of the Advisory Council of the Chicago World's Congress of Electricians was held at the rooms of the American Institute of Electrical Engineers, New York, on January 17.

The following gentlemen were present: Dr. Elisha Gray, Chairman, Prof. Wm. A. Anthony, Prof. Chas. R. Cross, Dr. Louis Duncan, Dr. Wm. Geyer, Mr. Carl Hering, Mr. Geo. A. Hamilton, Prof. F. B. Crocker, Mr. A. E. Kennelly, Mr. T. D. Lockwood, Mr. T. C. Martin, Mr. Geo. M. Phelps, Dr. M. I. Pupin, Mr. R. W. Pope, Prof. H. A. Rowland, Dr. Herbert Laws Webb.

Mr. H. L. Webb was elected Secretary of the meeting, in the absence of Prof. Carhart, permanent Secretary of the Council. The preliminary reports of the English and American Committees, already made public, were received.

It was resolved that the Electrical Congress of 1893 shall consist of two Chambers, of which the Legislative Chamber shall decide on units, names of units and standards, and shall consist solely of delegates named by their respective Governments.

A committee was appointed to determine the total number of official delegates and their apportionment to the various countries to be represented.

The following apportionment of delegates was made by the committee, whose report was adopted by the meeting. Great Britain 5, France 5, Germany 5, Austro-Hungary 5, United States 5, Belgium 3, Italy 3, Switzerland 3, Holland 2, Denmark 2, Norway and Sweden, 2, Russia 2, Spain 2, Portugal 1, British North America 1, Australian Colonies 1, India 1, Japan 1, China 1, Mexico 1, Brazil 1, Chili 1, Peru 1, Argentine Republic 1; making a total of 55 official delegates.

It was resolved that a Committee on Invitations be appointed by the chairman, this committee to consist of 5 members who shall select and recommend to the chairman the names of electricians, electrical engineers and others who shall be members of the Electrical Congress. Said committee to co-operate with the foreign committee.

It was further resolved that in addition to invitations to deliberating and voting members of the Congress, a general intimation shall be extended through the journals or otherwise that the meetings will open to the public, for attending the proceedings, but not for taking part therein.

It was resolved that a Committee on Programme and Papers be appointed by the chairman. This committee shall consist of eight members, whose duty it shall be to invite, receive and consider papers and other documents relating to the work to be done by the Congress. And it was further resolved that it shall be the duty of this committee to formulate a programme for the Congress.

It was resolved that the reports of the English and American sub-committees which were received at the meeting should be referred to the Committee on Programme and Papers, and that the committee confer with the English committee as fully as possible and with such other foreign committees as may be formed.

It was resolved that the Electrical Congress of 1893 shall last one week, beginning on August 21st.

It was resolved that a committee of three be appointed by the chairman as a Finance Committee.

It was resolved that an Executive Committee of five shall be appointed by the chairman, said committee to have full power to act for the Advisory Council.

It was resolved that the question of charging a fee for membership of the Congress and fixing the amount of such fee be referred to the Executive Committee.

A Westinghouse Victory.

The Hopkinson Three-Wire Patents Sustained in England.

The suit of the London Westinghouse Company against the Pall Mall and St. James Electric Company has been decided in favor of the plaintiff by Justice Romer. This suit was brought to sustain the validity of the patents of Dr. John Hopkinson on the three-wire system.

Mr. Reginald Bellefield, who has been in charge of the London business of the Westinghouse Company ever since the English branch was established, is at present in this country. He is reported as follows in an interview in the daily press:

"The Pall Mall and St. James Electric Company is one of the richest companies in London, and covers with its lighting plant probably one of the best fields in the world. It supplies the leading clubs and many theatres and a great many shops through Regent street. The suit was very bitterly contested and the arguments were heard in the early part of November and extended over a period of ten days, an extremely long time for a case to be before a judge in an English court. The counsel for the Westinghouse Company were Sir Richard Webster, Q. C., M. P.; Mr. Milton, Q. C.; Mr. Ashton, Q. C., and Mr. Hopkinson, Q. C., the latter being a brother of the inventor. The effect of the decision will be to place in the hands of the Westinghouse people the complete control of all three-wire systems throughout Great Britain. There are a large number of other users than the Pall Mall Company who will now have to pay large royalties to the Westinghouse Company, thus materially increasing the revenues of the latter.

"The importance of the decision can best be determined when it is known that according to English law it gives the Westinghouse Company the right to take possession of all plants using the three-wire system and compute and collect all profits accruing from the use of the patent, and also to compel the payment in the future of such royalties as the company in whose favor the decision was rendered may fix upon.

"The Hopkinson patent in England bears a date of several months prior to Edison's patent in the United States for substantially the same system.

"The value of this decision to the parent Westinghouse Electric and Manufacturing Company is, of course, very great, as it is the principal stockholder in the London company.

"The Westinghouse Company now practically control the electrical business in Great Britain. The Shallenberger converters, which are manufactured in Pittsburg, have been adopted in England. Some time ago a test was made of the various makes of converters and the Shallenberger came out on top. These converters have now been recommended by the Board of Trade. The meters made here in Pittsburg have also been recommended by the Board of Trade. The appliances I speak of are now used almost exclusively all over the Eastern Continent. They are all shipped direct from the Pittsburg works to London and distributed from that point."

COMMUNICATIONS.

The Subject of Fire Risks.

A Suggestion.

To the Editor of ELECTRICITY:

The timely article in the *Electrical Review* of January 14th, "The Insurance of Electrical Risks," attracted the attention of the writer, who considers it a subject well worthy of the careful consideration of the electrical fraternity, especially those engaged in the manufacture of apparatus for lighting and power purposes.

It is a well-known condition in the business that manufacturers frequently dispose of their apparatus to parties who see fit to arrange for the installation and construction work to be done by others than the company furnishing the apparatus, removing the opportunity for the manufacturer to exercise any control over the very important details of construction, notwithstanding he (the manufacturer) is fully cognizant of the fact that upon the character of the construction work depends in a great measure the successful operation of the apparatus, but owing to the existing conditions in the field of competition he is compelled to accept the situation and run the risk of the construction work being done by incompetent persons.

It cannot be questioned that there exists in all the principal business centers competent and experienced engineering and construction companies, fully equipped to install apparatus and do construction work in a satisfactory manner, but there also exists in the same localities a horde of locksmiths and bell-hangers, who conspicuously display upon their elaborately written signs the information that in addition to their ability to repair a lock or install a bell they are also electrical engineers. It is this class that come in competition with the capable engineering or construction company, and to them, as a rule, can be directly traced a large proportion of the imperfect electrical construction that exists in localities where electricity has been introduced for lighting and power purposes.

These conditions are not attributable or within the power of the manufacturer to prevent, and they are brought about by the desire of purchasers of electrical apparatus to secure a cheap installation of their plant, losing sight of the fact that upon the proper installation of their apparatus will depend its success and commercial efficiency.

No doubt the same individual who has engaged the incompetent construction company to do his electrical work has called to his aid the most competent architect that he could procure to prepare plans and specifications for his building operation, but has ignored the fact that his electrical installation was worthy the same skill in order to properly plan and lay out the work. Until purchasers of electrical apparatus realize the fact that the services of a competent electrical engineer is as indispensable in electrical matters as that of the architect or civil engineer in building operations, we may expect to be confronted with cases of imperfect electrical construction, which will result in indifferent results from first class apparatus and subject the parties using the same to a special rating or possible cancellation of insurance by the underwriters.

We recognize that the relations of the insurance interest with the manufacturer of electrical apparatus and the legitimate construction company should be of a mutual character, for the reason that it is quite as important to the manufacturer as to the insurance interest that apparatus be properly installed and construction work done with the greatest factor of safety and it is the endeavor of the manufacturer, as well as the responsible construction company, to work in perfect harmony with the insurance interest upon the matter above referred to. But I doubt if the electrical interest of the country have any intention of permitting their business to be arbitrarily placed on a hazard basis with petroleum or its products. We would also state that we cannot see the justice in the demands of the insurance interest that any portion of the expenses incidental to the conduct of their business or a proper surveillance upon their risks should be borne by the electric companies, and their demand for a fee of $10 for the services of an inspector to perform a duty which is a part of their own business is about as reasonable as their recent reclassification of hazards, and we would ask them how they would expect to be received with a similar proposition made to the various individuals and corporations who furnish gas, kerosene and other illuminants.

The available facts are that the insurance interest themselves are in a measure responsible for the conditions that they are now endeavoring to cover by a reclassification of hazards, for the reason that they have not employed individuals who in every case were sufficiently well versed in electrical matters to secure the results as anticipated by their principals. It has occurred to the writer that a proper solution of the question of proper rules and regulations as well as harmonious action between the two interests could be readily secured by the formation of a joint board, composed of the insurance interest representatives and representatives from the principal manufacturing or construction companies. It is self-evident that the interchange of opinions of such an organization would tend to elevate the standard of electrical construction and generally secure better results to both interests, and on the above point much sooner than they could be accomplished by either interest alone.

WALTER F. SMITH,
838 Drexel Building, Philadelphia.

Bogus Enterprise.

To the Editor of ELECTRICITY:

Reliable news regarding the progress of the plans for the World's Columbian Exposition is now of much importance to many electrical readers. The attempt of the *Electrical World* of this week to show in advance of the proper time of publication features which have not yet been decided upon regarding the proposed illuminated fountains recalls a similar effort by the same paper less than three years ago.

At that time I sent to the *Electrical World* for publication the following letter, which never appeared in its columns:

44 Wall street, New York City.
Editor of the Electrical World.

DEAR SIR:—I am greatly interested in the sketch in your issue of this week of the "Proposed Edison Light Tower at the Minneapolis Exposition," more especially because having the responsibility of designing and erecting this tower I am still undecided as to nearly all the detail which your sketch purports to illustrate.

I congratulate you upon the vividness of the imagination of your artist, and only regret that his idea and my own should have happened to be entirely dissimilar, and that his picture of this feature of the coming Exposition fails entirely to give your readers an adequate conception of the magnitude and beauty of the proposed structure and its surroundings.

Yours very truly, etc.

Both these unreliable batches of information came from the same source, the artist whose name appears on the illustrations. In the case of the Minneapolis tower the disclosure was simply imaginative and premature; in the present case of the Chicago fountains it is both imaginative and inaccurate and also a breach of faith. I presume it will be characterized as "newspaper enterprise"—the sort of enterprise that when it cannot print a genuine interview prints an imaginary one.

I believe it was the celebrated A. Ward who once said: "I had rather no nothing at all than no what aint so."

L. STIERINGER,
Consulting Electrical Engineer World's Fair.
Chicago, January 20, 1893.

ELECTRICITY.

The Popular Electrical Journal.

GEORGE R. METCALFE, - - - EDITOR.
R. H. WILLOUGHBY, - - ASSOCIATE EDITOR.

W. M. ALLISON, - - BUSINESS MANAGER.

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Our columns are open for the discussion of any question in which the interests of the Electrical Industry are at stake. News notes, descriptions of new devices with drawings or photographs, are at all times desired.

SUBSCRIPTION RATES:

UNITED STATES, - - - -	$2.50
IN CLUBS OF FIVE OR MORE, - - -	$2.00
FOREIGN COUNTRIES, - - - - -	$4.50

ADVERTISING RATES:

As ELECTRICITY reaches all classes interested in electrical work, its value as an advertising medium can be readily appreciated. Rates will be sent on application.

Changes for advertisements should reach the office not later than the Saturday preceding the date of publication.

ENTERED AT THE N. Y. POST OFFICE AS MAIL MATTER OF THE SECOND-CLASS.

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THE AMERICAN NEWS COMPANY,
THE WESTERN NEWS COMPANY,
And their Agencies in all Principal Cities.

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"Electricity," under its present ownership, has never solicited the advertising patronage of the General Electric Company.

Fire Risks.

In another column will be found a communication from Mr. Walter F. Smith in regard to the attitude assumed by fire underwriters concerning the equipment of buildings with electricity and the consequent increase in the insurance rates now demanded. This struggle between the insurance companies and the electrical fraternity is one of long standing and at the same time one for which no apparent necessity now exists. The facts leading up to this are sufficient to explain the origin of the trouble, but the primary cause has now entirely disappeared.

In the early days of electric lighting the matter of insulation was not understood as it is today, and almost any covering on the wires was considered sufficient.

The grade of wire known as "underwriters'" was the kind commonly used in almost all installations and it proved a costly experience, as it was found a totally inadequate insulation except for aerial lines. The result was that numerous fires occurred, the suspicions of the insurance companies were aroused and electrical installations came to be considered dangerous risks, and probably rightly so at that time.

These conditions are now entirely changed, and the subject of insulation has received most thorough attention, so that at present any specified degree of resistance to leakage can be guaranteed unquestionably.

In view of this the former attitude of the insurance companies is no longer warrantable, provided electrical installations are properly equipped. There is no doubt in the mind of anyone who has studied the subject that it is entirely possible to make an electric system safer than any other known method of illumination.

The only factors of uncertainty which exist now are the character of the work and the materials employed, and these are evidently so readily controllable that the efforts of insurance companies to make electricity a bugbear and an excuse for high rates have the appearance of an attempt to take an undue advantage of the public.

There is, however, one fact pointed out by our correspondent which is the only justification of this policy, and that is poor construction work—a circumstance which we have often taken occasion to condemn in these columns. Nevertheless, as this is now the exception, it seems hardly fair that the users of electric light, who are numbered by thousands in all the principal cities, should be heavily taxed on account of the few who in defiance of past experience continue to practise the false economy of employing the cheapest bidder regardless of consequences.

It has been the universal experience that no system of lighting can compare with electricity from the standpoint of safety ; and even including the cases where defective work has been the cause of fires, the total loss from this cause compared with that resulting from the use of gas, kerosene or candles is insignificant.

It is far from our object, however, to uphold the practice of installing cheap construction work, but it seems as though the suggestion to mutually establish the proper regulations for this work, as well as harmonious relations between fire underwriters and the reputable electrical manufacturers and engineers, could hardly fail to be of benefit to all concerned.

Shut out all botchwork in the line of electrical construction and the fire risk where it is installed will be found the most desirable and the least expensive to the underwriters.

* * *

Through by Lightning Regardless of Mud.

We trust our readers will pardon us for again devoting a little space to the Chicago-St. Louis Electric Road project.

We know Dr. Adams will pardon us, because space in ELECTRICITY costs him nothing.

It is admitted by electrical authorities that there are no considerable obstacles in the way of building a motor which will propel a train at the rate of 100 miles an hour safely and practically.

It is also admitted that no such motor has yet been built.

But let us suppose that Dr. Adams will be able to enlist the services of competent engineers, and that the motor for his road materializes, sustaining his rosiest claims. This is a charitable supposition, as no electrical engineer of brains and reputation could now be induced to identify himself with the scheme; but we will be charitable.

The magnet to draw the silver of small investors, the mucus to catch the flies, has been the claim that the road would be in operation by the time the World's Fair opens; that the novelty of the scheme and the marvellous speed would attract the curious, and that large, very large, profits would be made the first year from World's Fair traffic.

We will now proceed to prick this bubble.

The World's Fair opens in May. The Chicago and St. Louis road is not yet built. Twenty miles of track have been graded, we are told, but this is all the projectors claim. If the remaining 230 miles, or thereabouts, including depots, power houses, motors, cars, etc., etc., etc., can be built in ninety days, it would be the most remarkable example of hustling ever known in the West. The feat cannot be accomplished. The World's Fair gates will be closed before the road is fully equipped.

Further. If the track were all graded now a speed of one hundred miles an hour, or even fifty miles an hour, would not be attempted under a year by anyone but a lunatic.

To safely attain a speed of one hundred miles an hour by any method of traction whatever, upon a roadbed of Illinois mud, within a year after the road is built, would be as impossible as that Chicago should become a moral city or a New York police captain be faithful to the constitution.

Of course Dr. Adams will claim that his road will be the first favored exception in the great general plan of the Almighty—that it will not be subject to the effects of frost or thaw, of rain or sun.

But this view will not be treated seriously in the office of ELECTRICITY. We assert, first, that this road will not be built in time to carry World's Fair tourists; and second, that when it is built it cannot equal for many months the regular running time made on the Illinois Central or other old and settled roadbeds between Chicago and St. Louis.

* * *

THE Buckeye factory at Cleveland is still very much on deck, and the company has found no cessation in orders. No Ohio factories have as yet been moved against.

A Sensation.

Brand New Testimony Introduced by the Beacon Vacuum Pump and Electrical Company.

No Decision Expected.

BOSTON, January 24.—In the United States Circuit Court yesterday, before Judge Colt, the case of the General Electric Company v. Beacon Vacuum Pump and Electrical Company came up for hearing.

Mr. Fred. P. Fish, representing the plaintiff company, opened the case. Mr. Witter, of the law firm of Witter & Kenyon, appeared for the Beacon Company.

The chief argument for the General Electric Company was made by Mr. Dyer, of New York, who was followed by Mr. Witter, submitting an affidavit of Henry Goebel, a German optician and watchmaker, who made incandescent lamps soon after his arrival in this country in 1849, continuing his experiments until 1872.

Several of the lamps were shown in court and created much interest. The affidavit took the entire afternoon to read, and it proved to contain much evidence that was entirely new, interesting and surprising. The court adjourned until Tuesday, when much additional evidence of an even more interesting character is expected.

Everybody seemed taken aback by this new evidence, even Prof. Elihu Thomson, Clarence Seward and other prominent men present regarding it as somewhat of an "eye opener."

Some of Goebel's lamps were offered in evidence.

In the crowd that thronged the court room the general feeling was that even if the new evidence doesn't bring about a revocation of all that has already been done, at any rate it may prolong the fight indefinitely.

The news that after the years of litigation over the Edison lamp patent something new had been discovered, and that that something was of such a nature as to render the overthrow of the Edison patent as entirely probable, created great excitement in this city among those interested.

Goebel's experiments were begun before 1860, and his lamps were practically on the same lines as those made years afterward by Edison.

Of course it is well known that there were no dynamos at that time, and Goebel's lamps were necessarily run by a primary battery current.

Early in the sixties his outfit was a familiar sight in the Bowery and other crowded thoroughfares of New York.

His battery and lamps in circuit were carried about on a truck, along with a big telescope. After attracting the attention of the multitude with his wonderful lamps all aglow, he solicited the people to view the glories of the heavens through his telescope at "ten cents apiece."

The Beacon people first learned of Goebel about three weeks ago. He is now in a Home for the Aged in this city.

Convinced by his account of himself that he was no humbug, they took him to a laboratory, where he went to work at once and turned out in a very brief time lamps similar to those of his earlier work, and bearing out to the minutest detail his descriptions.

We present herewith an illustration of the Goebel lamp of 1860. Other styles were made, some of them with an arched filament.

In the cut here given (Fig. 1), A represents a glass tube corresponding to the globes now in use, B platinum leading-in wires, and C the portion of the glass tube in which the platinum wires are embedded. D represents a wire of a size that will carry the necessary current without undue heating, and which is connected, as shown, to the platinum leading-in wires. E is a bamboo filament which is inserted in the conductor, D. This filament is of high resistance, and becomes incandescent on the passage of the current. The ends of the filament are flattened in order to join it to the wire conductor. In some of these lamps the incandescent filament was in the form of a loop as in the present lamps.

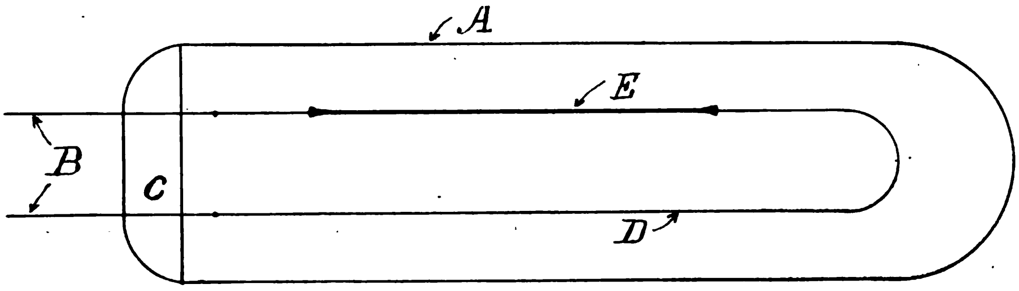


FIG. 1.

Trust Methods.

The Sinews of War.

Where They Come From.

The following is a copy of a late advertisement in the Boston daily press. It was first ordered for three insertions, and was subsequently continued for six more :

UNITED ELECTRIC
SECURITIES COMPANY
7 PER CENT. CUMULATED PREFERRED STOCK.

Total Amount Authorized, $4,000,000.

Amount of Present and First Issue, $1,000,000.

At a special meeting of the stockholders of the United Electric Securities Company, held December 29, 1892, an issue of preferred stock was voted, the terms of preference and issue being substantially as follows:

A dividend at the rate of 7 per cent. per annum, to be cumulative, payable semi-annually, in preference to any dividend on the common stock.

No dividend to be declared or paid on the common stock unless the company shall have at the time a net surplus sufficient in amount to pay all dividends to accrue within a period of three years on the preferred stock then issued and outstanding.

In case of the liquidation or winding up of the business of the company, the preferred stock to be paid in full at par before the common stock receives anything.

Preferred stock to be issued only as the total interest actually received during the year next prior to any such issue, from the bonds deposited by the company as collateral security for the payment of its own outstanding collateral trust 5 per cent. bonds, shall exceed the interest accrued during the given year on said collateral trust bonds by an amount at least 50 per cent. more than one year's dividend on the preferred stock, including both that outstanding and any additional issue proposed at the time.

The company makes the following statement of its business:

Actual difference between the annual interest at the present time upon the company's collateral trust 5 per cent. bonds and the annual interest upon the bonds deposited to secure the same		$131,235
This difference will be increased within 30 days by the issue of the ninth series of the company's collateral trust bonds to		156,235
Annual dividend required on $1,000,000 preferred stock	$70,000	
50 per cent. surplus required	35,000	
		$105,000

CONDENSED BALANCE SHEET.
Dec. 31, 1892.

ASSETS.

Stocks, bonds, cash and cash assets (net)	$1,173,220 17
First mortgage bonds, at par value, deposited with the American Loan and Trust Company, to secure collateral trust 5 per cent. bonds	4 707,500 00
	$5,880,720 17

LIABILITIES.

Capital stock	$1,000,000 00
Collateral trust 5 per cent. bonds	3,444,000 00
Reserve of 20 per cent. of first mortgage bonds to secure collateral trust 5s	953,684 25
Accounts payable, etc	107,277 82
Surplus	875,758 10
	$5 880,720 17

From July 31, 1892, the date of the last annual report of the company, to December 31, 1892, the total profits of the company, after the payment of all fixed charges, have been $102,867.27, being at the rate per annum of $246,882.89.

The company has issued to date eight series of collateral trust bonds, aggregating $6,000,000. The first, second, third and fourth series, each of $500,000, each secured by $625,000 or more first mortgage bonds of various electric railway, light and manufacturing companies; the fifth, sixth, seventh and eighth series, each of $1,000,000, and each secured by $1,250,000 or more first mortgaged bonds.

Of the first series, $382,000; of the second series, $399,000; of the third series, $232,000; of the fourth series, $213,000; of the fifth series, $270,000; and of the sixth series, $190,000, have been retired by the sale of collaterals.

We offer at 97½, subject to previous sale, any part of $750,000 preferred capital stock.

LEE, HIGGINSON & CO.,
No. 44 State street, Boston.
PARKINSON & BURR,
No. 53 State street, Boston,
January 17, 1893.

A leading Boston financier says: "These 7,500 shares of stock are the property of the General Electric Company, and the proceeds go into the General Electric Treasury. When the United Securities Company was organized it had a capital stock of $1,000,000, or 10,000 shares. Of these the Thomson-Houston Electric Company had 7,500 or 8,000 shares, and the trustees of the United Company were given the balance to be used as a bonus in selling its series of bonds up to $2,000,000, a share of stock being given with a bond. The idea was conceived of issuing preferred stock, though why this should be done is not entirely obvious. However, it was done, and of the total authorized issue of $4,000,000 a first issue of $1,000,000 was made and sold to the General Electric Company, payment being accepted in securities of subsidiary companies held in its treasury. A deal has been made with the public holders of common stock of the United Company for an exchange of five shares of the same for six shares of the 7 per cent. cumulative preferred stock. If the public now has 2,000 shares common it will hold, after the exchange, 2,400 shares of the 10,000 shares first issue of preferred, and the General Electric Company will have 7,600 shares. It is 7,500 of these shares, $750,000, which are now offered for sale at 97½ in the market.

"By this means the General Electric Company realizes $731,250, less brokerage, and thus converts a lot of treasury assets into cash. A peculiarity of this preferred stock is that the preference applies to the principal in the distribution of assets in liquidation, and becomes a rather choice security for the holders. It is practically a bond without foreclosure rights. The lien of the principal is upon treasury assets only. The concern holds no real estate. Of course, the common stock of the United Company suffers by what seems like the unnecessary creation of a lien before it, but the General Electric Company will be the common stockholder, and that company is supposably a gainer through the opportunity to realize on its treasury assets, and thus obtain ready money for use in its business."

The Press Agent Gets Down to Business,

And Uncovers the Claws of the Tiger.

The following is abstracted from a reading notice which has recently been sent out broadcast to country editors. The capital letters are copied as the Press Agent wished them to appear.

No further evidence is required that Mr. Coffin's company intend to "do this business," and that all others may as well "fold their tents and get out"—provided Mr. Coffin's plans do not miscarry. The wording of this notice is worth careful study:

"Of course the question arises 'What is embraced in the decision (sustaining the Edison patent)? What does it mean? and what do the benefits amount to?' It would seem that the language of the court makes it perfectly plain. It says:

"'Every one of the manufacturing corporations or competitors of the Edison commenced their operations with the knowledge of the existence of the patent suits. They were controlled by business men of intelligence and experience. Their promoters and managers may have believed, and probably did, that the patents could not be successfully maintained, but they entered upon the business with the understanding of its risks and of the consequences which would befall them as infringers if the patents should be sustained. None of them can now be justly heard to say that an injunction which is essential if not indispensable to the protection of the owners of the patents and their lessees ought not to be granted because of the great pecuniary loss which may result. If in consequence of being deprived of the use of the lamps their investment in their electrical apparatus will be greatly depreciated, THEY MUST TAKE THE CONSEQUENCE.

"'Again, as to the users, however, who have acquired these plants subsequent to the decision of the circuit court, if they are deprived of the use of the lamps, and as a consequence the value of their plants may be greatly impaired, THEY MUST ACCEPT THE RESULT AS A CONSEQUENCE OF THEIR OWN IMPRUDENCE.'

"Verily, this is plain English and certainly is amply sufficient to put any and all good business men on their guard.

"If this decision means anything, it says that the owners of the Edison patents are the only parties who can legally manufacture and sell the incandescent lamp, and as the owners of the Edison patents are now the General Electrical Company of New York, and as it seems to be 'a condition, not a theory,' that confronts the purchaser of incandescent lamps, he must buy his lamps from the General Electrical Company or their duly authorized agents. This being the case, the electric light gentlemen, when called upon, should be required to identify themselves and show from whence they come, as the general public or innocent purchaser should have some protection.

"It is reasonable to suppose that the owners of the patents, having made such a long, continuous and expensive fight, are likely to follow up the advantage they have gained, hence it behooves all users of incandescent lamps to familiarize themselves with the present condition of affairs as a matter for their own protection."

A Preliminary Exhibit.

The Westinghouse Company has an "At Home."

Special to "Electricity."

PITTSBURG, January 21.—The Westinghouse Electric and Manufacturing Company sent out invitations early this week to the people of Pittsburg and prominent electrical men throughout the country to inspect the company's plant which has been built to light the World's Fair on the contract which has become famous and which made the Electrical Trust tired.

The dynamos, twelve in number, are the largest yet built, and are of 15,000 16 C. P. light capacity each. Twelve engines, each of 1,000 H.P., are being built to drive these dynamos. The armatures weigh alone 42,000 pounds each, and the total weight of each dynamo is about eight tons.

Notwithstanding the magnitude of this exhibition of machinery, the chief interest of your representative, and of most electrical men, centred in the new incandescent lamps, which were shown in large numbers. Visitors were thus enabled to make as close an inspection as they desired, not only of the lamps burning, but of their separable parts.

Doubting Thomases were very scarce after the exhibition, and it should be a matter of congratulation to all independent concerns that the Westinghouse Company have solved the problem of incandescent lighting outside of the Edison patents.

ELECTRICAL COMPANY ELECTIONS.

The following are the officers chosen at recent elections by electrical companies in various cities:

Chester, Pa., Electric Light Company: President, G. P. Denis; directors, F. G. Sweeney, C. W. Perkins, N. A. W. Darling, J. R. Sweeney, H. B. Black, Joseph Deering, Joseph McGolrick, H. J. Riley, D. P. Paiste, William Burnley.

Reynoldsville (Pa.) and Rathmel Electric Railroad Company: President, F. K. Arnold; vice-president, Jos. Morrow; secretary, C. Mitchell; treasurer, W. B. Alexander; directors, F. J. Black, F. K. Arnold, H. S. Belknap, Jos. Morrow, Geo. Sprague, W. I. Cathers, M. C. Coleman.

Indiana (Pa.) Electric Company: Directors, Edward Rowe, Wellington B. Kline, W. S. Daugherty, G. P. McCartney, James St. Clair.

Canton (N. Y.) Electric Light and Power Company: President, L. P. Hale; secretary and treasurer, A. T. Martyn; superintendent, Luman Bailey; directors, Murray N. Ralph, R. B. Ellsworth, Judge L. W. Russell, Hon. W. R. Remington, Hon. J. C. Keeler, L. P. Hale, A. T. Martyn, C. S. Haley, Luman Bailey, R. D. Sackrider, Dr. J. C. Preston.

Columbia (Pa.) and Marietta Electric Railway Company: President, D. R. King; secretary, Robt. T. Ryon; treasurer, J. K. Sigfried; directors, D. R. King, J.K. Sigfried, C. H. Dengler, Jos. H. Black, George W. Ryon, R. T. Ryon and J. A. Ryon.

Norwalk (Conn.) and South Norwalk Electric Light Company: President, Charles Olmstead: vice-president, Horace F. Boardman; treasurer, E. T. Jackson; secretary, John H. Hoyt; auditors, D. J. Glazier and Thomas I. Raymond; directors, E. T. Jackson, Horace F. Boardman, J. N. Kemp, Charles Olmstead and John H. Hoyt.

Carondolet (Mo.) Electric Light Company: President, John Krauss; secretary, F. W. Mott; superintendent, R. J. Kilpatrick.

City Electric Light Company, Kalamazoo, Mich.: Directors, Leroy Cahill, Wm. E. Hill, G. E. Fisher, Wm. Shakespeare, J. W. Adams, J. Schuster.

Grand Rapids (Mich.) Electric Light and Power Company Directors, William T. Powers, William H. Powers, Henry Spring, John L. Shaw, Edwin S. Peirce, Jacob Kleinhans and James W. Converse. After the adjournment of the stockholders' meeting, the newly-elected directors met and organized by electing William T. Powers president, Henry Spring vice-president, and William H. Powers secretary and treasurer.

Schenley Park and Highlands Railway Company, Pittsburg, Pa.: Directors, Richard G. Wood, E. M. Fulton, of New York; S. J. Macferren, T. A. Noble, E. F. Hays and R. P. Cunningham. Mr. Macferren is vice-president and general manager.

East Reading (Pa.) Electric Railway: Directors, Jonathan G. Leinbach, John H. Printz, William R. McIlvain, Geo. W. Bard, A. H. Fegely, Jacob A. Strohecker, Frank P. Esterly and A. J. Brumbach.

The Electric Brake Company, Salem, Mass.: President, H. B. Walmsley of Lynn; secretary-treasurer, William Stopford of Beverly; directors, W.K. Bigelow of Salem, W. Y. Ober and F. S. Alley of Lynn, C. Keans of Danversport, and Ziney Goodell of Salem.

Sandy Hill (N. Y.) Electric Light and Power Company: Directors, Marcus C. Allen, John H. Derby, Charles T. Beach, John J. Cunningham, James E. Howland, Grenville M. Ingalsbe, S. H. Kenyon and Seymour Taylor. Mr. Howland was re-elected president, Mr. Allen vice-president, Mr. Beach treasurer and Mr. Ingalsbe secretary.

Consolidated Electric Light Company, Birmingham, Ala. Col. J. F. B. Jackson, the president and owner of a controlling interest, recently sold his stock and bonds to Mr. H. E. W. Palmer, general superintendent of the southern district of the Thomson-Houston Electric Company. At a meeting of the board of directors subsequently, the old board was re-elected with the exception of F. W. Dixon, who resigned. Mr. Palmer was elected a director and Col. Jackson is still a director, having retained some stock. The board of directors elected George Morris president, vice Col. Jackson, resigned, and Robert Jemison vice-president and general manager.

The Evansville Gas and Electric Light Company, Evansville, Ind. President, R. K. Dunkerson; vice-president and general manager, Herman Wilkemeyer; treasurer, Samuel Bayard; secretary, James H. Foster; directors, R. K. Dunkerson, Samuel Bayard, Francis J. Reitz, Thomas E. Garvin, John Gilbert, Jacob Weintz, Jacob Eichel, Herman Wilkemeyer.

Card Electric Motor and Dynamo Company, Cincinnati, Ohio. President and treasurer, J. W. Wilshire; vice-president and secretary, George Bullock; superintendent and electrician, O. W. Jantz; directors, S. R. Burton, P. R. Mitchell, George Bullock, C. B. Simrall, J.W. Bullock, J. W. Wilshire and Otto W. Jantz.

The Chicago Edison Company re-elected the old board of directors as follows: A. F. Seeberger, John B. Drake, Lambert Tree, R. C. Clowry, Robt. T. Lincoln, J. W. Doane, F. S. Gorton, A. A. Sprague, E. M. Phelps, Byron L. Smith. In regard to the consolidation with the Chicago Arc Light and Power Company, the matter was left to the directors to decide, and it is almost an assured fact that it will carry.

Duquesne Heat, Light and Power Co., McKeesport, Pa. President, C. F. Keyser; vice-president, C. W. Allebrand; secretary, H. L. Black; directors, Dr. C. F. Keyser, Charles W. Allebrand, J. Ren Wiley, M. G. Conlin, Thomas Carr, H. L. Black and Lewis McDonald.

Altoona [Pa.] and Logan Valley Electric Railway Company. President, John Lloyd; directors, Cornelius Campbell, A. C. Shand, John Lloyd, M. H. Canan of Altoona, and Wm. P. Smith of Hollidaysburg.

The City Electric Street Railway Company, Little Rock, Ark. The old directory was re-elected and H. G. Allis elected president, and H. G. Fleming vice-president and general manager.

The Electric Street Railway Company, Adrian, Mich. J. H. Blain was re-elected president. M E. Chittenden treasurer, and Charles Barker secretary.

Chicago Notes.

The directors of the Chicago City Railway Company, whose lines cover the entire southern portion of the city, evidently have begun to appreciate the value of electric roads. In the president's report at the annual meeting it was stated that sixteen miles of track had been equipped and the poles set for carrying the trolley wires. A new power house is most completed. Nearly all the motors and electric equipments are on the ground ready for operation as soon as the current is turned on. The cars are to run on four parallel streets, viz., Thirty-fifth, Forty-seventh, Sixty-first and Sixty third. The company expect to equip seventy-five miles of their cross town lines electrically, for which purpose they increased their capital stock from $7,000,000 to $9,000,000.

During the spell of cold weather which has lasted for over two weeks, Chicago has been in the throes of a coal famine. Most of the numerous electric light stations were pushed for want of fuel. The factories engaged in the manufacturing of electrical apparatus were also materially affected by the shortage. The Western Electric Company were nearly compelled to shut down as they had almost reached their last shovelfull when a load of coal arrived to tide them over.

At the last annual meeting of the Chicago Edison Company, the question of consolidating with the Chicago Arc Light and Power Company was discussed. No formal action was taken on the subject, excepting that the decision of the question was left to the board of directors. As both of the companies are licensees of the General Electric, and it is the known policy of the Trust to consolidate all of the central stations operating in the same city, it is almost an assured fact that the consolidation will go into effect. Should this take place, the patrons of the companies are speculating on the limit that will be placed on the already high rates.

The Illinois Legislature being in session, a Chicago Representative has introduced the bill, which annually appears in the House, to give the city of Chicago the right to extend its electric lighting system so as to compete with local companies for furnishing light and power to private consumers. There is little doubt that the bill will be killed as usual.

Louis Van Ness has associated himself with Mr. Henry Bishop to represent the Massachusetts Chemical Company in Chicago and the West.

Boston Notes.

Several Boston electrical firms are busy getting their exhibits ready for the World's Fair, and it looks as if the "Hub" would be well represented in the electrical department. Why shouldn't the bean-eating city make a big display? Boston is entitled to rank as one of the most important electrical centres in the world.

On Thursday evening Mr. W. H. Knight, of the General Electrical Company, gave an impromptu talk on "The Electrical Equipment of Central Stations" before the members of the Thomson Scientific Club, Lynn. There was a good attendance of members and the address was listened to with close interest by all present.

One of the finest brass bands in the State of Massachusetts is the one connected with and composed entirely of employees in the General Electric Company's factories at Lynn. During the past summer this band filled many important engagements; this winter the band is in frequent demand, while the outlook for the approaching pleasure season favors the belief that they will have many opportunities of entertaining thousands of music loving people.

The committee of the Thomson Scientific Club, Lynn, has arranged for the following lectures to be delivered in the club house during the next few weeks: "The Steam Equipment of Modern Central Stations," by Alfred A. Hunting, M. E., one of the prominent engineers of New England, on February 2; "The Design and Construction of Central Stations," by E. E. Pettee, February 16; "Atomic Molecular Motions," by Prof. A. E. Dolbear, the eminent scientist of Tufts College, March 2; "A Review of Astronomical Progress," by Prof. G. W. Carey, March 16. The foregoing list of speakers and subjects is certain to attract large audiences, the young men engaged in electrical pursuits showing an earnest desire at all times to increase their stock of accurate scientific knowledge.

Mr. F. H. Whipple, well known throughout the electrical field as the former publisher of "Whipple's Electrical Reports" and other publications, was found guilty in the Superior Court, Pittsfield, Mass., Friday, of obtaining money under false pretences.

An electric car is being constructed at the General Electric Company's factories in Lynn, for the post office department at Camden, Me., and will be used for collecting and distributing mail matter at that place.

The Quincy and Boston Street Railroad Co. has been experimenting with electric heaters. If they prove satisfactory all the cars on the road will be equipped.

The latest phase of the long-continued fight between the Old Colony Railroad and the Interstate Electric Railway Company over the grade crossing at Hebronville came up in the Massachusetts State Legislature Thursday, when Mr. J.H. Benton, counsel for the Old Colony Railroad, offered the following amendment to Section 37 of Chapter 113 of the Public Statutes, so that it should read as follows:

> "A street railway company may use such motive power on its tracks as the aldermen of cities or the selectmen of towns through which it is located may from time to time permit, but if it uses electric power it shall not cross the tracks of any steam railroad at grade, without the consent of the Railroad Commissioners."

It is not thought likely that the Legislature will adopt this amendment inasmuch as the Interstate Company holds a charter that entitles it to construct its road, and it has done so. Public opinion is decidedly with the electric railway company and against the Old Colony Railroad.

Last Saturday a most ambitious movement was inaugurated in Worcester, Mass. The promoters are to organize a State central street-railway, forty-five miles long, including branches, and the territory to be covered will include Worcester, Shrewsbury, Northboro, Marlboro, Grafton, Westboro, Auburn, Leicester, Oxford and Webster. The capital stock is to be placed at $450,000. The parties interested are chief owners of the Spencer, Leicester and Millbury electric roads. These gentlemen may not get all they want, for the Worcester and Shrewsbury Railway Company is seeking authority to extend its system through to Marlboro.

The movement recently made by a number of American capitalists for purchasing the entire street-railway system of the city and valley of Mexico is regarded very favorably by Boston people. The price to be paid is said to be $7,000,000 Mexican money. When the purchase has been effected the entire system, aggregating about 100 miles, will be equipped for electricity throughout.

General News.

What is Going on in the Electrical World.

Little Rock, Ark.—The telephone line between Pine Bluff and Little Rock has been completed.

Salem, Mass.—The new line of electric railway between Salem and Lynn has been opened for traffic.

Dover, N. H.—An electric railroad between Salmon Falls and Durham is projected, the line to run through Dover.

Greenville, Tex.—The city council are considering the question as to whether or not they shall sell the electric light plant to a corporation.

Rochester, N. Y.—The Denio fire alarm system has been approved by the executive board of the city and will probably be put into use here.

Rockville, Conn.—The preliminary survey for the proposed electric road from Rockville to Ellington is about completed, and work will begin on it in the spring.

Cleveland, Ohio.—The St. Clair street railway line is to be equipped for electricity.—The W. D. Graves Electrical Manufacturing Company has made an assignment.

Newburg, N. Y.—Colonel Dickey proposes to establish an electric street railroad in the place of the present horse car line and to extend it southward into New Windsor.

Woodbury, Pa.—Nearly all the stock of the projected electric road between Woodbury and Philadelphia has been subscribed, and the company will be incorporated at once.

Hoboken, N. J.—The electric cars began running on the North Hudson Railroad between Pavonia and Bergen avenues on the 18th. The route extends to the Hoboken Ferry.

Conshohocken, Pa.—The town council has been asked to grant permission to a company headed by James and Daniel Shepp to operate an electric railway line through this borough.

Seattle, Wash.—Guy C. Phinney has filed a petition for the privilege of locating and maintaining an electric street railway system from Pioneer place, this city, to Woodland Park.

Fort Wayne, Ind.—The work of repairing the damage done by the fire at the Electric Works is making rapid progress.—A movement is on foot to construct an electric street car line to New Haven.

Woodhaven, L. I., N. Y.—The taxpayers of this town and vicinity petitioned the town board to establish an electric lighting district in Woodhaven and the board has given its sanction to the project.

Paterson, N. J.—As soon as the weather permits work will begin on the new electric railway that is to connect Paterson and Hoboken, passing through Boiling Springs, Rutherford and Carlstadt.

Athens, Ga.—A new electric plant to be operated by water power is being set up here by the Athens Manufacturing Company, which will supply power to motors and machinery in different parts of the city.

Brownwood, Tex.—The Westinghouse incandescent lighting system is being installed here. The plant will have an eighty horse power Russell engine, a 125-horse power boiler, with a five mile circuit.

Plainfield, N. J.—It is probable that a company will shortly be organized, including the Plainfield Street Railway Company, to connect Plainfield, New Brunswick and Bound Brook by a system of electric railways.

Buffalc, N. Y.—Reports are in circulation here that a company is to be formed to build a $200,000 electrical works in the vicinity of Buffalo, to turn out a new incandescent lamp invented by Philip K. Stern, the electrical expert.

Santa Rosa, Cal.—The city council has granted a franchise to J. W. Morris, of Oakland, who is connected with the Sessions electric roads in this city, for an electric line to connect with the San Francisco and North Pacific road.

Waverly, N. Y.—At a special meeting of the trustees, a few days ago, the franchise for an electric railway in Waverly was granted to the Susquehanna Valley Electric Traction Company, of which A. N. Broadhead, of Jamestown, is president.

Tiffin, Ohio.—The Edison Electric Light Works in this city, together with a $15,000 plant which the company had almost completed to furnish power to the two electric street railway companies, has been burned, entailing a loss of $30,000.

Georgetown, Mass.—Surveyors are laying out a route for an electric railroad throughout Georgetown. It is reported by some that it will run through Rowley, Ipswich and Hamilton, but the surveying is through Boxford, Topsfield and Danvers.

St. John, N. B.—General Manager Jones of the street railway says he expects to have the electric railway in operation as early in the spring as possible, and the public will then get a street railway service equal to that of any city in America.

Harrisonville, Mo—The authorities are considering a proposition from the Fort Wayne Electric Light Company to put in a $10,000 plant, the city to pay for it in yearly instalments of $1,000. Mayor Bird believes the proposition is a good one for the city.

New London, Conn.—The electric plant of the New London Horse Car Company is to be sold to the owners of the Norwich street railway. It is said that ex-Governor Waller will be interested in the new company. The two electric roads will henceforth form one system.

. **Petersburg, Ind.**—An electric lighting company has been formed here composed of Gustoff Frank, president; Charles Burger, vice-president; Moses Frank, treasurer; George E. King, secretary; Sol Frank, W. V. Hargrove, S. J. Haines, L. J. Dunning and Clay Lemons.

Hightstown, N. J.—The Electric Supply Company of Asbury Park has secured the valuable franchise for lighting Hightstown with electricity. The terms include the lighting of the public streets on a contract, the lighting of Peddie Institute, and a large number of private lights.

Galena, Ill.—The stockholders of the Galena Electric Light Company have voted to increase the capital stock to $15,000, and to introduce the arc system. When the change has been accomplished the company will compete with the gas company for the contract for illuminating the streets.

Scranton, Pa.—James E. Burr, attorney for J. B. Newcombe, has had a writ of foreign attachment issued against the Thomson-Houston Company and for all of their property in the hands of Robert E. Dunstone, assignee the People's Street Railway Company and the Scranton Traction Company.

Hartford, Conn.—The Hartford Light and Power Company have in contemplation the erection of a dam on the Farmington River for the purpose of obtaining water power for the generation of electricity, which will be transmitted thence to the Pearl street station of the company in this city.

Bridgton, Me.—An electric road for freight and passengers, connecting Bridgton and Harrison, is likely to be built. It is said that the Giant Electric Company of Portland is largely interested in the enterprise, and proposes to equip the road and also furnish electric light for both places.

Akron, Ohio.—The Cuyahoga Falls and Akron Railway and Power Company has forfeited its franchises and new parties have taken up the work. M. N. Beatty, of Lima, has practically secured the right of way, and will push the work forward for the Brice Construction Company, which will own the new line.

Tacoma, Wash.—The Sunset Telephone Company has decided to build immediately a new copper line connecting Tacoma with Grays Harbor and South Bend. It will start at Centralia and follow the line of the Tacoma, Olympia and Grays Harbor Railroad to Aberdeen and Ocosta, continuing thence along the sea coast to South Bend.

Braintree, Mass.—At a special town meeting held here it was voted to expend $16,650 to make such additions to the present electric light plant as to enable the town to furnish light for its own buildings and for domestic and commercial uses. The service has been heretofore performed in part by corporations situated in different sections of the town.

San Antonio, Tex.--Charles E. Harris's petition for right of way over certain streets in the city for an electric railway line has been reported favorably by the council committee.—At a late meeting of council the committee on telephone, telegraph and railways reported favorably upon the petition of the Alamo Electric Street Railway Company for franchises for four different routes.

Brooklyn, N. Y.—The Brooklyn, Bath and West End Railroad has been sold to a syndicate, of which E. E. Dennison, of Philadelphia, is one of the heaviest stockholders. It is understood that the West End road will be connected with the Fifth avenue line of the Atlantic Avenue Railroad, and will be run by electricity. The new system will be in operation before the summer is over.

Toledo, Ohio. -- The Robinson Company's electric plant here is receiving some important additions. The company has bought two engines of 750 horse power each, which will be delivered in a few weeks, and is now contracting for a proportionate increase of boilers from three to five. A number of Westinghouse alternating current generators for incandescent lighting has already been added to the plant.

Philadelphia.—The *Ledger* says: "The trolley fever continues to rage. Eleven trolley ordinances were introduced in Common Council yesterday (19th); one other was passed by Select Council, and still another was reported favorably from committee. It is hard to keep track of them all, but apparently every railway line in Philadelphia is to be turned over to trolley or cable except the Chestnut and Walnut streets line."

Albany, N. Y.—The Erie Telegraph and Telephone Company has filed its annual report with the Secretary of State. The capital is $5,000,000, of which $4,000,000 has been paid in. The debts do not exceed $250,000 and the assets are not less than $250,000. The report is signed by Arthur H. Andrews, Levi Sprague, Charles J. Gladden, A. C. Russell, James A. Weston, A. S. Adams, C. E. Adams, Francis Jewett, Wesley A. Gove, H. A. Whitney and J. W. C. Pickering. —In the case of the Hudson River Telephone Company against the Watervliet Railroad Company, the decision of the Court of Appeals was in favor of the railroad.

Freeport, Ill.—After a recent meeting of the stockholders of the Freeport Street Car Company, held to discuss the advisability of adopting the electric or trolley system, the secretary of the company was instructed to open up communications with parties that are prepared to fully equip an electric system for operating street cars and ascertain what the cost of the same will be. It must be a first-class equipment and not defective in any way. The estimate will be on the district that the present system covers, with eight miles more added to it, which will cover the entire business portion of the town as well as a great many miles of the suburban part of the city.

Pittsburg, Pa.—The reorganized Squirrel Hill electric road, under the name of the Schenley Park and Highlands Railway Company, is shortly to be extended to Homestead and ultimately to McKeesport.—The *Leader* says that R. S. Waring, who is at present in Pittsburg, will leave for France about February 1 to personally superintend the execution of one of the largest orders yet given for telegraph and telephone cables at any one time in any country. Negotiations between Mr. Waring and the French Government have been concluded. The cables will be laid underground. They will be made in France. That was one of the stipulations of the contract. The machinery will be turned out in the United States--some of it in Pittsburg, the bulk in Eastern places.

Pullman, Ill.- The Illinois Electrical Forging Company, which has recently filed articles of incorporation, is equipping a factory at West Pullman with $70,000 worth of machinery, including dynamos of energy equal to 100,000 horse power. Walter G. Campbell, who owns nearly all of the stock of the concern, is a wealthy mine owner of California. The *Inter-Ocean*, from which we borrow the above information, says of the new process of forging to be employed by this company: "A bar of steel, for instance, will be laid on an anvil, the necessary quantity of current passes through it, heating it properly, evenly, and with constancy, as against the repeated heatings and coolings of ordinary forgery. A rail sixteen feet can be handled as easily, it is claimed, as a short bar one inch square."

New York.—On the evening of March 11, in Hardman Hall, Fifth avenue and Nineteenth street, a fast telegraphic tournament, or contest between expert telegraphers, will be held, the committee in charge being M. H. Toomey, R. L. DeAkers, M. W. Russell, J. N. Johnston, H. F. Warren and Charles Orr. The tests are intended, among other things, to develop the maximum carrying capacity of an absolutely "clear" and approximately perfect conductor when manipulated by the fastest operators and most expert receivers; to ascertain how much "press" matter might in an emergency be crowded over such a conductor, Walter P. Phillips's code of abbreviations being used, and to test the comparative worth of the pen and the various typewriting machines for recording Morse signals.—The trouble between the National Brotherhood of Electrical Workers and the Electrical Contractors' Association has at last been settled. The agreement, which is to go into effect February 1, provides that nine hours shall constitute a day's work at $3 a day, and the agreement to remains in effect for one year. The association is to employ none but union workmen, and union workmen will work for none but members of the association. No sympathetic strikes or lockouts are to be undertaken.

Spokane, Wash.—A syndicate of Spokane capitalists has purchased 1,100 acres of land within five miles of the city, and intend laying it out for suburban residences. An electric road to the locality will be built as a part of the scheme, which it is thought will be immensely profitable as the land was purchased for $110 an acre, and other parties are selling lots about the same distance from the city at $250 to $300 apiece, or at the rate of $1,250 to $1,500 an acre.--The plant of the Edison Electric Illuminating Company at this place is said to be the largest on the Pacific Coast, not even excepting San Francisco, and the hydraulic equipment both in design and magnitude is considered superior to any yet produced in any other part of the United States, and probably in the world. The total amount of horse power now used in this station for all departments is 2,300, of which amount 645 horse power is utilized by the street railroads, all of which now get their power from this station. The hydraulic equipment consists of two parallel flumes over 500 feet in length, each seven feet in diameter, constructed of steel, capable of discharging 425 cubic feet of water per second, and of delivering 2,700 horse power.—The construction of the electric road from Spokane to Cœur d' Alene is expected to begin early in the spring. The distance is thirty-two miles, and power will be supplied from two stations, one in Spokane, and the other at Post Falls, about twenty miles above, on the Spokane River.

The New Stanley Transformer.

A pamphlet is about to be issued by the Stanley Company announcing a new transformer, which is the result of their extensive experience in this line, and embodies a new method of insulation which has been perfected and which is said to be much superior to anything heretofore in use.

Every effort has been made to produce a thoroughly good article and detail improvements in design, methods of construction, etc., have been frequently adopted, but no radical changes made. Now, however, the company announce a change of the greatest importance because it goes to the very root of the most essential feature in a transformer, namely, insulation.

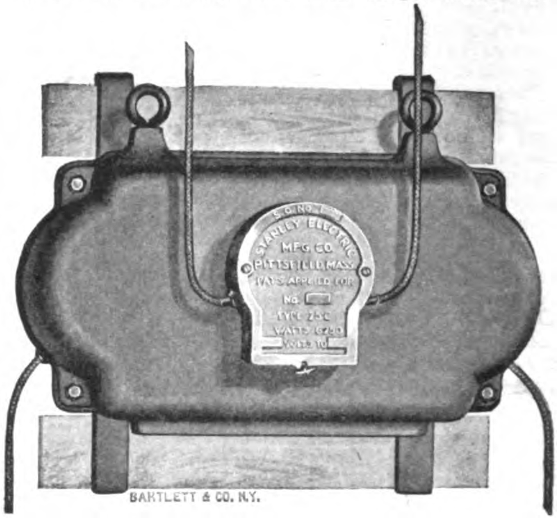


FIG. 1.

They have delayed the commercial introduction of this new transformer for the purpose of making absolutely sure of the value of the changes and the entire reliability of the transformer itself and the methods adopted for its manufacture.

The coils in the new instrument form a solid mass and are embedded in an insulating material of very high resistance which will not deteriorate with use.

These coils can be submerged in water indefinitely without injury to their insulation and as moisture is one of the worst enemies to electrical insulation it will at once be seen what a great step in advance this is. And the company will prove their confidence by insuring these transformers for five years for a nominal sum against all accident, and even against lightning.

The cost of this insurance will be but five per cent. of the selling price.

Every transformer made is submitted to severe tests, and must come up to a predetermined standard before it can leave the factory. These tests are made to determine efficiency, regulation and the insulating resistance of all parts of the transformer, and in addition to this the transformer is run for a long time on more than its full rated capacity, and afterwards is subjected to several times the E. M. F. on which it is to be used in practice, in order if there is any weak spot in the transformer that the company and not the customer may discover it.

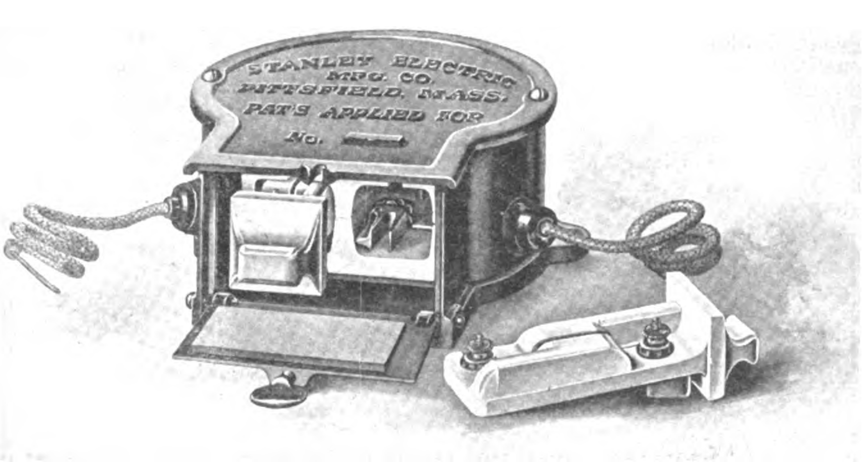


FIG. 2.

Fig 2 shows the details of the fuse box on these transformers. Only the primary circuit is fused, secondary fuses in the transformer itself being now very generally and properly regarded as unnecessary. The fuse is a double pole, each link being carried on a separate porcelain block.

To replace a fuse the door is dropped down by simply loosening one thumb screw, the plug pulled out and an extra one inserted, or a new fuse wire attached.

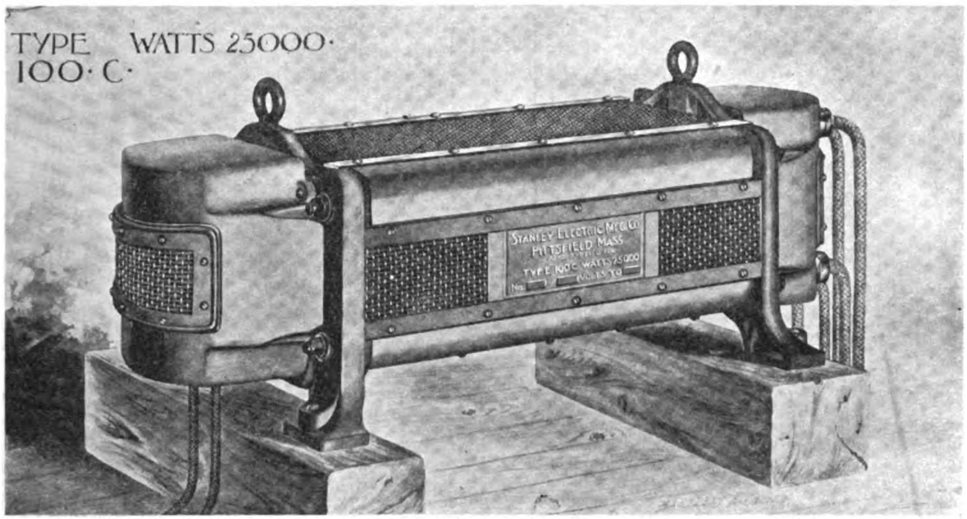


FIG. 3.

This company are now manufacturing regularly 500-light transformers, a cut of which appears above [Fig. 3], and are also supplying separate primary fuse boxes, shown in Fig. 4.

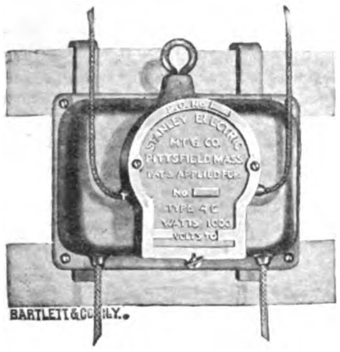


FIG. 4.

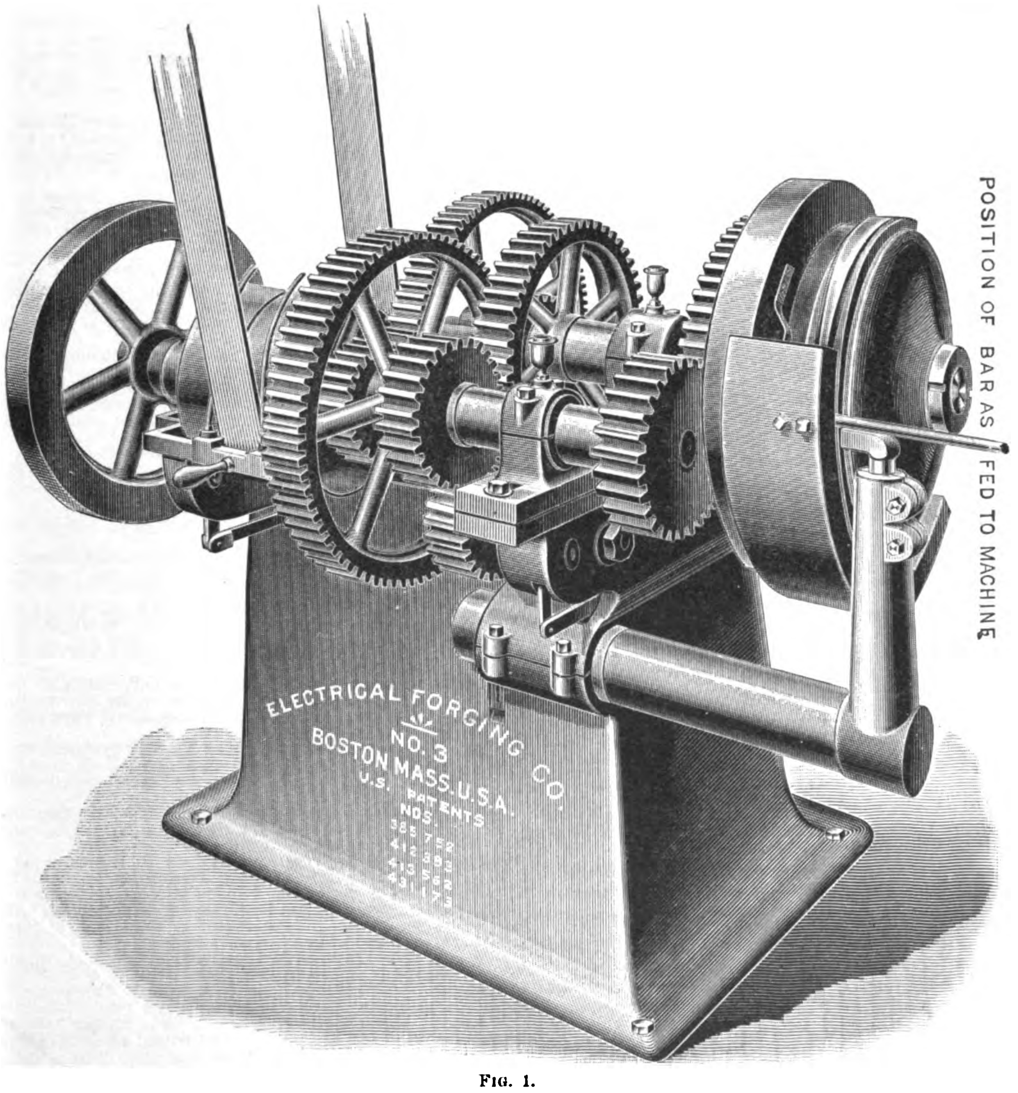


FIG. 1.

These transformers show a remarkably high efficiency throughout the whole range between no load and full load, and have come to be recognized as a standard of excellence by central station men.

Electrical Metal Working.

Round shapes have puzzled metal workers through all past ages. It has been generally conceded that the usual method of forging an approximate shape and then turning to accurate size on a lathe are tedious and expensive ways of doing the work. For nearly one hundred years the attempt to make round forgings by rolling process has been going on, but with indifferent success. A history of the attempts shows many partial successes, but in every case some vital principle has been omitted, or some mistake made which has prevented ultimate success.

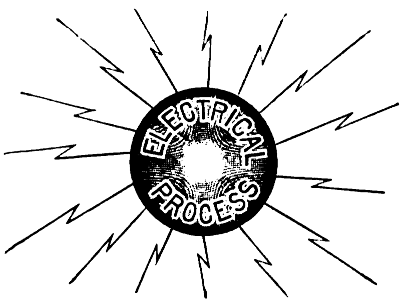


FIG. 2.

The accompanying cut shows the Electrical Forging Company's latest improved No. 3 Patent Rolling Machine for manufacturing rolled forgings. This machine was designed and built for rapid and accurate work, being rotary in all its movements no time or power is lost in the return of the dies to their working position. The machine may be worked at any speed from slow to fast according to the nature of the work required, it is quickly adjusted and automatic in all parts, and work from ⅛ up to 6 inches long and from ⅛ to 2 inches in diameter is turned out by this size machine. These machines are built in sizes ranging from 0 for the smallest work up to No. 10 for the largest and heaviest kind of work.

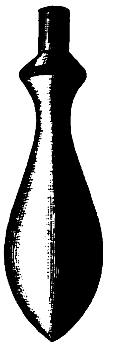


FIG. 3.

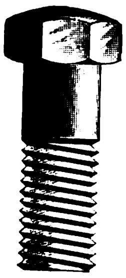


FIG. 4.

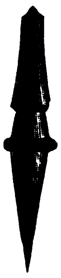


FIG. 5.

FIG. 6.

The uses to which these machines can be put are many and varied, as a great variety of things now produced are made of iron or steel of low carbon in order that they may be turned out economically. By this process highly carbonized steel may be worked equally as well as iron or soft steel and insures increased strength, an advantage of the first importance in all kinds of work. It is within the range of these machines to roll successfully steel of the highest grade of crucible down to the open hearth and Bessemer; also copper and brass are successfully worked. It is claimed that these machines stand alone in the matter of producing rolled forgings of irregular shape without leaving them hollow or piped, and articles rolled on this machine whether of regular or irregular shape are perfectly solid.

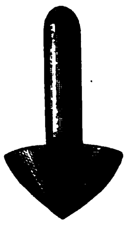


FIG. 7.

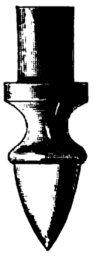


FIG. 8.

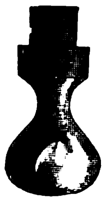


FIG. 9.

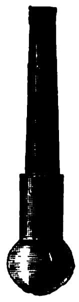


FIG. 10.

Steel handles of all sizes and shapes heretofore invariably made on the turning lathe may now be produced by the electrical rolling process at a saving of 99 per cent. over the required machine labor, it being possible to roll 100 perfect handles in the time required to make one by former methods; also in making handles a considerable saving is effected, in that there is practically no waste of metal.

Anti-friction steel balls from ⅛ up to 2 inches in diameter are made by the electrical rolled forging process at a speed unapproached by other methods. The work done by this process is perfectly accurate and the operation quick. A red hot steel bar is inserted between the revolving dies (the position of the steel bar is shown in the cut of the machine), and for every revolution of the dies a ball is forged, or a conical shot, a chair screw, a bolt with thread and head complete, a boiler rivet, tiny calks for lumbermen's shoes, or a spindle or taper pin, etc.

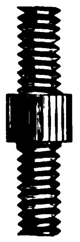


FIG. 11.

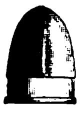


FIG. 12.

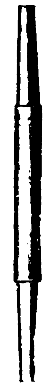


FIG. 13.

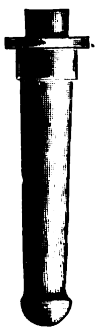


FIG. 14.

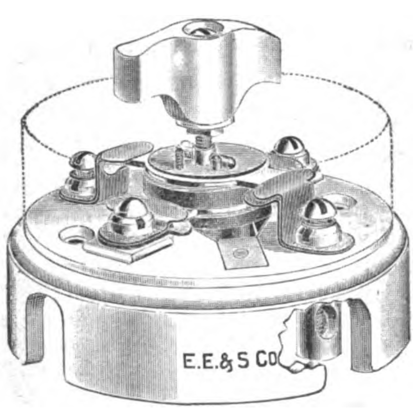
FIG. 15.

One hundred millions [100,000,000] of anti-friction steel balls are now required to supply the trade in the United States alone, and from 3,000,000 to 10,000,000 of boot calks, and the custom heretofore has been to forge these with a trip hammer, and a manufacturer has been unable to make over 4,000 per day, generally not over 2,000, while with our improved rolling machine 30,000 a day are made at a cost far below the price at which they have been heretofore produced.

The foregoing cuts show a few of the many samples of work made on our improved rolling machine: Fig. 2, Electrically heated and rolled forged Steel Ball. Fig. 3, rolled forged Machine Handle, made in several shapes and sizes. Fig. 4, rolled forged Hexagon Bolt, head and thread made at one operation, square and round headed bolts made by the same dies complete at one operation. Fig. 5, Shoe Calk, made in four sizes. Fig. 6, Conical Shell. Fig. 7, Shuttle Tip. Figs. 8 and 9, Hinge Tips. Fig. 10, Hames Start, made in several sizes. Fig. 11, Right and Left Hand Thread, made at one operation. Fig. 12, rolled steel Cane and Umbrella Tips. Fig. 13, rolled Bicycle Spindles, all sizes. Figs. 14 and 15, rolled Castor Pins.

Double Pole 25 Ampere Snap Switch of the Electric Engineering and Supply Company.

A close examination of this switch will show quite an improvement in this line of goods, and in the absence of the many defects of its predecessors it will compare very favorably with them. The contact is made by rotating metal arms mounted on a spindle insulated from each other, so that they pass between two metal contact pieces mounted on each of the four binding posts so as to make a long wiping knife contact between the parts on both sides of the contact arms. In order to make and break instantly there is arranged in a recess in the porcelain base two elliptic steel springs which press against the sides of a square frame-work holding a roller in each of its corners, so that in turning the handle the square frame-work is rotated until the rollers on two of the corners have compressed the two springs and are just passing the highest point when the contacts are about to be made or broken. Having passed this highest point, the springs press the rollers on the corners towards the center so as to rotate the switch through the part of the circle in which it travels. Owing to the lost motion left in the spindle there occurs instantly the make or break of the circuit with a sudden snap. The openings left in the side of the base facilitate surface wiring, so that the wires may pass directly into the binding posts, which are drilled in the side to receive the wires, which are held by a screw passed downwardly through the binding post, or, if preferred, the post is bored from the bottom up through the top and the wires held by a binding screw passing through the side of the contact post.



This switch has more carrying capacity than most switches designed for 25 amperes, and the wiping contacts constantly keeping the surface clean, the parts always run cool, and the sudden break is of such length as to make the switch safe for use with currents of an electro-motive force of from 400 to 600 volts.

This switch is finished in the same neat and workmanlike manner as all the goods of the Electric Engineering and Supply Company, Syracuse, N. Y., who are prepared to fill all orders promptly.

COMMERCIAL PARAGRAPHS.

Queen & Company, Incorporated, Philadelphia, are congratulating themselves upon the increasing demand for their "Magnetic Vane" Ammeters and Voltmeters as evidenced by the fact that more than twice as many of these instruments were sold by them in 1892 than in the preceding year. This advance is perhaps not astonishing when efficiency and cost of the apparatus are considered, but it shows a degree of appreciation on the part of the purchasers that is very significant.

The "M. V." are adapted for constant and switchboard use, and voltmeters as well as ammeters can be left in circuit constantly, a feature of great importance to the central station manager.

The makers are manufacturing in large quantities to supply demands which come from all over the United States. A number of prominent dynamo building companies have adopted the above type to install with isolated plants for incandescent lighting and for power circuits.

Descriptive circular No. 420, recently issued by Queen & Company, contains further information of value and will be mailed upon application.

Queen & Company, Incorporated, Philadelphia, have sold nearly all the Ayrton and Perry ammeters and voltmeters which they advertised so extensively at reduced prices, but a few still remain which are offered at a mere fraction of the original manufacturing cost; for instance, an ammeter with capacity of 400 amperes being placed at $16.00.

Any one who wants a portable instrument for general testing, where great accuracy is not required, will find it very advantageous to purchase now, before the stock is entirely exhausted. Descriptive circular No. 355 will be mailed by the makers upon application.

The annual meeting of the stockholders of the Railway Equipment Company, Chicago, was held on Tuesday, 17th inst., and the report of General Manager W. R. Mason showed a most satisfactory state of affairs. The business of the company has been very greatly in excess of expectations and is daily increasing. The late devices brought out by the company have had an unprecedented sale and are being adopted throughout the entire country. Mr. Mason called attention to the need of further increasing the manufacturing facilities, and it is understood that a prominent capitalist has become interested in the company with the intention of still further increasing its business.

The *Street Railway Review* of Chicago has recently moved to more commodious quarters at 269 Dearborn street, its former offices having proved too small for the business of this enterprising journal.

The firm of O. F. Zurn & Company, Philadelphia, has been dissolved by mutual consent. The business of said firm will hereafter be conducted by the same parties and incorporated under the name of O. F. Zurn Company, who will assume all liabilities and receive all money due the old firm.

The Railway Equipment Company, Chicago, announces that the business of that company during the last season, especially in the Type G overhead material of their manufacture has been enormous. It has been impossible to fill orders promptly on account of this large and constantly increasing business, and arrangements have been made whereby their manufacturing facilities will be very largely increased at once, and they will be able to fill orders promptly in the future.

INCORPORATIONS.

An act has been introduced in the Maine Legislature to incorporate the Portland and Yarmouth Electric Railway Company to construct an electric street railway from some point on Congress street, Portland, between Elm and Washington streets, thence through certain other streets and over Turkey's bridge to Deering; thence through Falmouth and Yarmouth over Martin's Point bridge, if desired, to Yarmouth. The capital stock must not exceed $300,000. Many moneyed men of Portland are among the incorporators.

The Electrical Company, Omaha, Neb. Capital stock, $1,000,000, of which $100,000 is paid up. Incorporators: S. D. and G. W. Mercer, of Omaha; Charles Suter of St. Louis, and T. J. Evans and S. B. Wadsworth of Council Bluffs. The business is the supplying of electricity for power, heat and all the purposes to which it may be put.

The Automatic Telephone and Electric Company, Chicago. Capital stock, $250,000. Incorporators: J. R. Griffith, Victor C. Sanborn and Sidney Coolidge.

A new electric light company has been organized at Delta, York county, Pa., with these officers: President, J. F. Crawford; vice-president, E. L. Ramsay; secretary, J. Egbert Smith; treasurer, C. O. McConkey.

Jenkintown Electric Railway Company, Jenkintown, Pa. Capital stock, $150.000. President, William Wharton, Jr., of Germantown, Pa. The line will be eight miles long.

The Lancaster and Terre Hill Electric Railway Company, Lancaster, Pa. Capital stock, $200.000. Directors: John D. Skiles, J. Hay Brown, W. W. Griest, John I. Hartman and A. B. Hassler. The proposed road will be eighteen miles in length, and will extend from the northern boundary of the city of Lancaster, where the Lancaster and Lititz turnpike road and the Lancaster and Ephrata turnpike road intersect to the village of Terre Hill, passing through the villages of Browntown, Farmersville and Martindale.

The Lancaster and Middletown Electric Railroad Company, Lancaster, Pa. Capital stock, $500.000. President, Luther S. Bent; directors: E. C. Felton, John Q. Denny, James Young, John A. Coyle, J. B. Long, W. M. Franklin, J. W. B. Bausman, M. D. H. Herr, B. J. McGrann, John D. Skiles and E. G. Smith.

The Electric Light and Power Company of Kennett Square, Pa., has applied for a charter of incorporation. It has a capital stock of $20,000, all of which is taken by eight persons, namely: Theo. Pennock, W. W. Gawthorp, J. M. Palmer, John M. Yeatman, D. W. Hutchinson, Horace W. Gawthrop, J. E. Worrall and Henry C. White. W. W. Gawthrop has been elected president, J. M. Palmer vice-president, and J. E. Worrall treasurer.

The North Kankakee Electric Light and Railway Company, at Kankakee, Ill., has increased its capital stock to $40,000.

The East St. Louis Belt Suburban Dummy or Electric Railway Company has filed articles of incorporation at Springfield, Ill. The principal office is to be at East St. Louis. Capital stock, $500,000. Incorporators and first board of directors: Louis Gross, James P. Slade, John W. Renshaw, M. F. Geary, Paul W. Abt, Henry Voss and W. H. Bennett. The company proposes to build the line from East St. Louis to East Carondolet, Kahokia, Brooklyn, Venice and Madison.

The Bridgeport (Conn.) Electric Light Company has increased its capital from $200,000 to $300,000, and the number of shares from 8,000 to 12,000.

The Carterville (Mo.) and Webb City Electric Railway Company. Capital stock, $100,000. The road is to extend from the twin cities to Carthage, ten miles.

Buffalo and Tonawanda Electric Railway Company. Capital stock, $100.000. Directors: Frederick Swift, Charles A. Lebritter, Wendell Goodwin and L. O. Mey of New York; W. P. Whitlock, of Elizabeth, N. J.; G. H. Wirth, of Brooklyn; Francis Gilbert, of East Orange, N. J.; and W. Caryl Ely and Frank A. Dudley, of Niagara Falls. Its business is to maintain and operate a street railroad from the Military Road at the northerly city line of Buffalo to Sweeney street in North Tonawanda.

The Illinois Electrical Forging Company, Pullman, Ill. Capital stock, $2,000,000. Incorporators: Walter G. Campbell, John P. Skinner and Thomas Crafty. The business of the company is to manufacture tools, rails and miscellaneous articles, the forging being accomplished by electricity.

The Lancaster and Manheim Electric Railway Company, Lancaster, Pa. Capital stock, $250,000. President, John A. Coyle; directors, Dr. M. L. Herr, Jacob B. Long, Walter M. Franklin and J. W. B. Bausman, of Lancaster. The company was chartered to build an electric railway from North Prince street, Lancaster, to Manheim borough.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JANUARY 17, 1893

ELECTRIC RAILWAYS AND APPLIANCES.

489,944. Electric Railway Switch. August C. Goetz, Milwaukee, Wis. Filed Sept. 27, 1892.

489,972. Electric Car Brake. Andrew C. Miller, Auburn, N. Y. Filed Nov. 30, 1891. Renewed Aug. 17, 1892.

490,028. Trolley. John C. Love, Chicago, Ill., assignor to the Love Electric Traction Company, same place. Filed May 17, 1892.

490,248. Electric Railway System. Thomas Harris, Detroit, Mich., assignor to the Harris Electrical Propulsion Company, Limited, same place. Filed Dec. 28, 1891.

DYNAMOS AND MOTORS.

490,081. Commutator Brush and Holder. James F. McLaughlin, Philadelphia, Pa. Filed March 31, 1890.

490,183. Commutator Brush. Carl O. C. Billberg, Philadelphia, Pa. Filed Sept. 20, 1890.

TELEPHONE AND TELEGRAPH APPARATUS.

490,012. Electric Telemeter Transmitter. Fernando J. Dibble, Peabody, Mass. Filed Nov. 21, 1891.

490,013. Electric Telemeter Transmitter. Fernando J. Dibble, Peabody, Mass. Filed Nov. 21, 1891

490,014. Electric Telemeter System. Fernando J. Dibble, Peabody, Mass. Filed May 12, 1892.

490,064. Telegraphy and Telephony. Fred. H. Brown, Chicago, Ill., assignor, by mesne assignments, of one-fifth to the Brown Telephone and Telegraph Company, same place. Filed Feb. 27, 1891.

489,990. Telephone. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed June 1, 1888.

BATTERIES.

489,938. Electric Battery. John H. Davis, Detroit, Mich. Filed March 28, 1892.

490,231. Galvanic Battery. Noah M. Powell, Galesburg, Ill., assignor to the United States Burglar Alarm Company, same place. Filed Dec. 19, 1891.

490,254. Secondary Battery. Henry H. Lloyd, Philadelphia, Pa., assignor to the Electric Storage Battery Company, Gloucester City, N. J. Filed Aug. 30, 1892.

MISCELLANEOUS.

489,931. Pneumatic Dispatch or Transit System. Henry Clay, Philadelphia, Pa., assignor to the Electric Pneumatic Transit Company, same place. Filed Oct. 26, 1889.

489,932. Pneumatic Dispatch or Transit System. Henry Clay, Philadelphia, Pa., assignor to the Electric Pneumatic Transit Company, same place. Filed Oct. 26, 1889.

489,983. Electric Cut Out. William B. Potter, Lynn, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed July 5, 1892

490,011. Electric Meter. Fernando J. Dibble, Peabody, Mass. Filed Nov. 21, 1891.

490,034. Electric Heater. Thomas E. Morford, Minneapolis, Minn., assignor of one-half, by direct and mesne assignments, to the Enamel Insulator Company, of Illinois. Filed Dec. 19, 1890.

490,082. Electric Heater. James F. McLaughlin, Philadelphia, Pa. Filed April 28, 1892.

490,161. Electric Alarm Lock. Joseph A. Nadeau, Detroit, Mich. Filed Sept. 2, 1892.

490,178. Electric Circuit Breaker. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company of New York. Filed Oct. 28, 1892.

490,256. Electrically Heated Soldering Iron. George R. Meltzler, Cincinnati, Ohio, assignor of one-half to William H. Osborne, Prince's Bay, N. Y. Filed March 31, 1892.

EXTRA!

ELECTRICITY.

VOL. IV. NEW YORK. JANUARY 26, 1893. CHICAGO. No. 2

IS THE EDISON LAMP PATENT VOID?

STARTLING TESTIMONY INTRODUCED BY THE BEACON VACUUM PUMP AND ELECTRICAL COMPANY.

HENRY GOEBEL MADE HIGH RESISTANCE INCANDESCENT LAMPS WITH BAMBOO FILAMENTS NEARLY THIRTY YEARS PRIOR TO EDISON'S INVENTIONS.

Summary of Proceedings in United States Circuit Court, Boston.

In the issue of ELECTRICITY for January 25 we printed a very brief outline of the new evidence which had been offered at the first day's hearing in the matter of the application for an injunction by the General Electric Company against the Beacon Vacuum Pump and Electrical Company.

Anxious to place the latest news before our constituency at the earliest possible moment, we print herewith, as a supplement to our regular issue, the leading matters of interest which came up at this trial.

The new evidence produced was of startling importance, and while the case has not yet been decided, the best opinion of those present at the trial is that the Beacon Company have performed a real service to the public and to the trade in the thoroughness with which they have prepared their case in a very brief time, and in bringing out new evidence the utility of which will not be exhausted in the present case whatever the outcome.

Goebel's early work was not entirely unknown, but it remained for the present defendants to trace it out and place it before the court in an intelligent manner.

Plaintiff's were represented by Messrs. Clarence A. Seward, Benjamin F. Dyer, and Fred. P. Fish; and the defendants by Messrs. ——— Brandeis of Boston and Witter & Kenyon of New York.

Following is a summary of the proceedings, Goebel's affidavit being given in full but the remainder necessarily condensed :

Court convened at 11 A. M., Monday, January 23, but was adjourned for an hour upon request of Mr. Frederick P. Fish, that counsel for plaintiff might have an opportunity to look over the new matter which was to be introduced by defendants.

On reconvening, Mr. Fish said: "We have gone over the affidavits and find that the defence is : Anticipation, viz., constant and continuous manufacture of lamps from about the year 1850 to the time when a patent was first granted, such manufacture being known to many persons. We propose ourselves to prepare two affidavits in reply to those that the opposite side is to submit."

Mr. Fish was followed by Mr. Benj. F. Dyer, who made the opening argument for the plaintiff. Mr. Dyer said in introduction : "After sustaining our patent through protracted litigation extending over seven years against a defendant more strongly entrenched than those who appear to-day and with large capital invested, we come here to-day to ask for a preliminary injunction against a company which went into the business during the pendency of that litigation and was protected by the strong arm of the first defendant, and has been enabled to continue in business making lamps that infringe our patent without the slightest molestation.

"The first question of importance to be settled upon is the question of infringement. We claim that in the denial of infringement of the patent in the affidavits we have looked over the defendants' lamps are admittedly an infringement of our patent. Our affidavits show that the defendants' lamps are identical with other lamps that are being made elsewhere.

"In the suit against the United States Electric Light Company, which was the one we prosecuted first, all the questions involved were tried. The investigation was thorough. The defendants had unlimited means in hand and every question was discussed. The investigation included a complete history of the art and its publication to the world. They claimed prior use of the art, but we claimed that point ourselves. We had made a complete research into the subject as set forth by the Sawyer-Man Company, which testimony filled from 700 to 800 pages.

"What is the character of the testimony we have brought here in these affidavits?

"It is that for upwards of thirty years a German named Henry Goebel has been making these lamps in quantities ; has exhibited them on the street, being placed on a wagon for that purpose, and they were seen by many people. It seems to us this story cannot be true.

"As is known, we have all over the country local companies which have paid large sums of money for exclusive rights, yet these local companies have not yet enjoyed what they have paid for. We have been paid money and stock for these rights, yet have never been able to deliver those rights which form the basis of these contracts.

"I cannot but express my conviction that an injunction against this company is necessary to prevent irreparable injury to our company, and such an injunction will bring about a cessation of the manufacture that is now going on."

The court then adjourned until 2 P. M.

When the court re-assembled, at 2 o'clock, Mr. Dyer continued: "I omitted to call the attention of the court to a rule which is now well established for the orderly administration of justice in this country. It is this: Where a patent has been sustained after protracted litigation in which the court has been asked to grant an injunction on new evidence, the law leaves that for final decision. That principle is applicable to a case of this kind as where priority of use and manufacture is claimed. The Adams prior use proved in the former case rested on depositions which were not attacked. The facts were accepted by the complainants, and the argument proceeded. In that instance the circumstances surrounding Dr. Adams's work made it probable that he would do the very thing he did do.

"That matter was discussed and the court concluded that it was not an anticipation, but an abandoned experiment.

"One material fact developed in the record in that case probably led to that conclusion of the court. The publicity given Edison's invention, and the public interest in what he was attempting, were factors in the matter (the decisions in the Adams case). In the fall of 1878, it was stated that Edison had subdivided the electric light in an incandescent lamp. That was sent all over the world, causing a great fall in gas stocks. Scientists, electricians and experimenters came forward and discussed these questions, with the result that it was declared impossible to divide the electric light. Treatises on the subject were published in scientific journals. That discussion continued throughout 1879, and every report was received with great interest and was discussed in the public press and the scientific press. Everybody who ~~had done anything in the business had~~ his attention called to the fact that Edison had claimed to divide the new light. When he gave a description to the world, the preconceived opinions on this subject were so strong that the scientists criticised his lamp and said it could not be done. Until he had accomplished it, they would not believe it possible. That fact undoubtedly influenced the courts in every action. There are other facts which go to prove that the Goebel lamp was not so well known and so familiar to the public. In view of these statements we urge it upon your Honor that this is a case to which the argument of prior use should not be applied. It should be relegated to the final hearing for its trial."

ARGUMENT OF MR. WITTER—FOR DEFENDANTS.

"In view of the statements made to the court just before adjournment, I will not repeat them. I will simply say that in view of the rush with which we have been brought before this tribunal by our adversaries we shall ask for an opportunity of submitting a report that the court may have it, and we ask for time to prepare the same.

"Before touching upon the subject of the prior state of the art, I may say that the question of non-infringement by the defendant in view of the new or present state of the art, must not be forgotten.

"I will allude to some considerations submitted by our adversaries.

"In the first place there has been but one decision on this patent. There has been no more than one, and that was by the Circuit Court of Appeals in the case of Edison and the United States Electric Light Company. That court said in its decision—the decision of Judge Wallace—that the court is agreed with the state of the art presented to me. We are agreed that the conclusions brought against the Sawyer-Man Company could not be denied. The same set of facts obtained when this same company became identified with a Pittsburg company. The same might be said when in Connecticut a verdict was given against the Perkins Lamp Company. In its case the Mather Electric Company asked permission to go into court; but through some misunderstanding their counsel did not appear. Patent Counsel Mitchell attended in court to object to the argument used. But it will be set right sometime. In St. Louis and Chicago there was no objection raised against the case.

"The opposing counsel says that the proposal made by us does not appear relevant to the case. He knows that something has been discovered that will give an entirely new view to this patent case. With some slight feeling of resentment, I beg to say that we are not here to deceive the court on that point. These people here to-day are new defendants, represented by new counsel to present new evidence which they have discovered, evidence that will convince the court that the injunction ought not to be granted. My brother says it is not the custom of the court to listen to claims of prior use. When the counsel asked if prior use had been set up in the United States case, I say it was not set up. Our position in relation to the case is found on page 320 of the Report of the Norton Door Check trial. Here was a case of final hearing, in which prior use or prior patent was set up in the case, yet a verdict was given for the complainants.

If that case had been appealed to the Supreme Court of the United States and it had declared that it found an infringement, we should find no decision in the opinion of the court below. In the Norton suit another defendant, named Hall, came into the case and said: 'We find new evidence which we think ought to convince the court that the case was rendered definitely and you ought to withhold any such order.'

"Now, in the prosecution of our case we present many such cases as the foregoing. A little man ought to have the same protection as a great company. This is the keynote of our defence, something we have got that was not known to the defendants and so was not used in the previous cases. Upon that subject I may say when your Honor comes to understand the construction we put upon our case I think you will see that it is a construction which even Mr. Edison himself has approved. In the Circuit Court it was declared that we want to give Mr. Edison all the breadth of construction we can, notwithstanding the defendants' lamp filament is different from Mr. Edison's. The contention of Mr. Edison and the objection we shall make to it is that the filament is entirely different. It is a filament coiled upon itself and the patent is limited to that ~~filament and~~ not to the present state of the art of lamp making.

"This will be evidence enough for our case.

"My brother made it easy for the court to assume that Goebel, who made this invention before Edison, told Mr. Crosby all about what he had done in this prior use, a statement which is not borne out by facts.

"When Crosby went to view Mr. Goebel's work, he found the latter had made many filaments. That was in 1882, and he engaged Goebel to make lamp filaments in New York. This filament proved to be better, and the lamps too, than what were being made by Edison himself, and so he continued making them for the American Electric Manufacturing Company.

"It does not appear that the latter company was connected at that time with the other two companies of which we have heard to-day."

Judge Colt—Is it not extremely improbable that the defendants in New York should not have known, or did not bring, evidence forward to protect themselves?

Mr. Dyer—Suppose they had known it all, it is not pertinent to the case that they did not use the information they possessed. It is not pertinent that if they did know anything about the matter they should have been under any obligation to present it. Suppose they did suffer in consequence of their own neglect.

Judge Colt—Of course the Beacon Company is not to suffer, but suppose Goebel had made these lamps, does it not seem strange that he is found out and yet not brought forward by the parties in their defence?

Mr. Witter—I think we can prove to the court what the reasons were that Goebel has not been brought forward. I now refer to the Adams use, and state what was the distinction between the Adams and Goebel use. The plaintiffs say that Adams may have done something prior to 1869, though he apparently did nothing until 1879, when Edison made his invention. They state that Adams's use was not an anticipation of the Edison patent; that the filament was not then in discussion. They assert that everything that appeared in the state of the art prior to Edison's change of material from platinum to a rod is of importance. The difference in size is all important, and the claim is not in degree but in quality.

The problem of electric lighting is as important as many other things. The complainants assert that to build a lamp plant would cost from $150,000 to $2,000,000 under the present patent, while to make Adams's type of lamp would mean an outlay of something like $421,000,000.

There was no abandonment by Goebel. There were never six months that he did not make and show these lamps to somebody. As to the filament, there can be evidence produced to prove that it was a filament, being about 8-1000ths of an inch in diameter, while the Edison filament was 64-1000ths. Now we can produce just the things that Goebel made.

The distinction between Adams's and Goebel's work does not appear anywhere in the statement made, though it would appear as if Adams's men used the lamps he made, and yet my brother stated that Adams's use was parallel to Goebel's—was identically the same. When this case is finally tried, it will be seen where the distinction lies.

I now propose to take up briefly this patent of Edison's, and see how some of the things of which he complains apply in relation to the use of these patents. The object of this invention is to produce light by a high resistance. If Goebel produced it he is entitled to be credited with all the uses that were gotten out of the device, whether as a series or a multiple arc lamp. It has seemed at times as if the lamp possessed certain qualities, whereas the distinction was in the uses to which it could be put. The invention consists of a carbon wire arranged so as to afford great resistance to the current, yet at the same time give off great resistance.

When your honor refers to the drawing, you will see that it states that this is a rod to be used for the light. The invention consists in placing the same filament in a perfect vacuum to prevent oxydization or disintegration, and in a manner to secure perfect contact between the filament and the conductors,

There were then the following points to be noted:

A coiled filament.

A filament of high resistance.

There must be a nearly perfect vacuum.

~~A wire to connect~~ the ~~filament with~~ the leading-in wires.

In making these lamps the globes have been made entirely of one piece for one and the more general type, while another plan was to make it in two pieces which were secured together with cement, which proved not to be the best way of securing a perfect vacuum, and so making a lamp of commercial value.

We have been challenged by our opponents to make a globe in two pieces and so make it a practical useful lamp. We shall show a glass globe Goebel made, glass and nothing else. We shall show you that the filament was not a carbon filament but a rod.

The patent says that two leading-in wires have always been used, and efforts have been made to reduce the resistance of the carbon rod in some other way. The inventor says the disadvantage of following this plan of making the lamps cannot always be followed. He says the leading-in wires may be made so large that they become very expensive. Mr. Dyer says the patent does not refer to the conductors leading into the lamp, but the conductors of the socket only.

The use of gas in the receiver of an incandescent lamp at the atmospheric pressure serves to destroy all air washing or attrition of the passage of the gas, which disintegrates the filament. The Goebel lamp did not contain any gas, therefore it was not subject to those objections which enter into the Edison patent, or in any of his works. By reference to the testimony in the United States Courts, it will be seen that the filaments in Edison's experiments were unsuccessful and that the bamboo fibre used for filaments came later in the development of the art.

Because Edison accomplished so much, and because we do not find in the state of the art either the bent horseshoe shape or a spirally coiled filament, although in his patent a claim is made of a coiled filament, we are going to give him both, because the claim is for a carbon filament.

Goebel used a bamboo fibre and never used any one of those articles which appear in the specification, every one of which Edison and his assistants say were used.

I would now refer to the testimony of Edison and his witnesses on the particular point under dispute. By an examination I have made, Edison says he produced a carbon of high resistance. That is synonymous with a filamentary carbon. Whenever a filament is defined it is an article made of this or that substance, of sufficient resistance to produce incandescence and with resistance enough so that it may be kept at its proper illuminating point by a small current from any point. Edison claims to have made the carbon filament. Now it is not denied that a platinum wire as fine as you please had been used as the light-giving part of a lamp, but it is said when you get to the point of heating a platinum wire that it will give a suitable light you have reached the point when it may disappear and go out. It is then argued that it was an obvious thing to change from a filamentary rod to a carbon, which is the real invention of Edison. This may have been an obviously desirable change, but the change of material is not so obvious. Goebel used filamentary carbon in his lamps but of different shapes. This man does not speak much English. He never reads the newspapers, and when in various papers and magazines in 1879 so much was being written about Edison and his inventions, Goebel had no idea what was being talked about. He is a foreigner who has always lived in his own little circle in New York.

Of what Edison was doing he knew nothing until he connected himself with the American Electric Light Company, though he made his carbons at home and was never employed in their factory. This man was in business as an optician and watchmaker. He never seems to have interested himself with people outside his own relations and neighbors. In his affidavit, which I will now read, he states:

"I came to the United States in 1848 and settled in New York. My business in Germany was that of a watchmaker. I learned my trade at Springer in Germany. I formerly assisted Professor Moenighausen in making experiments in physics, among them being the making of light from electricity. I also made many instruments for use by teachers. We made experiments in electric lamps. Besides understanding how to make an electric arc, I believed a practical and useful light could be made by a carbon in a small globe. We perfectly understood the use of the common exhaust air pump, the use of the blowpipe, the manner of producing a vacuum by the use of mercury. We were frequently engaged in this kind of work. While I was still at Springer, before I came to the United States, in 1848, we used authracite coal for producing a light. The capacity for producing light by carbon is accomplished by being placed in a vacuum. We thus learned that this material was a suitable conductor. I also learned how to burn carbons by burning the wood inside the ferule of a broken walking-stick. This suggested to my mind how wood could be carbonized. I found that carbonized wood was a good conductor. I also made a magnetic machine for generating current. I used carbon for producing electric arcs. I found that incandescence could be produced by passing a current through a carbon after being placed in a vacuum. Professor Moenighausen had told me that these carbons when placed in a chamber from which the oxygen had been removed would burn steadily. At this time I became familiar with the fact that the co-efficients of platinum and glass were the same.

"I studied chemistry off and on for ten or twelve years. My father was a manufacturer of chocolate. I became familiar with persons moving in the higher ranks of society. I left Germany in 1848 and reached New York in 1849. First I lived at 391 Monroe street, then at 271 same street, next at 500½ Grand street, then at 468 Grand street. My name is Heinrich Goebel. Immediately on my arrival in New York I began my business. I have had and still have a thorough knowledge of the art of watchmaking. I always had an inventive turn of mind and have always been busy trying to make inventions and improvements. As soon as I got over here I began to work at my electrical devices. I exhibited an arc lamp on the roof of my house and soon had a fire engine around to put out the supposed fire. Soon after this I turned my attention to glow lamps, or incandescent lamps as they are now called. What I have done in that line I have always tried to carry out the idea of Professor Moenighausen, and used such material as I had in hand. The first incandescent lamp I made in the early fifties had its filament in the form of a fiddle bow or a meat-saw bow. These lamps are shown in the sketches herewith given. The matallic wires were directly fused into the glass, no cement being used in the lamps at all.

"The first lamps I made of this kind were made from cologne bottles and afterwards I made them from tube glass. I was living at the time in Monroe street, New York. I left that street in 1872.

"The next form of lamp I made was the hairpin lamp, from the shape of the carbon, the leading-in wires being sometimes made of iron, platinum, or copper. Sometimes I made them of other metals. As late as 1890 lamps with platinum leading-in wires were made. In the accompaniyng sketch the support (B) was first made of glass. This lamp I made as follows: The top (F) was first made and cut off. At A A the incandescent conductor having been heated it was placed in the tube (F). The glass cup or tube (D) was thin, the air being exhausted by a blowpipe. While working on this lamp I lived in Munroe Street, where I made many similar ones.

"I made from time to time many more of the fiddle-bow type. After gas was laid through Monroe street some of the employees of the gas company would sometimes come in to see my lamps burning. These men became so suspicious that I was stealing their company's gas that they insisted on going down into my cellar to investigate. I would not show them my battery and its connection with the lamps.

"When I went out of business in 1890 my possessions got scattered and with them about all my lamps, some of which I now know are in existence somewhere. I sometimes made the platinum wires into curious shapes. I then moved into Grand street. No six months ever elapsed during which I did not make and exhibit some of my electrical devices. In 1881 I was sent for by some one connected with the American Electric Light Company and made them carbons for a long time. All the incandescent lamps I made were fitted with carbons which I made from vegetable material. The carbons had a diameter of about 1-100th of an inch, and whenever I increased the resistance I found I had not a sufficient number of cells of battery to supply current for them.

"The reason why these lamps never came into commercial use at that time was really because there was not, at that time, an adequate source of electricity, the battery being unreliable then as now. The conductors I made were carbonized in crucibles and I used flax, black cane, tampico, a species of grass, and other materials. I built a furnace wherein my carbons could be properly carbonized. I even tried to use the lead from lead pencils, but found it was too earthy. In those early days I used to attach the ends of the wires to the filament proper, twisting them together. For sealing up the aperture that led into the lamp proper I used stove polish and found it to answer very well. My electrical current was produced by battery, and when in Monroe street I had a battery of 80 cells; it required so many to illuminate a single meat-saw lamp. From 1860 to 1880 I showed these lamps to my customers and friends. I gave away many of these lamps at different times. When I lived in Grand street in 1890, I had about twelve lamps. The lamps I exhibited in Monroe street attracted a large share of attention. I could make them very incandescent at times. When I found that a thick carbon was not so efficient as a thin one, I began to make the latter thin and with very gratifying results. About this time I built a large telescope and exhibited in Union Square and elsewhere. This was while I was living in Monroe street. When I got it where I wanted it to be, I made a small charge for looking through it. I had the telescope in a wagon and around the vehicle I hung a number of these lamps, current for which was supplied from a battery placed under the driver's seat. I sometimes took my son with me to assist me. One use of my lamp was to illuminate the face of a large case clock which stood in my own bedroom. I attached the wires to the mechanism of the clock, the circuit being made through the lamp. When the hours struck the current was turned on automatically, thus illuminating the face of the clock for a few moments. This was in practical operation for years. After removing from Grand street I fitted up another clock with a similar device. There was no time from 1861 to 1880 when I had not some lamps in hand to show my friends. I made no secret of their construction or any part of them. Prior to 1879 I made and used over one hundred lamps. I removed from Grand street in 1879. I made lamps of various sizes and gave them away to my friends. I never heard of a dynamo machine for lighting until I worked for the American Electric Light Company in 1882. I never heard of Edison until 1881 or 1882. I had to buy all the materials for my battery and lamps, which made it expensive for me. I did not hear or know that anybody had made or used an incandescent lamp. About that time I first heard of a dynamo machine for lighting purposes.

"I had never read in the newspapers for I cannot read. Until my engagement with the American Electric Light Company, I knew very little of what was doing. I never saw Edison; in fact, never knew his name. About the year I came to this country I made a vacuum pump which I have used from time to time. It was with some considerable difficulty I got this mercurial pump applicable for my lamps. When I heard of the Geisler pump I made one and was successful in exhausting my lamps; I then made a larger sized one. This was in June, 1882. I afterwards met Mr. Crosby; he was much interested in my lamps. I gave him some of them to try. He wanted me to go into the employ of his company. He allowed my son Adolph to work for them. He pressed me to make their carbons and I did so in my own workshop. For more than a year I made lamps of various kinds. The company furnished me with men to do the work while I attended to my own business. I recognize the Goebel lamps numbers 1, 2 and 3. They were made by me in Munroe street. I laid the gas into my house in that street, and immediately after I fitted up an apparatus for using my blowpipe. I used a double blow-pipe. I tried to work cologne bottles but it did not do, the glass was very brittle.

"Prior to 1867 I invented a hammer and attachment. This was attached by the Singer Company without any profit to myself."

Mr. Crosby's affidavit was then read, in which he detailed the manner of making the acquaintance of Henry Goebel. He first heard of the latter in 1880 and found him in his workshop in Grand street. Goebel told him that such lamps as he was then making he had made for years past. He gave Crosby some of his carbons to take away with him, and subsequently his company employed him to make carbons. His carbons were of very high resistance. Goebel's lamps proved to be very superior to the American Company's lamps. Mr. Crosby asserted that Goebel's knowledge of and familiarity with incandescent lamps greatly surprised him. As a former assistant of Mr. Edison's at Menlo Park, Mr. Crosby claimed to know a good deal about such lamps.

Mr. Witter then read the affidavits of John C. Goebel, son of Henry Goebel, which strongly supported in minute detail the statements made by Henry Goebel.

Affidavits were also read of Henry Goebel, Jr., another son of the inventor, H. Schenalenberg, John J. Benson, W. Newman, George Linden, W. Heghter, Thos. Brader, Sophia Stearns, daughter of Henry Goebel, Nicholas Finck, Jacob Fey, Julius Zoller, James F. Conerty, James Benson, J. Harrigan, Celeste West, W. W. Nykart, Elias Brush, H. McArthur, H. Vanrance and D. L. Foss. These various deponents testified that they had each and severally known Henry Goebel for many years, had seen him at work on his lamps, had seen them displayed on the wagon whereon his telescope was erected, had seen the lamps illuminating his clock, also show cases and work table in shop. Goebel, according to their statements, had kept working on from his first coming to this country to a few years ago, and they never knew him when he was not experimenting with these lamps.

A long affidavit, which included sketches of the lamps shown in court, together with a technical description of incandescent lamps, was read.

The testimony of Mr. Franklin L. Pope was then read. This evoked a discussion on the respective thicknesses and nature of various lamp filaments and the methods of their preparation and application.

Mr. Henry S. Kaliske, manager of the Beacon Vacuum Pump and Electrical Company, also testified by affidavit.

Professor Elihu Thomson deposed that he read of Henry Goebel being engaged to make carbons for the American Electric Company. He did not think there was much in the story of Goebel's inventions. In 1881 he visited Goebel's workshop and saw what was being done, but he (Thomson) could not be induced to believe in the commercial value of Goebel's inventions.

The affidavit of John E. Randall, lamp examiner for the General Electric Company, also of Mr. J. W. Howell, endorsed Prof. Thomson's opinion as to the value of Goebel's lamps.

Professor Charles R. Cross by affidavit deposed to the character of Goebel's lamps, pointing out their prominent features and enumerating the usefulness and value of such an early invention.

After the reading of the affidavit of Mr. L. E. Curtis, the court then adjourned until 10 A. M. Wednesday, with the understanding that the case should be closed that day.

The case was renewed at 10 A. M. Wednesday.

Mr. Kenyon, in behalf of the Beacon Vacuum Pump and Electrical Company, proceeded to consider an affidavit sworn to by Mr. Edison himself, in which that gentleman went over the history of the efforts that had been put forth in the accomplishment of producing an incandescent lamp; also describing the state of the art as it was in 1879, when Mr. Edison succeeded in making a filament that proved to be a commercial success by reason of the fact that it was of a high resistance and did not disintegrate. Mr. Kenyon could not concede that twenty-five witnesses could be mistaken in their opinion as to what they had all seen and were familiar with.

It might be urged that the story embodied was an improbable one, but that was not so.

The first argument against the improbability of the story was that it had not been brought up in any previous case. Mr. Curtis, an eminent lawyer, had asserted that he knew Goebel in 1882. His talk with that individual impressed him with the belief that Goebel was honest and truthful, and was confident of his invention, but Mr. Curtis drew the inference that Goebel's work had been abandoned after 1850. That was a wrong inference and Mr. Curtis had stated just how the misunderstanding arose and his explanation was a very plausible one. It was entirely owing to Goebel's imperfect knowledge of English, which fact also explained why Goebel had never heard of Edison and his patent until about two years after it was granted.

Coming to Prof. Thomson's affidavit it was shown that no criticism whatever was made by the deponent of the methods adopted by Goebel whether in the matter of a vacuum, the filament or the leading-in wires. Prof. Thomson would appear to have been interested in the lamps and the ingenuity displayed. Mr. Pope and Professor Charles R. Cross in their evidences, showed that they examined Goebel's lamps carefully and formed favorable opinions about them for the merits they appeared to possess.

Mr. Brandeis, on the same side, then called the court's attention to a point that had not been discussed, and that was the defendant was a company in good financial standing, doing a good business, not cutting down prices, in a position to bear the expenses it incurred. Capital had been invested, a large plant equipped, many hands employed, and were an injunction to be issued the company would be wronged, unless it could have a full hearing of its case, and that was just what they asked for and nothing more.

ARGUMENT OF MR. SEWARD.

Mr. Clarence Seward then addressed the court in behalf of the plaintiff company. He alluded to the litigation that had continued for seven years which had proved very expensive to his clients. It was a contract with the Government, this patent, and all that was sought was to secure a fulfilment of the contract.

In the case under discussion no attempt had been made to deny infringement, and therefore they were entitled to what they asked for.

Nothing had been brought forward to disprove Edison's right to his patent. It could be proved that even in 1845 a man named King had accomplished all that Goebel now claimed to have accomplished, so what was the value of the latter's work? The entire case as presented was simply the Sawyer-Man Company's case over again. But not only had King done so much in 1845 and given it to the world, other men in different countries also did much in the same direction. Even Sawyer and Man had laid claim to having invented an efficient incandescent lamp years before Edison made his discovery.

The evidence about the Goebel lamp was anything but convincing, and it was impossible to admit that such a device could ever have been made a commercial success.

Continuing after recess, Mr. Seward argued that no actual service had been performed by Goebel's lamps; they were only glow lamps. There was no evidence that they were uniform, no proof that they were 16 c. p. or any other c. p. The vacuum was not proved, and there was no evidence as to what Goebel's carbon was in any certain lamp. They could not be called filamentary; there were no filaments to show the court.

Mr. Witter showed some impatience here, and interrupted Mr. Seward to exhibit the three Goebel lamps which still retain their filaments; although broken, enough remained to show that they were not only filamentary carbons, but had been pronounced by good authority of high resistance.

Mr. Seward contended that Goebel's carbons must dave been much larger thirty years ago, and that they had grown smaller with age, that there was no evidence that these carbons were of over 25 to 30 ohms resistance, while Edison's lamps, to be practicable, had a resistance of 100 ohms and upwards.

Mr. Seward was followed by Mr. Frederick P. Fish, who spoke for about an hour, closing the plaintiff's case. Mr. Fish's argument was largely citations from the authorities.

No Restraining Order Granted.

At the close of Mr. Fish's remarks, Judge Colt, at the request of counsel for the defence, granted one week for the filing of briefs, and the printed affidavits in the case, leaving it open for both sides to hand in meantime, such additional affidavits, etc., as they may desire.

The result of this case was awaited with much interest by the trade throughout the country. The result is anything but satisfactory to the General Electric Company. Mr. Fish remarking at the close of the trial that he did not see how he could make any further move just now in other cases.

Among those present at the hearing were Messrs. Rothamel, of the Columbia Lamp Company; Barton, of Barton & Brown, Chicago; Wheelwright, counsel for the Germania Company; Curtis and Terry of the Westinghouse interest; Prof. Elihu Thomson; Paul G. Friedler, of the Boston Braid Company.

All the New York electrical journals were represented, the *Electrical World* by Messrs. N.W. Perry and —— Walters, ELECTRICITY by W. S. Key and B. E. Greene, and the *Electrical Engineer* by Mr. Geo. M. Phelps and Mr. A. C. Shaw.

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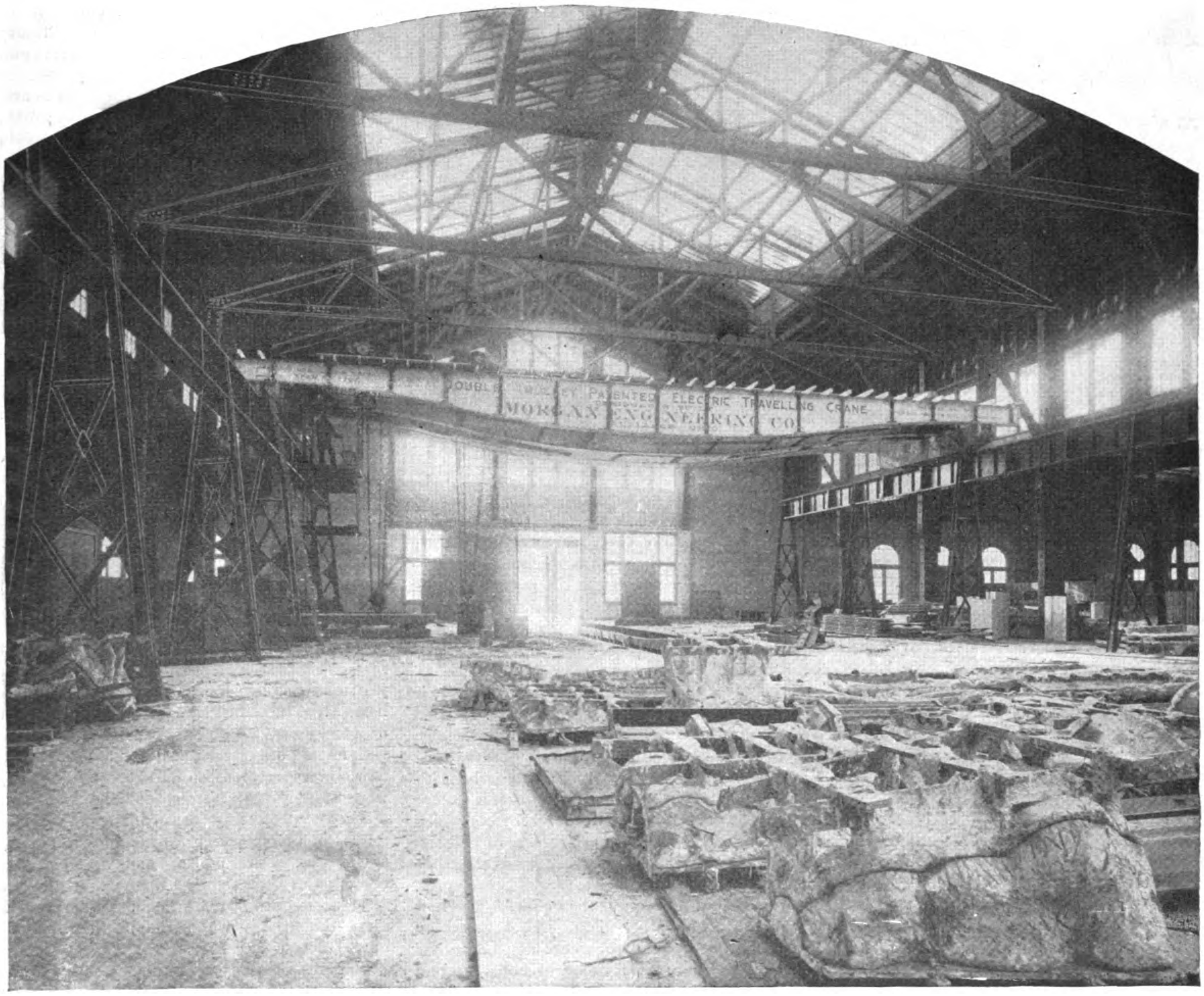
VOL. IV. NEW YORK. FEBRUARY 1, 1893. CHICAGO. No. 3



A MAMMOTH ELECTRIC CRANE. (SEE WORLD'S FAIR NEWS, PAGE 26.)

World's Fair News.

That the head of the Department of Machinery has made ample provision for unloading and handling the heavy machinery which will be on exhibition in Machinery Hall may be seen by the illustration of the electric crane shown in the Frontispiece. The crane is capable of lifting and transferring a weight of 40,000 pounds. The span between the two tracks is seventy-five feet, the tracks are mounted twenty-five feet above the floor and run the entire length of Machinery Hall and its annex, a distance of some 400 feet. Two of these cranes are now in operation handling the exhibits as they arrive at the building. The electric crane was designed and built by the Morgan Engineering Company of Alliance, Ohio.

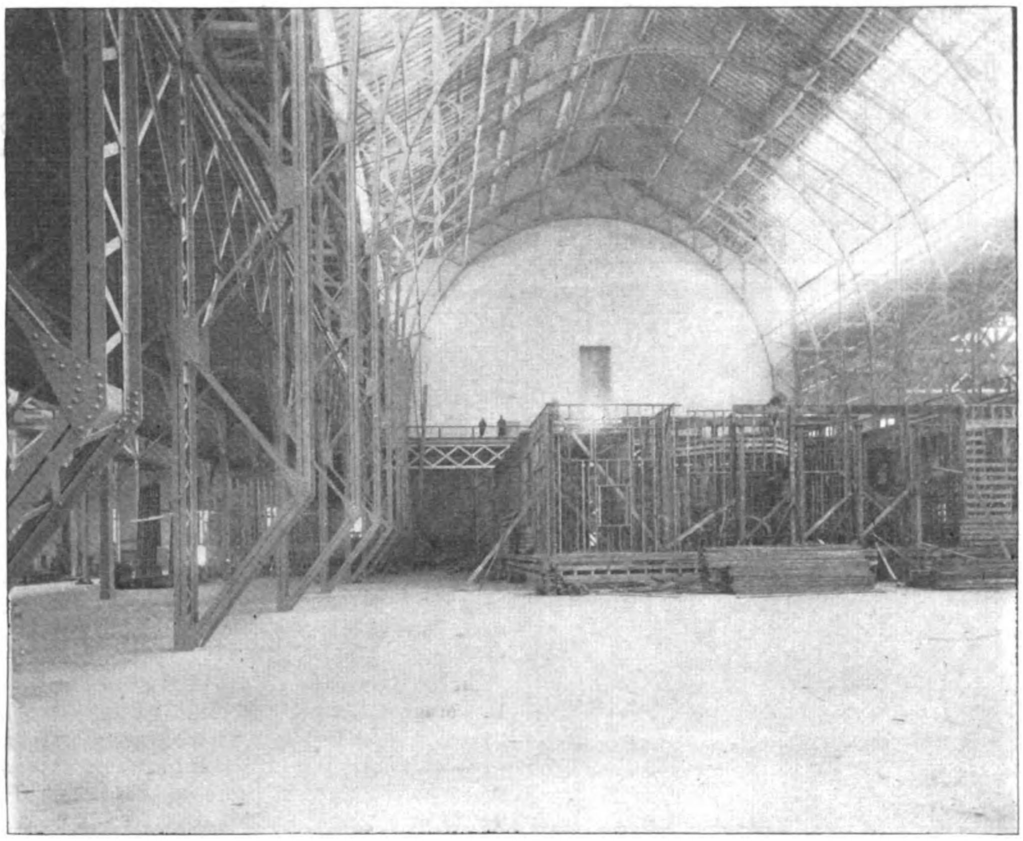


Fig. 1.

Fig. 1 shows a portion of the interior of the Electricity Building, and also the work that has been done by the Bell Telephone Company. This is the first booth that has been erected by any of the intending exhibitors. A portion of the space on the right is to be occupied by the Western Electric Company.

The report of the Committee on Ways and Means shows that out of the total of $3,500,000 revenue to be obtained from concessions granted the Intramural Railroad will yield $400,000. The electric launch privileges will return $75,000. It is thought by members of the committee that these estimates are very low, as the companies to whom concessions have been granted are obliged under their contract to pay a certain per cent. of their gross receipts to the Exposition treasury.

Proposals are advertised for by Director Burnham to furnish the electric light fixtures in the Administration Building. As these fixtures are to be of the very highest grade, there is expected to be considerable competition between the different companies who manufacture them.

The St. Louis Meeting.

Mr. James Cox, secretary of the St. Louis Autumnal Festivities Association, extends an invitation to newspaper men offering them the free use of the office of the Association during the Convention next month.

Electric Meters.

BY JOHN F. GILCHRIST.*

With the first appearance of electricity upon the markets of the world as a commercial commodity came the demand for an electricity meter. Business men were interested and enthusiastic over this new force which was attracting the attention of so many of their scientific brethren. They were anxious to see it developed and to assist in procuring the benefits which would result to the world, but when the time came to offer it to them as an article of commerce, something to assist them in their business and for which they must pay, they were none the less exacting. If electricity was on the market to be bought and sold as merchandise, there must be some way devised to measure it, or placing it in some tangible form so that it could be transferred from one to another for a price, so that buyers would know whether they were getting the full worth of their money or not. Here was a hard nut for the electrical men to crack—but crack it they must, for all the plans for doing business without a means of exact measurement were showing defects and proving unsatisfactory both to producer and consumer. A meter must be devised.

Naturally, in their labors in this direction their first thoughts were something like this: In what ways does this current make its force known which are subject to control and observation? By what facts can an idea of its force be estimated? It creates heat in conductors, it excites magnets, it decomposes water, and by combined chemical and mechanical application of this last law it will deposit metal from one plate or electrode to another. This last named action of the current, known as electrolysis, was the one with which it was most easy to experiment, and it was soon found that the quantity of metal deposited by a given current in a given time was constant, and that the amount of current was accurately measured by the weight of metal deposited. Here then was something to work on, and from which has come the electrolitic meter, a meter for continuous current of constant potential in which the amount of current passed is determined by the weight of metal deposited on small plates submerged in a metal solution by the electrolitic action of the current.

When the first experiments were made with the chemical meter the entire current to be used was conducted through the measuring bottles, but this was soon found to be not only impracticable but unnecessary, and a high resistance circuit of which the measuring bottle formed a part was connected in shunt with the main line so that only a small percentage of the current measured was conducted through the bottles.

Numerous experiments have proved that absolutely accurate measurements can be obtained even in cases of very small amounts of current by passing a 1-1000 of the entire current through the measuring bottles, and from that up to 1-14000 in the case of heavy currents.

In theory this might be carried out to infinity, and even in practice to a much smaller amount, if the most favorable conditions of operation could always be relied upon, but under ordinary conditions it is unsafe, for the obvious reason that any slight increase of resistance which may occur in the bottle shunt creates an error which is greatly magnified in the main circuit. This change referred to was made before the meter was put into practice, and no radical changes have been made since. With the exception of small details of construction intended to facilitate operation, the meter is the same to-day as when first brought out. All the patents on this meter are owned and controlled by the Edison Company, and its use is confined almost entirely to plants installed by this company; for this reason I will refer to it hereafter as the Edison meter.

The first Edison meters constructed were made of tin, shallow rectangular boxes designed to be fastened upon the wall. These boxes were provided with hinged doors, full size of one side of meter. The meter was divided by a shelf into two equal compartments. In the lower space were placed the heavy conductors extending from one side to the other of the space. The ends of these conductors were set in binding posts made to admit and secure the main circuit wires. To these binding posts the small wires of the shunt circuit were fastened. This smaller circuit included a resistance coil and the measuring bottles, the latter being connected in circuit by flexibles provided with binding posts at the loose end to be fastened to the rods of the electrodes in the bottles.

Operation proved that improvements could be made. The metal case, which demanded great care in insulation and which also proved too flimsy to stand the work, was discarded and a substantial wooden case somewhat larger took its place. The flexible connections for receiving the measuring bottles required too much time to adjust, and also had the bad habit of getting their heads together and short-circuiting the bottle, or worse yet, getting mixed with the opposite pole and putting out customers' lights, so that in these new meters metal clips or strips of spring copper were substituted, fastened to the back of the meter and projecting forward in a way which admitted of being sprung up and down, but rigid as regarded lateral motion, and were placed just far enough apart so that the ends of the bottle electrodes could be placed beneath them and thus close the circuit when the bottle itself stood upon the meter shelf.

The three-wire type of this meter is shown in this figure, being simply two two-wire meters placed in the same case, the two left hand bottles measuring the current of the upper outside wire and the two right hand measuring the lower one, the two bottles on one side being wired in multiple with each other, and the circuit thus formed in multiple with the main conductors.

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* Paper read before the Chicago Electric Club.

Thus you see the two bottles should read the same, one acting as a check upon the other. The resistants used in these meters are small coils of copper wire varying in resistance according to the size of the meters, or rather the size of the main conductors, so that the ratio of resistance of the bottle circuit to the resistance of the main circuit is the same in all sizes of meters, namely, as 1: 974. The measuring bottles, as you will see by illustration, as well as sample, resemble a patent fruit jar in appearance, having a glass cover provided with two small holes for the rods of electrodes and held in place by metal screw rings, while a rubber gasket and small corks fitting over the rods into the holes in the cover prevent the fluid from spilling or evaporating. Each bottle is equipped with a pair of plates or zincs, small rectangular pieces stamped out of ¼" metal and having a copper rod screwed into one end for the purpose of making contact. These plates are provided with small holes through which pass the rubber bolts which fasten the pair together, while small rubber fittings prevent their coming into actual contact with each other. The bottles are filled so that the zinc portion of the plates are entirely submerged with a light solution of zinc sulphate. These bottles and plates vary in size according to the amount of current they are designed to measure. The smallest ones are constructed to measure a three ampere current, holding a quarter of a pint of fluid and their plates having an electrolytic surface about ¾ square inch. From this they increase in pressure by geometrical progression, the largest bottles holding over a quart of fluid and weighing when prepared five pounds.

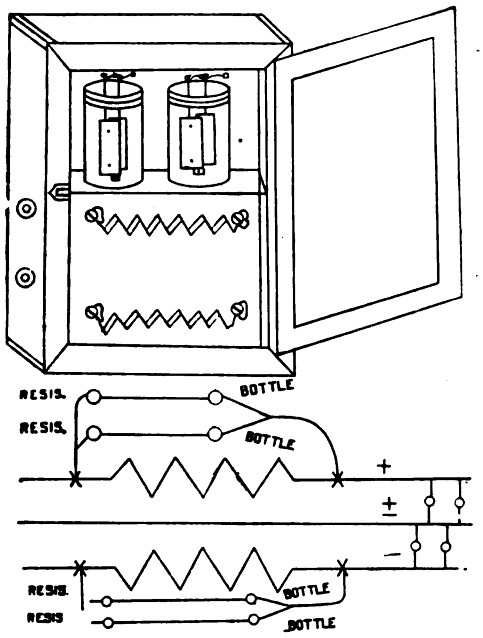

FIG. 1.

This is the meter which is most largely used by the Edison station to-day, and is very satisfactory with the single exception of being quite expensive to operate. The last meter brought out by the Edison people, known as the "Standard Meter," has still further lessened the labor of operation, and would be more generally used were it not for the fact that it is constructed to use a heavier solution, so that it is not wise to use it with the old meter when all are operated from the same room, as a chance for error is created by getting the solutions mixed. In this meter the bottles are placed in the lower part of the meter, which is an improvement over the old style for several reasons: the fluid from the broken bottle cannot drip into the zigzag of the main conductor and thus eat it out by the action of the current; there is less danger of the meter man making an accidental short circuit on the main wires if he is not obliged to reach up over them in changing bottles, and as meters are generally placed above a man's head they are easier to reach. But the change which most facilitates operation is the use of one size of bottles in all meters. This is accomplished by varying the ratio of resistance between the main circuit and the bottle shunt in the meters of different capacity.

Whereas in the smallest meter the ratio is that of 1223 : 1 and a deposit of 1 milligram on the plates means that one ampere hour of current has passed on the main wires, in the largest meters the ratio is that of 9784 : 1, and one milligram on the plates means that eight ampere hours of current have passed in main circuit, this of course requiring a different constant for each size of meter when figuring out bills.

In this meter the bottles are about the size and shape of a whiskey glass, and have a large cork instead of a glass cover and rings of the old style bottle, by which much labor is saved.

The plates also are something of a departure in size and shape. When this meter was brought out the confidence in the chemical meter had become so great, and the system of bottles in multiple used in checking showed so little variation from absolute accuracy that the second bottle in the smaller size of meter was deemed unnecessary and was discarded.

Aside from these changes the meter is the same as before, being made in about the same sizes and of the same material. In the Edison meter everything depends upon operation, and in order to operate well the first and greatest requirement is one which has not up to the present time been fully appreciated, namely, a spacious and commodious meter room, well provided with necessary apparatus and furniture, good light and all the red tape and system in the matter of handling that can be used.

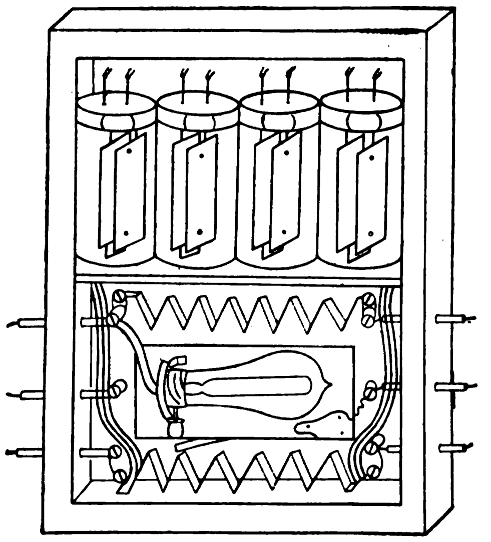

FIG. 2.

For the sake of getting an idea of the necessary work and care let us follow a set of meter bottles through the mill. The zinc plates are first ground in order to clean and brighten the surface. For this a sand paper is used, run by a motor, then the tops and joints between the plates and rods are carefully painted with asphalt varnish to protect the paint from the action of the mercury. After grinding and painting the plates are amalgamated, then brushed off carefully with a stiff nail-brush, or better yet, a revolving brush, and placed in racks to dry over night.

When the mercury is thoroughly dry the plate is found to be covered with crystals of mercury. These must be removed before weighing. This is done by polishing them on a scratch wheel or steel buff, which removes the crystals and leaves a clean smooth surface. The plates are then wiped off with a clean crash towel to remove dust and particles of mercury, and are turned over to the scale man to be weighed.

The scales used for weighing plates are the finest assayer's balances, laboratory style, and will weigh to 1-10th of a milligram. Here the plates are weighed, each one having attached a tag bearing the name of the consumer, the weight of the plate and a letter designating the position of the bottle in the meeting; only one plate in each bottle is weighed. The plates are then made up, that is, fastened together by rubber bolts, placed in the bottles which are filled with fluid and the covers adjusted, no small part of the work; the bottles sorted into sets, and placed in carrying cases, ready to be carried out to the meters. In putting the bottles into the meters the only care necessary is to see that good contact is made between rod and clip, and that the bottle is so placed that the weighed plate in each bottle shall come under the positive pole, and thus become the losing plate. This is really immaterial, as the theory that one plate gains the exact amount that the other loses is well borne out in practice; but it is well to have some system, and in occasional cases where the deposit is not firm, having been deposited very rapidly, it is better to have the positive plate, as nothing but current will loosen the firm new zinc of the losing plate, while the crystals of the gaining plate may be removed by abrasion due to careless handling. The new bottles having been put in place, and the meter resealed, the old bottles taken from meter go into the case, are returned to the meter room, knocked down, that is, plates removed from bottles and taken apart, and are put into racks to dry. When dry, plates are again weighed, the weight being entered upon customer's record directly beneath the weight of same plate when it left the meter room the previous month; then, having accomplished their mission, they are sent to the grinding room to go through the same form for some other meter the following month. Meter plates in ordinary use will last from six to eight months, when they become thin and small and go to the scrap pile.

Between the losses of plate from multiple bottles an average is taken and from this the bill is easily figured, using for convenience a previously figured constant. The action which takes place between plates when current is passed through bottle, and upon which the entire system is based, is the same as that employed in electroplating. As we say in explaining to customers, it is a chemical action which amounts practically to deposit of metal from one plate to the next. The exact action is this: a molecule of zinc sulphate solution is decomposed at the negative electrode; the zinc in the molecule immediately adheres to the zinc plate, while the other elements seize

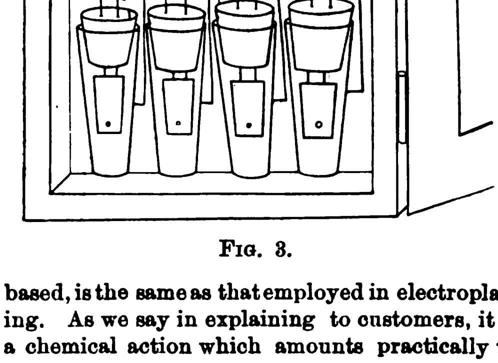

FIG. 3.

upon the zinc of the molecule behind and toward the other plate and form a new molecule; this action keeps up throughout the distance from one plate to the other until the freed element of the lost molecule seizes upon an atom of zinc from the positive plate, and the chain is complete.

This action is very slow and of course entirely invisible, but extremely sure. Occasional cases will occur when, on account of overloading, the deposit will not be good, but they are safe and are taken care of by the use of the second bottle. This is the whole of the Edison Meter System.

The meter stands upon its own merits; it is more largely used to-day than any other meter; its accuracy is unquestioned, and the fact that it is somewhat cumbrous is the only fault that can be found in it by any one who will take the trouble to familiarize himself with it, and this to the practical man resolves itself immediately into a question of dollars and cents, and when results are taken into consideration it is a very cheap meter to operate. It has great advantage over other meters in the matter of first cost, and it will stand wear and tear and rough usage very well, while damp cellars and an occasional shower bath do not affect its accuracy. There is nothing about it to get out of order, and repairs amount to nothing, while the double check system and the matter of starting fresh each month act as detectives to immediately locate any error or defection in reading.

This is only a brief outline of the construction and working of this admirable meter, but I hope it will open the way for thoughts and questions in answer, to which you will find more entertainment and instruction than in the paper itself.

Must Sell Lamps.

Chicago Edison Company Strikes a Snag.

Chicago, January 28.—The Chicago Edison Company as a lessee of the Trust has taken it upon its shoulders to stop all sales of lamps in Cook County, which it claims as its territory. In the injunction suit against the Sunbeam Lamp Company, which has been postponed till February 20, a new feature has developed. The National Electrical Construction Company interjected a plea to become a party in the suit, as it was previously to the granting of the injunction a customer of the Sunbeam Company, and under the present decision it claims that it has been unable to buy any lamps for its circuits.

The trial has consumed the greater portion of Judge Grosscup's time for the last week. After Attorneys F. W. Parker for the National Electric Construction Company and W. G. Beale for the General Electric Company had made their arguments before the court, and considerable quibbling on minor points, the Judge ruled that the Chicago Edison Company as agent of the General Electric Company would be obliged to furnish the National Electric Construction Company all the lamps necessary to supply its customers, and at a price not to exceed forty-two cents per lamp. The complainants in the case claim that the decision is all they asked for, and the verdict is a decided victory for the users of incandescent lamps.

Manager Tebbets of the Chicago office of the Westinghouse Electric and Manufacturing Company had the pleasure of exhibiting a number of the new lamps to the many customers who called during last week to inquire into the truth of the General Electric Company's statements regarding the incandescent lamp situation. Those who called at the Western office of the Westinghouse Company saw ample proof that the new incandescent lamp was a reality.

The Chicago office expects to receive a consignment of 10,000 lamps the latter part of next week.

Discussion of the Paper on Micanite Read Before the American Institute of Electrical Engineers.

Mr. Hammer—We have seen what seems to be a most important advance in the art of armature insulation, which, while it may be new to many, has, I understand, been thoroughly tested, endorsed and adopted by the largest electrical company in this country.

Mr. Thompson very truthfully remarks "that change of volume has caused nine-tenths of the armature breakdowns." This change of volume has been mainly due to mechanical strains and heat.

Moisture by lowering the insulation between adjacent coils, framework and coils, commutator and shaft, etc., causes grounds and short-circuits followed by overload, charring and burning of insulation and disastrous results; besides this, the swelling of substances used upon the armature which absorb moisture create serious mechanical difficulties, such as bursting of wire bands, chafing against field magnets, putting armature out of balance, etc.

Increasing the speed involves increase of mechanical difficulties due to centrifugal force, which strains connections at commutator bars, lugs and radial bars, endangers the insulation of overlapping coils at ends of the armature, and strains the bands.

From the foregoing it is self-evident that it is of paramount importance in armature construction that materials be employed possessing strength, rigidity, excellent qualities to resist heat and moisture, and to the highest degree insulators of electricity. These qualities, experience has shown us mica possesses perhaps to a greater degree than any substance known, and apparently the inventors of the process which has resulted in the remarkable samples we see here to-night have by using "scrap mica" silenced the objections to its extensive use on account of its price, and by the methods of manufacture, enabling them to form this refractory material into almost any shape, have very greatly enlarged mica's sphere of usefulness and conferred a great benefit upon the electrical profession and the world at large. It would be interesting to know the specific inductive capacity and specific resistance of the micanite or combination of mica and shellac.

Fleming Jenkins gives the specific inductive capacity of mica as compared with air as 5, while that of gum lac or shellac is as low as 1.95.

Gordon and Silow give shellac a value as compared with air of 2.74. Mica not given.

Culley gives shellac fourth place in the list of materials of highest resistance and lowest conductivity, rating dry air first, ebonite second and paraffin third.

Munroe and Jamieson give the same rating excepting in case of certain kinds of glass, which they rank as second.

Ayrton and Perry give the approximate specific resistance of shellac after several minutes' electrification as over 100 times that of mica.

Extension of alternate current practice, and use of high potentials, especially in power transmission work, gives a far greater importance to insulating substances, such as are here shown, and they should meet with an extensive application.

Besides its application to dynamo and motor work, there are other fields of great importance, such as in the construction of alternate current transformers, this method admitting of the forming of the insulating substance for separating the high and low potential coils, insulating the core and encasing the high potential leading-in wires, and in the construction of direct current motor transformers, which I look to as developing a large field in this country, this material should find an extensive application in insulating the high and low potential wires in the armature.

In physical apparatus, such as induction coils of large power, the problem of insulation is of vital importance. It is interesting to observe that the largest two coils ever made in the world, the Apps or Spottiswood coil in England and the Wallace coil of this country, have both been pierced, due to insufficient insulation at the high potentials employed, notwithstanding the great care in manufacture. I have here a photograph of the great Wallace coil, made by William Wallace of Ansonia, Conn., in 1869-70, which gave a spark 27 inches in length.

Mr. Thompson refers to the use of micanite in long tubes aboard ship and in general interior conduit installations. I should like to learn if it can be made cheaply enough in this form to fill such requirements.

Mr. Thompson—As to interior insulation for shops and houses, a micanite tube, I suppose, would be used in the most important places, as through partitions, if too expensive to use generally. I simply mentioned that as a possible use of it. The principal object in bringing the tubes before the meeting was to show in what curious forms the substance could be produced, the tube being probably the most difficult one, natural mica being never known in a tubular form. In ships its cost would not prevent its use, because so superior to cheaper insulators. The *best* should be employed in ships, regardless of cost.

Mr. Chas. P. Steinmetz—We have listened to-night and at the last meeting to some very interesting statements regarding that quantity which is called electrical resistance—not the resistance offered to the currents flowing in our electric circuits which we want as low as possible, but that resistance which hinders the escape of current from our circuits, which resistance we want as high as possible; that is, in other words, the insulation resistance. I have given the problem of electric insulation a good deal of attention also in the last year, and have made quite a number of tests which I hope to be able at a future meeting to report more fully.

My experience, however, has led me to an opinion somewhat different from that generally expressed. *I believe very little in insulation resistance.* It is a very nice thing indeed—on paper—to read that the insulation resistance of a a machine is twenty or thirty megohms, or even higher. But when you have determined the insulation resistance in the usual way, by the deflection of the galvanometer using a storage battery of say 100 volts, and then starting the machine, relying upon the "insulating resistance" of 30 megohms, it is not so nice upon breaking the circuit for the first time to see the inductive discharge from the series field break clear through your 30 megohms, reducing the insulating resistance to nil and burning out the armature, while, on the other hand, the insulation resistance of the machine may be suspiciously low, only a few hundred thousands of ohms, and still the machine may run continuously for years and years under all conditions of bad and over load, without breaking down, nay, getting better all the time, the more the insulating material dries by the heat developed in the machine.

What we want is to insulate the electric circuits of the machine so that the machine will stand and work without breakdown under all conditions of usage and as long as air, which is the *poorest* insulation, that is, which breaks down easiest, has an *infinite* electric resistance, while just the *best* insulating materials — best in "disruptive strength," that is, standing electric stresses without giving way—as mica, have a comparatively *low* electric resistance, the insulating resistance gives us no indication as to the reliability of the insulation of the machine. To see this more plainly, let us examine the behavior of different insulating materials.

Take, for instance, two plates, put them against each other at a distance of say one-tenth of a millimeter, that is, 1.250 of an inch of air between them. Now, measure the resistance at say 100 volts difference of potential between the plates. It is infinitely high. For I do not think anybody ever measured the true resistance of air and found any other result than infinite. Now raise the potential difference between the plates to 500 volts. A spark will pass across the gap and this insulating resistance which a moment before was infinite is now reduced to nil; it has broken down. Now replace the air-gap by a piece of dry fibre of the same thickness, and measure again the insulating resistance in the usual way. You will find the resistance measurable, hence infinitely smaller than the resistance of your air-gap. Still you may raise the potential to 500 or to 1,000 volts, and the fibre will stand the pressure. It will break down under a stress of about 1,300 volts. Now replace the fibre sheet with a sheet of mica. The resistance is very much smaller than the resistance of the fibre, to say nothing of the air. But you may raise the difference of potential at the terminals to 10,000 or 20,000 volts and the mica sheet will stand. The electricity will rush out from the terminal plates upon the mica sheet in long, glowing streamers, beating against the mica with a hissing noise, and forming a broad, electrostatic aurora of violet light, and still the mica will not break down. This is the property we want, but this disruptive strength has nothing to do with insulation resistance. On the contrary, those insulating materials which have the highest resistance, like air, just happen to have the lowest disruptive strength, while those materials which are relatively inferior in insulating resistance, like mica, stand electric stress best. I have never found another material which will stand such enormous electrostatic stress, for the same thickness, as mica will stand, and still its resistance is comparatively low. The consequence, therefore, is, if we insulate a machine or any other apparatus, the measured insulating resistance will say nothing to us about the disruptive strength of the machine. There may be, perhaps, two bare wires almost touching each other, with a thin film of air between; a galvanometer test will show a resistance of heaven knows how many megohms, and still the machine will break down instantly, while you may insulate this whole machine with, say ordinary fibre or mica, and you will find—if the fibre is a little damp—perhaps only a few hundred thousands of ohms resistance; still the longer the machine runs, the higher its resistance becomes, and the better the machine gets, and it will not break down. So a very high insulating resistance is not a measure of the reliability of the machine against breakdowns. If we consider it from this point of view, we may learn something even from the civil engineer, though we generally boast—properly—that we are farthest advanced in exactness of methods. When the civil engineer wants to build a bridge, for instance, he does not measure the elongation of a test piece of the iron to be used by a micrometer, but he loads it until it breaks, and then determines the breaking strain, and thereupon bases his calculations.

Resistance tests will not show how safe the machine is. But it will show if we connect the copper part to one terminal and the iron part to the other terminal of a circuit carrying a potential of 3,000 volts and then see the machine not broken down. The megohms might be all right—the fire underwriters occasionally require them. But otherwise it is safer to test by applying a higher potential than the machine has to carry. Because if an insulation stands a potential of 3,000 volts we are sure it will stand a potential of 500 volts. But then there are other points to consider in insulation—the mechanical behavior of insulating materials. While mica has enormous strength against breakdowns, the least kink in a mica sheet, the least bend, will reduce the strength enormously, and while a single sheet of mica will stand enormous potential, simply bend it over a couple of times—you hardly see any kink—still it breaks down at a much smaller potential. But still it is very much better than air or even dry fibre.

Furthermore, you have to consider how the insulating material behaves not only against heat but against electric arcking, because in many cases, for instance at the commutator or the breaking-switch, you want insulating material which is fire proof and keeps up its insulating qualities against the electric arc. All organic compounds are not fire proof and consequently not fit for places where the electric arc strikes. Take any one of these mixed compounds, even micanite, put it between the discharge plates and raise the potential difference until a spark, followed by the arc, strikes across—it is set on fire. Micanite may stand the heat of the armature all right where the spark does not touch it. The temperature may rise several hundreds of degrees, so that the micanite gets black, the cement is charred, and it will continue to insulate, but still the arc will set it on fire. While if you take a sheet of genuine mica and let the arc strike across, along the edges of the mica sheet, the arc simply melts the mica down farther and farther, but it cannot set it on fire. Most of the other organic compounds are very much worse indeed, because they are set on fire by the least arc, some even with a kind of explosion. This is another point to be considered.

Hence we must make up our minds that there is no insulating material which is fit for every purpose; that each insulating material has its special application; what is very good for one case is not good for another. So for places where arcking is to be expected, as on commutators or switches, I do not think that we can ever get anything better than genuine mica, or asbestos paper, or soapstone, porcelain, or any other mineral compound. In all places, where not exposed to arcking, mixed organic compounds will be very good. The disruptive charge will not pass through micanite at even more than moderate potential. It is not as strong as genuine mica—perhaps not more than one-half or one-quarter as strong, but even then far superior to any other similar material. In other cases ordinary dry fibre is a very good insulating material; it has come into discredit more than it deserves, because it gets damp, and when it gets damp it no longer insulates, but in places where it cannot get damp, especially where it is kept slightly warm, it is a very reliable material and has a much higher value than is often supposed. Again, where very high insulating resistance is required, as in electrostatic apparatus, there is paraffin and hard rubber, which surpass, I believe, all materials except air. So we have to find out which insulating material is the best for a particular use; there is no insulating material which is good for every purpose.

Mr. A. E. Kennelly—I would like to say, in reference to the subject last mentioned, that the value of a material like micanite does not seem to lie wholly in its insulating capabilities, but rather in the fact that enables us to employ in it a substance with say one-fourth of the resistance to electrostatic rupture that true mica has, at a far lesser cost; and it is surely better to have something which has a quarter of that capability and which is within your commercial means than to know that a substance exists having the full capability but which is so precious that you cannot use it at all. I think the paper is an interesting one, because it gives us a number of details which can only be gained by experience.

In regard to mixtures, I should think that any material which contained silicate of soda would be a suspicious one, for silicate of soda is not an insulator. It is, of course, a high resistance material, but it conducts quite appreciably.

CORRESPONDENCE.

NEW YORK, January 27, 1893.

To the Editor of ELECTRICITY:

You printed last week in your columns a letter from Mr. Stieringer, in which he terms my drawings of the electrical fountains at the World's Fair "a batch of unreliable news." While in Chicago recently I sketched carefully the situation of the fountains and the surrounding grounds. Before I disposed of my drawings, however, I received from Mr. Stieringer an order for a large birdseye view of the fountains. In order that I should have his drawing correct he showed me all the plans and drawings, and gave me a great many figures regarding them. I finished his drawing and subsequently corrected and finished my original with the aid of the information I had gained. Had I not seen Mr. Stieringer's plans I might have assumed that with him in charge of the fountains an exact copy of what had been done by others in the past would represent his work and have had a fairly good idea of what I was doing.

Respectfully yours,
R. F. OUTCAULT.

The Pulse of the People.

A Sample Letter.

ELECTRICITY NEWSPAPER CO.,
6 Park Place, New York.

Gentlemen: Inclosed find P. O. order for $2.50, amount of my subscription in your bill, also enclosed, which you can return to me receipted. I take much interest in paying this with the hope that it may encourage you to fight the Trust that all of us central stations are beginning to feel so seriously. Yours respectfully,

D.

From a Dynamo Builder.

B. E. GREENE, Publisher ELECTRICITY:

DEAR SIR: We wish to say to you, in view of the *Electrical World*, *Engineer* and *Electrician* being wholly subsidized by certain manufacturing concerns, they are practically worthless to men who are in this business in a smaller way. We have been in business since Sept., '88, and have done very well.

We have frequently asked the editors of the above named papers for information on some points not well understood by us. They always professed ignorance. L. H. J.

Personal.

Mr. James W. Godfrey, of the New York Insulated Wire Company, left for Chicago on Saturday, where he will remain for several weeks looking after the company's construction work on the World's Fair buildings.

No Jobbers Need Apply.

The following is a copy of a circular letter mailed to supply houses throughout the country which explains itself. When the "actual users" apply, they will doubtless be required to prove that their dynamos are of the proper brand:

GENERAL ELECTRIC COMPANY.
44 Broad st., New York.
620 Atlantic Ave., Boston.

New York, Jan. 21, 1893.

Your are hereby respectfully notified that until further notice orders for incandescent lamps will be filled by us only when coming from actual users of the lamps.

Yours very truly,
CHAS. T. HUGHES,
District Manager.

The Prizes Awarded.

Two Former Editors of "Electricity" are Winners.

CHICAGO, January 28.—The three cash prizes of $100, $50, and $25, offered by *World's Fair Electrical Engineering* for the best three essays in answer to the question, "How can the Department of Electricity of the World's Columbian Exposition best serve the electrical interests?" have been awarded respectively to Herbert Laws Webb and Nelson W. Perry of New York City, and W. Clyde Jones of Chicago.

His Decorations are Gone.

PARIS, January 28.—A decree is officially published announcing the removal of the name of Dr. Cornelius Herz from the roll of the Legion of Honor.

Fundamental Patents Sold.

The Green trolley patents, owned by Mr. O. S. Kelley, of Springfield, Ohio, are reported to have been sold to the General Electric Company for a sum amounting to several hundred thousand dollars.

The patents of Green are among the earliest taken out on electric railways and claim to be fundamental. They were prosecuted in the Patent Office and the courts for a number of years, and previous to this sale were owned outright by Mr. Kelley.

Who Will Get It?

A Handsome Contract for Some One?

The Cataract Construction Company award a most important contract next month. It will be for the construction of dynamos of 5,000 horse power, the largest ever built, and also for a system of transmitting the power from the generating station at Niagara Falls to the place of use with small loss of power.

Five electrical companies—three foreign and two domestic—have entered in competition. These are the Oerlikon Electrical Company of Zurich, Brown, Boverie & Co. of Baden, Compagnie de l'Industry Electrique of Geneve, the General Electric Company of New York, and the Westinghouse Electric and Manufacturing Company of Pittsburg.

All these have submitted plans, designs and miniature plants for the inspection of the Cataract Company. These designs will be finally passed upon by Prof. George Forbes, of London, England, the electrical expert of the company.

George A. Scott.

The late George Augustus Scott, Superintendent of the Gold and Stock Telegraph Company, whose funeral took place on Tuesday of last week, was a prominent electrician. A native of Canada, he came to New York some years ago. In the study of his profession he visited France, Italy and Germany, and while at Berlin gained a thorough knowledge of the dynamo from its inventor, the late Dr. W. Siemens. At the time of his death Mr. Scott was electrician of the Interior Conduit and Insulation Company in New York.

ELECTRICITY.

The Popular Electrical Journal.

GEORGE R. METCALFE, - - - EDITOR.
R. H. WILLOUGHBY, - - ASSOCIATE EDITOR.

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As ELECTRICITY reaches all classes interested in electrical work, its value as an advertising medium can be readily appreciated. Rates will be sent on application.

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"Electricity," under its present ownership, has never solicited the advertising patronage of the General Electric Company.

The Incandescent Lamp Situation.

The sensation of the hour among electrical men continues to be the startling evidence introduced by the Beacon Company in answer to the application for an injunction by the General Electric Company, of which a complete synopsis was published exclusively by ELECTRICITY in a supplement issued on the morning following the close of the trial.

The claim of anticipation by Goebel which was set up by the defendants was a well-directed attack on the validity of the Edison patent, and unlike former attempts to prove priority of invention by Weston, Sawyer & Man, Brush and others whose work was contemporaneous with Edison's, Goebel's work was so far in advance of these others—and this fact was supported by numerous affidavits—that the chief argument in rebuttal of this point attempted by the plaintiff's attorneys was to express the conviction that the story could not be true for the reason that it had not been offered in evidence during the previous litigation over the patent.

The affidavits of Goebel and those who witnessed his experiments, together with the lamps exhibited which were made by him thirty years ago, lend an aspect to this case different from that of any of the previous ones, and present the strongest defence that has ever been offered in opposition to Edison's claims.

It must be remembered, however, that the burden of proof lies with the defendants, and the patent holds good unless absolute proof of priority of invention is established. In case Goebel's affidavit can be sustained by conclusive evidence, there would be little doubt as to the outcome of the suit, as the lamps exhibited by him conform with remarkable accuracy to the second claim of the Edison patent, which is the one upheld by the Court of Appeals.

This court says the claim may be paraphrased thus: "A combination of three elements, consisting of a tube or tubes, a carbon filament in a glass receiver and conductors passing through said glass receiver."

A reference to the diagram of the Goebel lamp given in the last number of ELECTRICITY will show a striking illustration of this claim.

There can be no question but that the proof of Goebel's invention of the incandescent lamp will be found a most difficult task, as every reasonable doubt must resolve in favor of the patent. A preponderance of evidence is not sufficient to overthrow a patent. The proof must be absolute.

The defense as presented by the Beacon Company appears to have been sufficient, however, to demoralize the plaintiff's attorneys, as their answers to many of the points submitted by the defendants seem to be vague enough to be classed as humorous.

Mr. Seward submitted that the Goebel lamps did not perform any actual service; that they were only glow lamps; and the affidavit of Mr. Goebel did not relate any instance of their actual use. Concerning this the courts have decided that novelty is negatived by prior knowledge and use in this country, even by a single person, of the thing patented. This rule applies even to cases where that knowledge and use were purposely kept secret; and it applies no matter how limited that use may have been.

Novelty is also negatived by the evidence that even one specimen of the thing patented was made in this country prior to the invention of the patentee, even though it was not used prior to that time, for the reason that patent laws do not contemplate rewarding inventors for producing articles which, while new to them, are known to other people. The use of his lamps by Goebel while exhibiting his telescope appears to constitute actual use.

It was also claimed that there was no evidence to show that Goebel's lamps were uniform, or that they were up to sixteen candle power, or any other candle power, and the vacuum in the bulb was not proved.

In regard to this there is no apparent reason why the lamps should be uniform, or why they should be equal to sixteen candle power, or to any other candle power, in order to constitute priority of invention. The Edison patent does not specify the candle power of the lamps for which the invention is claimed, and the fact that Goebel's lamp burned for any length of time would prove that the filament was in *vacuuo*, otherwise the filament would have been consumed at once, as will be shown by breaking the bulb of a lamp.

Mr. Seward further objected that there was no evidence to prove what Goebel's carbons were originally; that they were not filamentary, and only one carbon remained; that they would not resist disintegration, had grown smaller with age and use, and were merely abandoned curiosities and experiments,—all of which was pretty well refuted by the testimony and exhibits of the defendants.

As to what Goebel's carbons originally were, with respect to being filaments or rods, it is merely a quibble hardly worthy of answering. A carbon in the neighborhood of three inches in length which, at Mr. Seward's estimate, has a resistance of from 25 to 30 ohms, is not a rod in this sense, and if the Goebel filament does not resist disintegration it presents another striking analogy to the present lamps, as will be noted by the black coating on the interior of the bulbs of the lamps now in use.

In the discussion of the question of high resistance of the filaments, considerable irrelevant argument was advanced, involving the meaning of this term. It was contended that the Goebel filaments, having withered with age, had probably not more than twenty-five or thirty ohms resistance originally, while Edison's lamps, to be practicable, needed a resistance of 100 ohms or more.

If this be true there are many impracticable Edison lamps on the market now, as the municipal lamp first manufactured by the Edison Company had a resistance of 3.3 ohms (4 ampere 16 c. p. lamp) and the present 3 ampere lamp has a resistance of 3.8 ohms. Besides these, their low volt 16 c. p. lamps for batteries run from 8 to 13 ohms, which is not far from and probably somewhat less than the hot resistance of the Goebel lamp. Their 50 volt 16 c. p. lamps (B lamps) have a resistance of 35 ohms, while in the old style of domestic lamps (100 volts 16 c. p.) the resistance is 139 ohms, and in the present lamps it is 201 ohms.

As these figures show a range for 16 c. p. lamps of from 3.3 ohms to over 200 ohms, it is evident that the term *high resistance* is merely a relative one, the value of which depends entirely on the current and pressure which is to be used.

It is only necessary in order to produce a practicable lamp to have the resistance of the filament enough higher than that of the leading-in wires to produce incandescence in the former without burning the latter. Of course the higher the resistance of the lamps for a distributing system the greater the economy, but this increase in the resistance does not constitute a patentable novelty, as it has been decided in several other cases that the novelty of an article that performs a useful function, even if but poorly, is not negatived by another thing which is practically similar and which performs the same function much more efficiently. If the authenticity of the Goebel lamps can be proved it can be shown that Edison lamps of a resistance much lower than these are being manufactured now.

The lamps alleged to have been manufactured by Goebel about 1860 are obviously too nearly identical with the present type of lamps in use to admit any claim of novelty for the Edison lamp patent. The important points which must be established by the defendants are the conclusive evidence of the priority of Goebel's work and the identity of the lamps exhibited in evidence.

* * *

The Factor of Safety. In calculating the strength of a mechanical structure, or in testing the capacity of a machine, the civil or mechanical engineer assumes the load to be carried to be from three to forty times the normal amount for which the structure is intended, in order to secure a margin of safety against unforeseen and incalculable conditions. This factor of safety, although it has been derisively called the factor of ignorance, is a well recognized necessity, and there appear to be grounds for its adoption, in the case of insulation tests at least, by electrical engineers.

The fact that a dynamo can be designed which will agree within two or three per cent. with the conditions assumed in calculating its proportions shows that the science of electrical engineering is in general an exact one, and may be reduced to a strict mathematical basis. There is a vital point in the designing of these machines, however, and one upon which their continuous successful performance depends, which cannot be predetermined with certainty, and that is the question of resistance to the passage of induced currents or disruptive discharge between insulated parts of the armature. It is for this reason that the insulation of the machine should be maintained at the highest resistance that is practicable, and the insulating material should be carefully chosen with a view to its adaptability to the part of the armature where it is to be used.

Mr. Steinmetz pointed out in the discussion at the last meeting of the Institute of Electrical Engineers, printed elsewhere, that the liability to rupture of the insulation is, in a measure, independent of the insulation resistance, but depends more directly upon the nature of the material used. This he illustrates by the fact that a discharge is effected between two plates separated by an air space which offers practically an infinite resistance more readily than when the plates are separated by some solid insulation whose resistance is infinitely lower. At the commutator the conditions differ from those of the other parts of the machine, and its insulation requires special properties not so essential elsewhere. From this it will be seen that the suitability of any insulation is determined as much by other properties as by its electrical resistance.

The causes which operate to break down the insulation of the armature are both electrical and mechanical, and are subject to wide and sudden variations under different conditions of use of the machine. For this reason the use of a large factor of safety for the insulation is desirable, and from the remarks of Prof. Crocker and others during the discussion mentioned above, the practice of testing electrical machines at four or five times their normal pressure appears to be extending among manufacturers. This is certainly a step in the right direction, and is of importance to the purchasers, for it is usually under the condition of severe service that faults in the armature insulation develop, and these defects are the cause of a large proportion of the accidents which occur in this class of machinery. An excessive overload or short circuit is almost sure to burn out the insulation of the windings, but with the core properly insulated an armature should be able to carry its normal current for any desired length of time without undue heating. If eddy currents are formed through the lack of insulation in the core, the heat developed not only reduces the capacity of the machine, but causes it to deteriorate rapidily by destroying the insulation or the armature wire, cutting the bearings, fusing any soldered connections, and melting the brushes. The expansion of the meter due to heating also introduces a number of troubles.

When the armature insulation, however, is tested up to several times the pressure it is to withstand in practice without breaking down, it is safe to predict that the machine will run continuously without any of the annoying accidents which keep a hot running machine in a continual state of being repaired.

* * *

THE manager of one of the leading manufacturing concerns in the West writes an appreciative letter to ELECTRICITY, in which he says: "We realize that the fight which is on in the electrical world in this country is one to the death. We have nailed our flag to the mast, and it will not be hauled down. . . . We cannot be killed by any legitimate means."

HERR HEINRICH GOEBEL, hoch, Hoiero!

* * *

"By dint of no small effort night and day, and by the unstinted use of the long-distance telephone, we are enabled to present our readers with that which is . . . one of the most remarkable stories of invention we are acquainted with." —*Electrical Engineer*, January 25.

Mr. Franklin L. Pope has never been in the habit of dictating to his stenographer over the long-distance telephone, and we don't believe he did in this case. What was the need of telephone or telegraph? Go to.

* * *

THE question of the authenticity of the drawings of the Stieringer fountains bids fair to take its place among the Unsolved Mysteries of Journalism, along with the authorship of "Beautiful Snow" and "Ta-ra-ra Boom de Ay." The comment of one of our contemporaries, however, the *Western Electrician*, is decidedly unfair to the editor of the *Electrical World*.

An eminent Shakspearian commentator, Mr. J. O. Halliwell, F.R.S., F.S.A., has truly said: "While criticism requires likelihood and consistency with the truth from an author, it must not be too literal and exacting; if so, it breaks the poet's [or editor's] wing, and dooms him forever to grovel on the ground." To have described these fountains with the designer's own data at hand would have been an easy matter for any penny-a-liner, and would at best have proved dry reading. But to produce a readable, nay, an enchanting, description out of one's own mind, without commonplace details, was the work of a true literary artist. But Chicago never did appreciate art, or poetry.

* * *

Dr. Cornelius Herz was placed under arrest within twenty-four hours after a solitary copy of the *Electrical Review*, eulogizing him, reached England. One more similar effort on the part of our microcephalous contemporary, and Herz will be hung without trial.

* * *

THE Westinghouse Company announces in a recent circular letter that "The company proposes, if it can secure the needed space, to make as part of its exhibit at the World's Fair a model lamp factory where it will produce new lamps and renew the carbon burners of those burned out, thereby making a most interesting and instructive exhibit, and at the same time effecting a saving in the cost of lamp renewals." No exhibit could surpass this in interest, and we hope the space will be granted.

* * *

ONE word from Mr. C. A. Coffin would close the Thomson-Houston lamp factory at Lynn and the Bernstien lamp factory at Boston, both pirates. The Edison Illuminating Companies should give this matter immediate attention.

Favorable Mention.

The General Electric Company is the Subject.

The Pekin (Ill.) *Post* says that "the General Electric Company of Chicago that is 'bucking' the Pekin and Peoria Electric Railway Company, which is composed largely of Bloomington men, is trying to 'sandbag' the latter company into buying their supplies from the Thomson-Houston Company, and that the former has no intention whatever of building any railroad in the town."

Is the Syracuse Deal "Arranged"?

We Infer That It Is.

An official of the Onondaga Electric Light Company of Syracuse, which lately received some mention in these columns, is reported as follows in the Syracuse *Standard*, in an interview regarding a consolidation rumor;

> "You can say without hesitation," said he, "that there will be no consolidation of the electric light companies. It is true that the old company has made us an offer, but it has not been accepted. We have purchased and paid for a lot at the corner of James and Pearl streets and will build on it. The letting of the contracts has been necessarily delayed. We can't change our identity as a company without losing the Edison contract for which we paid $25,000. Since the negotiations for the new plant have failed some of the stockholders in the old company are trying to buy up stock in the new company. They may acquire an interest in the new company, and some of the stockholders in the new company may acquire an interest in the old company. The Onondaga Electrical Company will be distinct from the Syracuse Electric Light and Power Company, but if there is an exchange of stock, as there probably will be, the contracts may be modified."

Technical Literature Disgraced.

Our Servile Contemporaries the Subject of Unfavorable Comment.

(*From the London "Electrical Engineer."*)

There is a lying spirit abroad, and we are sorry to see technical literature so disgraced as it is at the present moment. Politicians and religious communities find it convenient to run their own organs, so that their views may be faithfully promulgated and those of their opponents satisfactorily criticised. It has been left to technical journalism—to the electrical era—for company-mongers and wire-pullers of companies to obtain control of special organs. The technical journals so controlled are run for no worthy object. They are intended to mislead the multitudes who are ignorant of the behind-the-scenes. They pretend to the highest respectability, and at the same time are *carefully abstaining from obtaining or* TELLING THE TRUTH in directions which in every case it would not be difficult to indicate. Not speaking is ofttimes worse than too much speaking. These journals are not intended to benefit the trade generally after benefiting the proprietors specially; they are intended to benefit a portion of the trade by the active propaganda of biassed opinions, and to injure the remainder of the trade *by the suppression of what might with advantage be told.*

Articles are written in these papers, not for the purpose of telling the truth, but solely with the object of influencing opinions in certain directions. The general public, who can for a time, and for a time only, be influenced by these pernicious measures, is to be pitied. Some are induced to entrust work in directions in which, if the truth was known to them, it would not go. But not only is damage done in these directions, but the investing public is hoodwinked.

Financial difficulties are very real in electrical work, and everything possible should be done to give investors a firm belief in paying capabilities for electrical work, when carried out honestly and faithfully. You cannot get this independent criticism from papers which are run by company promoters, directors and financial agents.

The corporation of Neuchatel offers prizes of 12,000 francs for the best three schemes submitted for the utilization of the water power of the river Reuss for lighting the city, which is distant nine kilometres from the proposed generating station at Poé au Clíes. "Tenders will be required," says the *Electrical Engineer*, "for turbines, dynamos and mains. The turbines are to give 950 H. P. at minimum and 2,800 H. P. at maximum. Head available, 56 metres; flow—maximum, 5,000; mean, 3,000; minimum, 1,700 litres per second."

A bill has been introduced in the New York Legislature by Mr. Cahill requiring the placing underground of all electric wires used in operating street cars.

The Citizens' Street Railway of Indianapolis announces that in 1888, when horses were used, the gross earnings of the company were $389,319.40; and in 1891, with the trolley system, they reached $689,413.73.

Committees for the Chicago Electrical Congress.

At the meeting of the Advisory Council of the Chicago World's Congress of Electricians, four committees were decided upon to take up the active work in connection with preparations for the Congress. These committees were the Finance, three members; Executive, five members; Invitations, five members, and Programme and Papers, eight members. Dr. Elisha Gray, Chairman of the Advisory Council, has now selected the following members of these committees from the Advisory Council and his local Chicago committee:

Executive Committee—Prof. Elihu Thomson, Enos. M. Barton, G. M. Phelps, F. S. Terry and Prof. B. F. Thomas.

Finance Committee—B. E. Sunny, Prof. E. J. Houston and W. A. Kreidler.

Programme and Papers Committee—Prof. H. A. Rowland, Prof. H. S. Carhart, Carl Hering, A. E. Kennelly, Prof. W. A. Anthony, Prof. F. B. Crocker, Prof. E. L. Nichols and Prof. T. C. Mendenhall.

Invitations Committee — T. C. Martin, Dr. Louis Duncan, Prof. C. R. Cross, T. D. Lockwood and C. H. Wilmerding.

Of all these committees, and any others that may be formed, Dr. Elisha Gray is a member *ex officio*. He will participate actively in the work of each. It is proposed to establish headquarters for the Congress at Chicago at an early date, at which Mr. R. W. Pope, the secretary of the American Institute of Electrical Engineers, will probably be stationed to carry on all the detail work in conjunction with Prof. H. S. Carhart, the acting secretary.

Electric Railway Projects in Connecticut.

The New Haven *Register* says that "one of the big subjects before the present Legislature will be that of street railroads run by electricity," and the same paper furnishes the following list of petitions that have been placed on file with the Secretary of State:

Charles O. Hotchkiss and others, for an electric road in Bridgeport.

The Bridgeport Horse Railroad Company, for an extension of the line and permission to use electricity.

W. H. Allen and others, to build a surface road in Groton to be operated by electricity if necessary.

Frank W. Cheney and others, for a tramway company in Manchester, the same to be run by electricity if the company feels so disposed.

The Norwalk Tramway Company, for charter amendment to extend lines and to use electricity.

John W. Nichols, of Branford, and E. A. Smith, of New Haven, for an electric road that will run through Branford, East Haven, Orange, Woodbridge and Hamden.

A. J. Muzzy and others, for a tramway company to operate electric lines in Bristol, Plainville, New Britain and other towns in that locality.

C. H. Prince and others, of Enfield, for an electric railway in that town.

Charles Perrin, of Stonington, and others, for a street railway in Stonington and Pawtucket, to be operated by electricity if the owners desire.

A. A. Young, of Griswold, Windham County, for an electric road in Plainfield, Killingly, Putnam, Pomfret, Hampton, Canterbury, Brooklyn and Windham.

Eugene S. Boss, O. H. K. Risley, J. Griffin Martin and John M. Hall, of Windham, for a horse car road in Franklin, Sprague, Coventry and Morefield and to use electricity if the owners want to.

Norwich Street Railway Company, for amendment to charter for extension of the company's lines and to use electricity.

Lucius Briggs, for street railroad in Griswold and Voluntown.

F. M. Manning and others, for a charter for a street railroad in Mystic, Mystic River and Mystic Bridge.

"In every one of the petitions so far recorded," says the *Register*, "whether it is for a new road or whether for an extension of the lines of the old company, there is certain to be found mention of the fact that the petitioner wishes the right to use electricity. There is evidence in this fact alone that in many localities citizens have suffered and been tormented by the slow-going horse cars just as they are suffering in New Haven from the same kind of miserable horse car accommodations on some of the roads."

Asbestos Porcelain.

M. Garros is the inventor of a new substance somewhat resembling ordinary porcelain, but which possesses, as he claims, many advantages over that substance. The fibres of asbestos are exceedingly fine, their diameter varying between .00016 millimetres and .0002 millimetres, and consequently a very fine powder can be obtained from these. If it were possible to amalgamate these small particles without the addition of any foreign substance it is evident that a substance could be obtained which would be porous in nature, but with pores so fine that they could hardly be seen under the microscope. This substance is formed by pulverizing the asbestos, a process which is rather difficult if the ordinary mortar is used, but which is comparatively easy when the proper apparatus is employed. From this powder a paste is made by mixture with water, and this paste is kneaded, diluted with water, dried and kneaded again, and then molded into the proper form. By heating the objects in a crucible to a temperature of 1,700° Centigrade, a porcelain is obtained with a translucency comparable to that of ordinary porcelain, and for this reason the inventor has given the name of asbestos porcelain to the substance. If it is heated for 18 hours at a temperature of 1,200° Centigrade, then porous asbestos porcelain is obtained of a light yellow, or white color, if care be taken to wash the asbestos powder with sulphuric acid. Professor d'Arsonval states that porous cups made of asbestos porcelain used in electric batteries have much less resistance than the ordinary porous cups, and it has been found that this substance is about 2.75 times a better insulator than the porcelain in common use at this time.—*Electricity*.

What Constitutes Good Vulcanized Indiarubber?

An investigation has recently been conducted by Lieut. L. Vladimiroff, at the St. Petersburg Technical Institute, with a view to establishing rules or tests whereby the quality of vulcanized indiarubber may be efficiently judged. It is a notorious fact that no method of chemical analysis gives reliable results for this substance; hence the tests applied were chiefly of a physical nature. From a lengthy series of experiments the following conclusions were deduced, namely: 1. Indiarubber should not give the least sign of superficial cracking when bent to an angle of 180° after five hours of exposure in a closed air bath to a temperature of 125° Centigrade. The test pieces should be 6 centimetres thick. 2. Rubber that does not contain more than half its weight of metallic oxides should stretch to five times its length without breaking. 3. Caoutchouc, free from all foreign matter except the sulphur used in vulcanizing it, should stretch at least seven times its length before rupture. 4. The extension measured immediately after rupture has taken place should not exceed 12 per cent. of the original length of the test piece of rubber. The test piece should be from 3 to 12 mm. long, 3 cm. wide, and not more than 6 mm. thick. 5. Softness may be determined by measuring the percentage of ash formed on incineration; it may form the basis for deciding between different grades of rubber for certain purposes. 6. The vulcanized rubber should not harden under the influence of cold temperature. These conclusions are to serve in the establishment of rules governing the introduction of vulcanized rubber in the Russian Navy.—*The Electrician*.

Faster and Faster.

The east-bound Empire State Express made another magnificent run over the Mohawk Division last Tuesday, covering the distance from Syracuse to Utica, 52 miles, in 46 minutes, an average of 67.38 miles per hour; rather fast running for an average railroad, but only an ordinary spurt on the New York Central, which leads the world in speed and equipment.—*Utica Morning Herald.*

Electrical Recording Meters.—II.

BY CARYL D. HASKINS.*

Another ingenious and quite positive form of heat meter consists of two metallic rods, or in some cases of two bimetallic rods, somewhat similar to an ordinary thermostat; such meters being in fact a simple application of the thermostat principle to a recording device. Two rods of this kind may be placed vertically, one under each end of a walking-beam mechanism, the familiar pole-changing device being again brought into play to throw the current first through one rod and then through the other. The character of the walking-beam must be such that only a slight movement is needed to actuate the recording mechanism and also the pole-changer.

The method of operation of a meter of this kind is obvious; the alternate expansion and contraction of the two rods as they are thrown in and out of circuit will occur with a rapidity dependent upon the current passing, and, as each rod lengthens, it throws over the walking-beam onto the shorter cool rod, and the same action follows from that side.

I think no comments are needed on such a device as this; it probably lacks sensitiveness to a marked degree and it has other objections which are sufficiently apparent.

Probably better than this is the system of bimetallic rods with one contracting and one expanding side, which bend to right and left, or up and down, with a rapidity dependent upon the strength of the current, a pole-changer of course being used as before.

The method of actuating a train of gears by this system is comparatively simple, and not open to as many objections as the device just described.

I have neglected to state heretofore that the bulk of the thermo-meters are actuated on the shunt principle. It is obviously out of the question to operate a pole-changer by means of a meter which shall cause one to break the full current passing to the lamps. As a rule, a very small portion of the total current is carried through the meter around a positive shunt. Instead of shunting the current, this device has at times been applied to alternating work by the introduction of a kind of transformer which takes a few turns of wire in series with the lamps and transfers the energy through a secondary to actuate the meter; thus the meter is not on the lamp circuit at all, but on the independent secondary. But this intervention of induction is probably not desirable in cases of this kind.

A patent issued in the year 1889 to a Mr. Dahl tells us of another quite unique form of thermometer, and this is probably the only heat meter actuated by an actual field and armature arrangement. In this instrument, the inventor provides a field of iron excited by a few series turns on the lamp circuit. The strength of the field should therefore bear a more or less definite relation to the amount of current passing through its turns. On a shaft is suspended a kind of armature consisting of a flat disc-like ring of iron, supported by a number of spokes and mounted as a wheel; in fact it is mounted on a quite ordinary shaft mechanism suspended in proper bearings. The iron portion of the wheel rotates between the poles of the electro-magnet or at times permanent magnet just described. We have, in fact, a disc armature rotating in such a manner as to pass between two poles of a more or less strong field. On the principle of the familiar thermo-magnetic motor, rotation is obtained in this meter by so placing coils of wire or other suitable material under certain portions of the disc, and in series with the lamp circuit, that the disc is differentially heated at the proper point; thus, with the peculiar armature construction described, a thermo-magnetic action is set up, somewhat akin probably to the action of the thermo-pile. The portion of the disc heated is attracted toward the field coils, and thus the disc being progressively heated and cooling rapidly owing to its thinness, continuous rotation is set up. Sometimes in this construction the field is in series with the heating device and sometimes the heating device alone is in series with the lamp circuit, and the field is either a permanent magnet or independently excited by a battery. Neither of these changes involves the principle of the meter, which is assuredly ingenious.

The final form, and I think I may say the last form, of thermo-meter at all worthy of description is distinctly a clock meter also. The clock meters will come under our consideration somewhat later in this paper, but this meter which I am about to describe can scarcely be separated from its kindred, the heat meters. Briefly, however, I may define the clock meter as one whose recording device or whose movement is actuated by an independent source of power, generally a clock, though sometimes a constant speed motor or other device.

The thermo-meter now under consideration is also a thermometer (a commentary perhaps on the English language). An ordinary thermometer of somewhat modified construction is surrounded at the bulb by a coil of wire in series or in shunt series with the circuit to be measured. It is apparent that the rise and fall of this thermometer will be *more or less* dependent upon the heat developed by the coil, and the heat again will be more or less dependent upon the current passing, but of course the temperature of the surrounding atmosphere must necessarily introduce serious error.

To compensate for external temperature it was suggested that the meter be so encased as to practically insulate it from heat or cold; but this is probably not feasible.

Clock mechanism can be combined with any indicating device; it is only necessary to supply the connection which shall cause the indicator to mark the paper, and draw a crooked line. First attempts of this kind are generally made with an ordinary solenoid, or sometimes with a simple coil and iron core rising and falling with the current. Whatever the character of the indicator or method of communication between the indicator and paper, it remains necessary to keep the friction of contact low.

First attempts were made with a pencil bearing directly upon the paper, but the friction introduced by this device was fatal to accuracy. A glass pen has been substituted for the pencil with better results, but even this caused too much friction. The photographic method of line drawing is one of the best systems yet introduced, and is probably more familiar to the majority of us than the other methods, because it forms a component part of the Walker meter which has attracted attention at various times.

One of the best methods of accomplishing the registration, perhaps when all things are considered the very best, is to attach to the pointer of the indicator a steel point or needle with an iron armature mounted in the form of a spring, or in some similar manner. By placing an electro-magnet behind the paper to be marked, and sending through this magnet an electrical impulse at fixed periods of say one, two or five minutes, the pointer is drawn sharply down to the paper, puncturing it, and is immediately released by the cessation of energizing current in the electro-magnet. Thus the paper when removed will have a continuous marking of punctures tantamount to a curved line. This device presents practically no friction, and is more or less simple and easy to carry out. The make-and-break necessary for the electro-magnet is easily actuated by the clock movements. But we may say of these forms, as well as of the forms of clock meter which are to follow, that there is one serious objection to them all—they have to be wound up, which is certainly a fault. We may modify this statement by saying that many of these devices have an electrical attachment which makes them self winding, and this is a step in the right direction at least. Whether it fully meets commercial necessities is, I believe, an open question.

All of these instruments being curve-drawing meters, they cannot properly be considered as the thoroughly commercial article, which the successful electric meter must be. For to be successful the meter of to-day positively must have a direct reading dial, equally available for the consumer and supplier.

This brings us to a second form of clock meter of a preferable character. This class comprises those meters whose clock mechanism is accelerated or retarded by the strength of the current passing through them. There are several methods of accomplishing this, all of which apply the influence of the current to the pendulum of the clock.

The most successful and probably the best form of meter of this kind consists of two clocks with a differential gear between. One of these clocks runs at a constant speed, the speed of the other being governed by the circuit to be measured. When nothing is passing through the meter, the speed of both clocks is the same and the differential gear does not move; but when lamps are turned on, and the regulating device begins to act, one clock is accelerated or retarded according as the principle may be applied, and the difference between the constant speed clock and the varying speed clock indicates the consumption in directly read units.

The Aron meter, the typical meter of this type, proved itself so accurate at the recent meter competition in Paris that it succeeded in dividing the first prize of 10,000 francs and a gold medal with the Thomson recording wattmeter.

In the majority of cases, motor meters have been designed for alternating circuits, and these again naturally divide themselves into two classes, those actuated by inductive principles and those whose motive powers act direct and which are similar in character to the electric motor.

Now the theory of meters as set forth in most of the patents on file claims a torque proportional to the square of the current, which doubtless would be correct could we neglect the effect of certain minor influences. In reality, careful tests seem to show that torque falls somewhat below the square and above the direct proportion, and the proportion does not seem to hold good at various points of load.

The speed of motor meters is naturally approximately proportional to the torque, and they therefore tend to run too fast and have to be restrained.

None of the inductive meters will run on direct current, of course. We now come to the second form of motor meters—those which are not dependent upon inductive action for their rotation, and are consequently equally serviceable for alternating or direct circuits.

Of these there are but a few, all of them having a field in series with the lamps and an armature —sometimes in series and sometimes in shunt. Of the former kind but few have been tried carefully enough to thoroughly prove their merits.

The remaining class of motor meters embraces those with a series field and shunt armature.

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*Abstract of a paper read at the Seventy-third Meeting of the American Institute of Electrical Engineers, New York, January 17, 1893.

These are somewhat of a departure from the others, since they are not current meters but power or watt meters. Their construction is in all cases quite similar to an ordinary shunt motor, the conditions of field and armature being reversed.

The field is in series with the lamps; the armature, which is of high resistance, and generally of Siemens construction, with a commutator of a few segments, is placed "in shunt across the line," the shunt being taken off beyond the field coils. An outside resistance is placed in this shunt circuit, to reduce the current in the armature to the necessary small quantity and to prevent any appreciable waste across the line.

The strength of armature then may be seen to be dependent on the pressure, whilst that of the field depends on the expenditure of current. The torque of this meter then is directly proportional to the power passing, and the speed is naturally proportional to the torque (again minus the friction), but the friction is balanced in these meters, as in the previous one, by the presence of a "shunt field," since the armature circuit is taken off beyond the fields, and consequently passes through them in addition to the current for the lamps.

Motor meters, as a class, rotate far more rapidly than is allowable in practice. It has been found necessary, therefore, to introduce a "drag," or resistance to rotation, to slow the meter to a reasonable speed. This has been done in several ways; perhaps the most common method being to attach to the shaft a number of air fans. These are quite largely used and with fair success. The resistance of an air fan to rotation is approximately proportional to the square of the speed. Therefore this device is only fitted for combination with such meters as have a torque increasing with the square of the current. But since the torque of such meters does not quite reach the square, the retarding effect increases rather too rapidly and has a tendency, though not always pronounced, to cause the speed of the meter to fall off proportionately on high loads.

An effort has been made to overcome this disproportion of the fan's resistance by substituting folding fans which close by centrifugal force, on the principle of the steam engine governor. This novel idea, whilst a decided improvement, scarcely overcomes the difficulty.

Another method of drag which has been used with some success is the rotation of a small fan in liquid, a method perhaps rather better than the previous one, since resistance to rotation falls below the square of the speed when the liquid itself begins to rotate. Much depends in this case on the shape of the receptacle containing the fluid.

A third method, certainly by far the best, consists in rotating a small inefficient dynamo, generally a mere disk, turning between permanent or electro magnets. This resistance is of course directly proportional to the speed, and therefore to the torque, being indeed the machine reversed. By applying this drag, friction is again the only difficulty to contend with.

One other important point in connection with the drag and the friction we must not neglect. The greater the drag (commensurate, of course, with sufficient speed), the smaller the proportion of friction to the total load will be, and the greater the accuracy of the instrument's registration.

To sum up, then, it would seem that the most practical and useful meter, according to our present light, would be a motor meter of other than inductive type—preferably an energy rather than a current meter—with some force to balance friction, with a drag which is directly proportional to the speed, and which will be comparatively heavy, making the irregular friction as small a portion of the load as possible.

There is another form of motor meter somewhat akin to the clock meters which we discussed some little time ago. This comprises those instruments whose motors would rotate at a constant speed provided the resistance to rotation were also constant. In other words, the current passing through the meter would be so arranged as not to cause fluctuations of speed in the motor directly. This is easily accomplished by placing the motor in shunt across the line like a lamp, and properly proportioning its windings. Variation in speed of the motor which is geared directly to the dial is accomplished in this class of meters by varying the resistance to rotation or drag.

(Concluded.)

Good Words for the Trolley.

The Salem, Mass., *Gazette* says: "The determined opposition to the trolley system shown in New York, Brooklyn, Philadelphia, Baltimore and other of the large cities of the country seems strange to people in this vicinity. To read the discussions in the legislative chambers of those places, and the editorials in the leading papers there, one would think that some frightful monster was about to be let loose upon them. People at all familiar with its workings know that these evils and dangers exist almost wholly in the distempered fancy of those not well informed in the matter. As we write, we can recall no single fatality directly traceable to this source. The fires supposed to spring from it are nearly as imaginative. It is, as yet, the only practicable method of electrical propulsion. And despite the vigorous opposition made, it is gaining a foothold in nearly all these cities. Once in full operation there, all will see that in delaying its introduction they have been standing in their own light."

Boston Notes.

The Electric Railway Company at Springfield, Mass., contemplates a large power station next spring. While enjoying satisfactory service from the local electric light company, its business is rapidly becoming so extensive that it is deemed advisable to own its own power station. It is estimated that about 1,500 H. P. of generators will be installed at first.

The promoters of the electric railway extending between Pigeon Cove and Rockport, Me., are beginning to fear they may have to abandon their undertaking owing to their inability to secure authority that would enable them to do a freight as well as a passenger business.

A wealthy syndicate has secured possession of about all the electric roads in the northeast part of Massachusetts. Under the title of the Lowell, Lawrence and Haverhill Street Railroad Company, this syndicate will absorb the Haverhill and Amesbury railway, which runs to Salisbury and Newburyport, thus connecting Lowell, the Spindle City, directly with the ocean. The system will include sixty miles of track. Along the route a series of parks and picnic grounds will be laid out for the pleasure of the big crowds of patrons which the road is certain to secure.

The Thomson Houston Electric Band gave a concert and dance last Friday evening in Larter's Hall, Lynn. Mr. J. B. Claus, the accomplished bandmaster, presented a splendid programme. About one hundred couples enjoyed the terpsichorean part and gayly twirled on the light fantastic toe. Mr. John J. Mitchell, a popular member of the factory staff, was floor director.

It is some time since there was so lively an interest taken in things electrical as in the suit of the General Electric Company vs. Beacon Vacuum Pump and Electrical Company. As will be seen from our report of the case, the General Electric Company has struck an ugly snag at last, and the case of the Beacon Company is a strong one.

The opinion is gaining ground in this city that the outcome of the recent numerous and costly fires, in which several million dollars of property either went up in smoke or down in ashes, will be to stir up public opinion against all overhead wires, and create a demand that they be buried for all time.

A massive 50-ton crane built by the Morgan Engineering Company is being placed in the new foundry just erected at Lynn by the General Electric Company. It will be equipped with electric motors and be operated on an elevated track running 300 feet, the entire length of the building.

Bellows Falls and Paxton Mills, Vt., are to be connected by an electric railway eight miles long. The undertaking will open up a section of country that hitherto has not enjoyed any great advantages of an electrical kind, and it is confidently expected that the entire territory to be traversed will enjoy a boom at once.

The various electrical supply houses of this city are doing excellently well just now, booking orders for spring delivery. Some really large contracts have recently been placed, and everything points to a fine spring trade in both departments of lighting and railroading.

The Richmond paper mills plant in East Providence has been sold to the American Electrical Works of Providence. The American Electrical Works will use the newly acquired property for the extension of their present business, the manufacture of insulated electric wire. E. F. Phillips, president of the company, expects to have the work in operation about the first of June. The heavy work of the business will be done at the East Providence branch, and an additional force of 200 men will be employed.

Chicago Notes.

W. E. Lewis, the St. Louis representative of the National Electric Manufacturing Company, was in Chicago this week.

Mr. James H. Dean, a prominent electrical engineer of St. Paul, was married last week to Miss Adelaide M. Gordon. Mr. Dean's many Chicago friends wish him success.

Mr. Chas. D. Jenney, of Indianapolis, Ind., was a visitor in Chicago this week.

Robert L. Allen, of Joliet, has been appointed warden of the Illinois State Penitentiary. Mr. Allen has become quite prominent in electrical circles as manager of the Consolidated Electric Light and Street Railways Company of Joliet.

Al. J. Veneman, until recently a member of the firm of Masters & Veneman, Evansville, Ind., has again resumed his position with the Electrical Supply Company of Chicago.

A number of prominent electrical men gave a banquet to Geo. B. Burton, the inventor of the Burton Heater, at the Victoria Hotel last week.

General News.

What is Going on in the Electrical World.

Burlington, Vt.—The Winooski and Burlington horse railroad will be equipped with the trolley system in the spring.

Portland, Ore.—The Portland and Vancouver Railroad is, using the local vernacular, to be "electrified" within six months.

Kansas City, Mo.—The stockholders in the Kensington branch of the "L" road are actively engaged in an effort to equip it as an electric line.

Big Timber, Mont.—It is reported that a company has been formed to build and operate an electric railway between this place and Boulder.

Hartford, Conn.—The Schuyler Electric Company is preparing electric devices to be used for illuminating purposes at the World's Fair at Chicago.

Toronto, Can.—The Toronto and Scarboro' Electric Railway Company have applied to the Mayor for permission to lay their tracks down the east banks of the Don.

Bristol, Pa.—The borough councils of Langhorne and Hulmeville have practically agreed to grant the right of way for the proposed electric road from Bristol to Newtown.

Reading, Pa.—The mayor has signed the bill granting the Reading City Passenger Railway Company permission to operate its entire system of nearly twenty miles with the trolley.

Trenton, N. J.—Among the bills recently introduced in the State Legislature was one repealing the act of last year creating a State Electrical Subway Commission.

St. Louis.—Work upon the Delmar Avenue and Clayton Electric Railway will be begun early in the spring, and the projectors promise to have it completed within six months.

Marion, Ind.—A franchise has been granted for an electric railway to Gas City. It is probable that all the principal points in the Indiana gas field will soon be connected by an electric railway system.

Peekskill, N. Y.—The board of trustees have set February 4 as the date on which the legal voters of the town are to vote on the question, "Whether Peekskill shall have an electric street railroad or not."

Auburn, Ind.—At the electric-light station at Nappanee, on the Baltimore and Ohio road, in Elkhart County, a few days ago, the boiler exploded with terrific force, instantly killing Electrician Johnson.

Hoboken, N. J.—The North Hudson Railway Company propose to establish an electric mail route on their several lines and also to substitute the trolley system for the present horse cars on their line to Jersey City.

Erie, Pa.—Some Venango capitalists will ask the present Legislature to grant a charter for the Meadville and Erie Electric Railway. The water power at George's Mills, Venango, will be utilized for generating the electricity to be used.

Greenport, L. I., N. Y.—The feasibility of building an electric railroad between Greenport and Orient, and possibly Orient Point, is being discussed among some of the stockholders of the Greenport Electric Light and Power Company.

Elgin, Ill.—The Elgin, Aurora and Fox River electric road is making progress. The boulevard between Geneva and St. Charles is developing renewed interest in connection with the proposed electric railway from Carpentersville to Montgomery.

New York.—The application of the various electric light companies, the Metropolitan Telephone Company and the Empire Subway Company for permission to construct subways in streets where overhead wires have been ordered down has been granted.

Peoria, Ill.—The power house of the Central Railway was recently destroyed by fire, causing a loss of about $100,000. It furnished the motive power for the Adams street, Hurlburt, Knoxville avenue, Main street, Rapid Transit and Lakeside electric railways.

Wheeling, W. Va.—Work is progressing rapidly on the new power house on the South Side for the electric street railway company. The boilers are already in position, and it is expected that in thirty days the system will receive power from the new plant.

Altoona, Pa.—The Altoona and Logan Valley Electric Railway Company have closed the the contracts with the Pennsylvania General Electric Company, who are the proprietors of the Edison and Thomson-Houston devices, for the complete equipment of the line.

Moorestown, Pa.—The contract for street lighting expires in March.—The Moorestown Electric Light Company are making experiments with arc lights for incandescent circuits, with a view to their substitution for the present incandescent lights in the principal streets.

Jersey City, N. J.—The company that is building the trolley line from Jersey City to Newark is pushing the work with great rapidity. This line is of great importance as it will connect with the street car lines of Essex and Hudson Counties as well as with the projected lines to Paterson and Passaic.

Indianapolis. Ind.—R. T. McDonald, the millionaire capitalist of Fort Wayne, has agreed to purchase Dr. Light's park at Broad Ripple, convert it into a summer resort, and make it a place of suburban attraction, provided he can secure a franchise to build an electric line from the city to that point.

San Francisco, Cal.—It is evident that important changes in the electric light business throughout this State are pending. Heretofore that business was almost entirely controlled by two corporations—the Edison Light and Power Company and the Electric Improvement Company. The companies are understood to have made arrangements to consolidate.

Brattleboro, Vt.—A company composed of E. L. Waterman, S. N. Herrick, E. C. Crosby, S. S. Hunt and H. F. Weatherhead has been organized here for the purpose of constructing and operating an electric railway.—The Pettingill-Andrews Company of Boston have obtained from the incorporators the right to build an electric road between Brattleboro and Saxton's River village.

Needham, Mass.—A company is about to be formed to be known as the Needham and Newton Electric Railroad Company. It is proposed to build the road from Railroad Square, Needham, to the Boston and Maine depot at Newton Highlands. There is also talk of another electric road to run from South Natick through Needham to Dedham, and parties interested are now looking over the ground.

Schenectady, N. Y.—The managers of the General Electric Company of Schenectady have in contemplation the erection of two enormous new buildings. They will be at least 200 feet long and will be very wide. One of these buildings will probably be used for the manufacture of porcelain ware, such as is used for electrical fixtures. The other building will be used for general machine shop work.

Colorado Springs, Col.—Local and Eastern capitalists are pushing the prŏject to connect Colorado Springs with Cripple Creek by an electric railway. The route is to follow the new county road over Cheyenne mountain to Beaver Creek. The power is to be obtained from the electric plant in this city. The route will be made as direct as possible and will be selected for its scenic attraction by way of Seven Lakes.

Springfield, Mass.—The Electric Meter, Governor and Power Company, now in process of organization, has bought a tract of land on the Wilbraham road, near the New England Railroad Depot, for the purpose of establishing an electrical plant there. The capital stock is $250,000. L. G. Watkins is the local manager of the project; George M. Jewett, General George B. Hibbard and A. T. Pierce are the executive board, while Fred T. Greenwood is the secretary.

Bay City, Mich.—A comprehensive electric railway system is being arranged by the West Bay City Electric Railway Company. The company has not decided just how to arrange the lines. The street cars that are being changed at present will have a single Westinghouse motor of 25 horse power. The wheels of the truck are 33 inches high, or three inches higher than those of the present electric cars. Greater speed is promised. Eighteen cars are to be rebuilt.

Liverpool, Eng.—The elevated electric road has been completed and a trial train was recently sent over the road at a speed of twenty to thirty miles an hour despite a heavy fall of snow. The power is generated by four horizontal compound engines of 400 H. P. each. Each train has a motor at either end which takes the current from a steel conductor at the side of the line by means of a brush or slipper. There are thirteen stations on the line. All the signals are worked by electricity.

New Bedford, Mass.—A proposed electric railway is to commence at a point on the Dartmouth road in this city, thence to Padanaram village in South Dartmouth, from thence by the Tucker road to the village of Smith Mills, thence through the Hathaway road in Dartmouth to Rockdale avenue and Mount Pleasant, its terminus. Its entire length will be about ten miles. The company will be named the New Bedford and Padanaram Street Railway Company.

Bridgeport, Conn.—The Newark, N. J., *Advertiser* says a syndicate comprising several prominent citizens of Newark has purchased the East End Railroad of Bridgeport, Conn., $300,000 in cash being the price paid. The purchasers are Elias S. Ward, Gottfried Cruger, Andrew Radel, H. M. Doremus, Julius Stapff, William Scheerer, Wilbur A. Mott and others, of Newark; Colonel N. H. Heft, of New York, and John Fritz, of Bethlehem, Pa. The road has hitherto been run by horse power, but electricity will be introduced at once, as the necessary permission has been obtained from the city.—The Waterbury, Conn., *American* says: "Bridgeport is to have a new industry in the shape of a corporation formed to introduce in this State the recently discovered Pennock storage system of electricity. The new company will be organized under the Pennock Battery Electric Light and Improvement Company, which is at present located at 22 Exchange Place, Boston, but the headquarters of which are at Chicago. The new company will open a plant within sixty days and proposes to have an exhibition car on the tracks in ninety days."

ELECTRICAL COMPANY ELECTIONS.

The Seattle Consolidated Railway Company, Seattle, Wash. President, F. T. Blunck; vice-president, Jacob Furth; secretary, V. Hugo Smith; treasurer, R. R. Spencer; auditor, A. Dunn; general superintendent, C. S. Clark. Mr. Blunck, the new president, is a wealthy capitalist of Davenport, Iowa, and the largest individual stockholder in the company. In addition to the above, Wm. D. Wood and F. Fonda compose the directory.

Saco River Telephone and Telegraph Company, Saco, Me. President, Mark P. Emery; vice-president, J. R. Libby; secretary and treasurer, John Berryman; superintendent, Freeman Palmer; directors, Mark P. Emery, J. R. Libby, F. H. Hargrave, John Berryman and S. B. Sheperd.

City Passenger Railway Company, Reading, Pa. President, John A. Rigg; vice-president, Matthias Moyer; secretary and treasurer, Frank S. Livingood; directors, M. B. McKnight, William McIlvain, Matthias Moyer, W. L. Leaman and Frank S. Livingood.

West Side Electric Street Railway Company, Kansas City, Mo. President, W. N. Coler, Jr.; vice-president, B. F. Moats; secretary, C. F. Hutchings; directors, C. F. Hutchings, L. H. Hale, W. N. Coler, Jr., B. F. Moats, Ben Jacobs and W. S. Nelson.

Chicago Telephone Company. Directors, John De Koven, John B. Drake, Arthur G. Fuller, John E. Hudson, J. Russell Jones, Robert T. Lincoln, C. E. Perkins, Henry B. Stone and Norman Williams.

Edison Illuminating Company, Brooklyn, N.Y. President, Ethan Allen Doty; vice-president, Edwin Packard, secretary and treasurer, Royal C. Peabody; directors additional to above: E. Le Grand Beers, Charles E. Crowell, F. S. Hatings, C. N. Hoagland, Martin Joost, J. G. Jenkins, D. R. James, George Foster Peabody, Lowell M. Palmer, Charles M. Pratt and George H. Southard.

The Edison Electric Light Company, Philadelphia. Directors, Samuel B. Huey, Wm. D. Marks, Charles M. Swain, Amos R. Little, John Lucas, H. Blake Tyler, D. S. Lindsey, L. D. Brown, Arthur Colburn, Wm. T. Tiers and C. A. Coffin.

The Chicago City Railway Company, Chicago. The old officers were all re-elected as follows: President, George H. Wheeler; first vice-president, James C. King; second vice-president, Erskine M. Phelps; treasurer, T. C. Pennington; secretary, F. R. Greene; superintendent, M. K. Bowen. The directors elected are: L. Z. Leiter, Erskine M. Phelps, Samuel W. Allerton, George H. Wheeler, James C. King, D. K. Pearsons, William B. Walker.

The Frankfort Electric Light Company, Frankfort, N. Y. President, F. C. Eaton; vice-president, S. S. Richards; secretary and treasurer, J. L. Seger; directors, S. S. Richards, G. N. Lehr, J. L. Seger, W. D. Allen and F C. Eaton.

COMMERCIAL PARAGRAPHS.

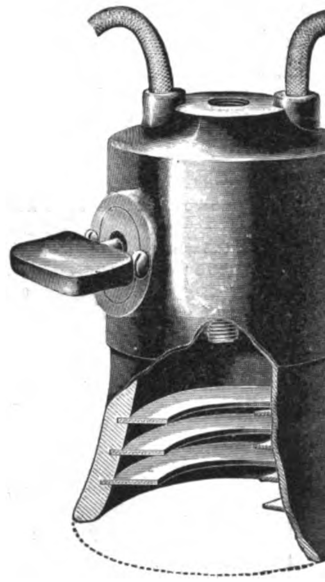
The Detroit Electric Motor Company, through their Chicago office, have closed a contract with the Calumet Railway Company to furnish fourteen 40-horse power equipments and ten 100 k. w. generators.

The National Electric Company of Eau Claire, Wis., report the sale of a complete electric equipment, including a 500-light alternating dynamo, to the Beacon Electric Company, for a new electric light station in Fenton, Mich. The company also expect to start four of their 500-light machines in the Cook County Hospital within a week.

Cutter's Mine Socket.

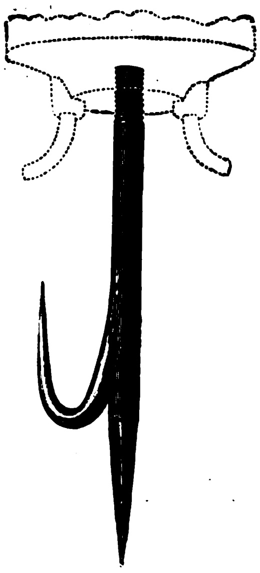
Those who have used incandescent lamps in places where water is apt to run over them know how the so-called water-proof sockets fall short of the mark. They apparently shield the works of the socket from the dripping water, but do not prevent the moisture from creeping up on the lamp and short-circuiting the cap. The result is that the fuses are blown much too often, thus leaving the men in darkness unless they have other lamps on hand.

These defects in the ordinary rubber, glass or porcelain sockets have been considered by George Cutter in developing the socket shown in the cut. This has a well built interior (with porcelain insulations) protected by a casing of polished hard rubber. The leading-in wires are cemented into the shell, while the handle or key passes through a bushing which is made watertight by soft rubber washers.



Cutter Water-Proof Socket.

These prevent any moisture from entering the shell at the sides, so that the only danger would be from the creeping of the water along the bulb of the lamp. To avoid this, the shell has a series of soft rubber rings which press against the bulb of the lamp when screwed into place and prevent any moisture from reaching the lamp base. It is evident that such a socket can be used with safety in places where there is a steady dripping of water, and it is claimed that it can be entirely immersed without any danger from short-circuit. When used in mines it is furnished with a prong, as shown in the cut, so that it can be hooked into any convenient position. The socket is made either with or without a key and is being exploited by George Cutter, of Chicago.



Cutter Lamp Hook.

Business is Good.

Riehle Bros.' Testing Machine Company report the following orders:

Taylor Iron and Steel Company. High Bridge, N. J., one 200,000 lb. vertical screw power testing machine.

Booth, Garrett & Blair, Philadelphia, for their new physical laboratory, one Riehle 100,000 lb. vertical screw power testing machine.

Atlas Engine Company, Indianapolis, Ind., one 50,000 lb. screw power testing machine.

Logan Iron and Steel Company, Burnham, Pa., one 300,000 lb. horizontal testing machine for car couplers, car links, pins, and chains, adjusted to British Lloyd Register.

Chicago Tire and Spring Company, Chicago, Ill., one 200,000 lb. car coupler.

Boston Belting Company, Boston, Mass., one special testing machine for testing rubber springs.

Pickel Marble and Stone Company, St. Louis, Mo., one 8 ft. bed marble machine.

Pullman Iron and Steel Company, Pullman, Ill., one 100.000 lb. vertical screw power testing machine.

F. P. Bagley and Company, Chicago, Ill., one 8 ft. bed marble machine, with quarter circle, surface molder, and countersinking tools; one sanding machine; one round hole borer.

Rutland Marble Manufacturing Company, Rutland, Vt., one 6 ft. bed marble machine, complete with all appliances.

Howard-Harrison Iron Company, Bessemer, Ala., one hay and straw rope twister.

Thomson-Houston Electric Company, Lynn, Mass., one 85 ton hydraulic press.

Baltimore Manual Training School, Baltimore, Md., one 50,000 lb. vertical screw power testing machine.

Pennsylvania Steel Casting Company, Chester, Pa., one 100.000 vertical screw power testing machine.

Canadian Government, five 2,000 lb. cement testing machines.

Johnson Company, Johnstown, Pa., one Riehle-Yale Extensometer; one Riehle-Vernier.

Pennsylvania Railroad, Altoona, Pa., one Riehle-Vernier beam for their Riehle testing machine.

This concern also announces orders received for Riehle-Roble patented screwjacks from the following:

United States Government, Columbian Exposition. Columbia Iron Company, Columbia. Pa. Slatington Foundry, Machinery and Boiler Works, Slatington. J. P. & J. M. Cornell, New York City. S. Tompkins, Engineer, Charlottesville, Va. United States Government. Boston Navy Yard. Terre Haute and Indiana Railroad, Terre Haute, Ind. Tippitt & Wood, Phillipsburg, N. J. Bryden Horse Shoe Company, Catasauqua, Pa. Allentown Rolling Mill Company, Allentown, Pa. Lukens Iron and Steel Company, Coatesville, Pa. Bethlehem Electric Light Company, Bethlehem, Pa.

INCORPORATIONS.

The Columbus Electric Company, of Columbus, Kan. Capital stock, $10,000. Directors: B. F. Hogg, E. M. Tracewell, H. R. Crowell, A. H. Crowell and F. D. Crowell, of Columbus.

The North Arkansas Railway Company, Mammoth Spring, Ark. Capital stock, $100,000. President, P. Arlund; vice-president and general manager, R. D. Welsh; secretary, G. C. Buford; treasurer, H. G. King. The company proposes to build and operate a railway, build water works, electric light plants, etc.

Electric Dice Game Company, Chicago. Capital stock, $5,000. Incorporators: John H. Brown, Walter R. Vaughan and Edmund D. Dubois.

A company has been formed to build an electric railway from Everett to Snohomish, Wash., eight miles. The incorporators are M. Swartout, Thomas Dwyer, R. M. Mitchell, John E. McManus and W. DeF. Edwards. Among the trustees are ex-Governor Merriam, of Minnesota; A. F. McClaine and O. N. Nelson.

Another electric street railway company has been formed in Newton, Mass. Capital stock, $100,000. Directors: H. B. Parker, George W. Morse, Frederic Johnson, W. F. Hammett, Austin R. Mitchell and James W. French. The route of the proposed road is from a point near the centre of the town of Wellesley, through Newton Lower Falls and Auburndale to West Newton, to connect with the line of the Newton and Waltham Company, which in turn is to connect with another line running to Oak Square.

The Commercial Light and Power Company, Duluth, Minn. Capital stock, $500,000. Incorporators: Morgan Brooks, of St. Paul; Franklin Paine and G. A. Leland, of Duluth. The company proposes to furnish electricity for light and power purposes.

The New Castle Electric Railway Company, New Castle, Del. The capital stock is placed at $100,000, divided into 10,000 shares at $10 each, with power to increase to a sum not exceeding $500,000. The commissioners named in the bill of incorporation presented to the Legislature are Mayor Frank E. Herbert, Howard Ogle, James B. Toman, Dr. Peter Cooper, Evan G. Boyd, City Auditor Henry H. Billany and Peter L. Cooper, Jr. The company was formed to establish an electric plant in New Castle to generate electricity for lighting public and private property, etc.

The Alton Electric Street Railway Company, Alton, Ill. Capital stock, $25,000. Incorporators: Manning Mayfield, Henry G. McPike and John F. McGinnis.

The Calumet Electric Manufacturing and Engineering Company, Chicago. Capital stock, $10,000. Incorporators: Lucius Alvin Hine, George Edenson Lorman and E. M. Ashcraft.

The Belt Line Electric Company, of Superior, Wis. Capital stock, $600,000. Incorporators: R. C. Pope, G. R. Smith and W. B. Perry.

The Metropolitan Development Company, Norfolk, Va. Capital stock, $100,000. The company's purpose is the construction or repair of works of internal improvement in the United States and Territories, and to operate water, gas, pneumatic power and electric works.

The Freeport Telegraph and Telephone Company, Freeport, Sacramento County, Cal. Capital stock, $40,000. Directors: D. T. Lufkins, H. T. Lufkins, F. Kunsting, Geo. Lawlor, J. G. Hite and H. T. Huggins. The company will construct, maintain and operate a telephone and telegraph line from Sacramento to Freeport and thence down the Sacramento River to Richland and to other points.

The Metropolitan Gas and Electric Light Company, Omaha, Neb. Capital stock, $200,000. Incorporators: J. H. McMurthy, K. K. Hayden, E. Finney, of Lincoln; Thomas J. Ross, of Chicago, and A. M. Coffman, of Boston.

Flatbush District Telegraph Company, Flatbush, N. Y. Capital stock, $10,000. Directors: William L. Lynan, Henry Hesterberg, Isaac Davis John Maguire and James Ryan, of Flatbush, and William H. Piarson, of Brooklyn. It is proposed to construct and operate lines of telegraph and telephone from the city of Brooklyn to the patent line dividing the city from the town of Flatbush, and from said patent line through Flatbush and the towns of Flatlands and Gravesend.

Conestoga Valley Railway Company, Lancaster, Pa. Capital stock, $600,000. The company proposes to build an electric car line from the city of Lancaster to the city of Reading, a distance of thirty miles. The road will traverse a thickly populated section of country.

A number of Webb City, Mo., capitalists have procured a certificate of incorporation, the object being to construct and operate an electric motor line from Webb City to Carthage, a distance of twelve miles. The same company intend to construct a belt line connecting Webb City, Carterville, Johnstown, Prosperity and the principal mines.

The McKeesport Telephone Company, McKeesport, Pa. Capital stock, $50,000.

Columbian Manufacturing Company, of Binghamton, N. Y. Capital stock, $20,000. Directors: Eli S. Meeker, R. W. Meeker, S. H. Sharpsteen, of Binghamton, and others. To own and operate a machine and repair shop, and to manufacture and sell water and electric motors.

The Central and South American Telegraph Company has filed with the Secretary of State at Albany, N. Y., a certificate showing that its capital stock had been increased from $6,500,000 to $8,000,000. The amount of capital actually paid in is $6,088,000.

Municipal Electric Company, Decatur, Ill. Capital stock, $25,000. Incorporators: John N. Culver, James M. Willard and Elmer E. Gibson.

The Kankakee Telephone and Electric Company, Kankakee, Ill. Capital stock, $35,000. Incorporators: Milford Hatch, Frederick C. Ehrich and Irvan W. Powell.

ELECTRICAL PATENT RECORD.

Letters Patent Issued January 24, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

490,297. Electric-Railway Conductor. Howard A. Miner, New York, N. Y. Filed June 2, 1892.

490,806. Closed Conduit for Electric Railways. Russell Parker and Benjamin F. Sutton, Brooklyn, N. Y. Filed Jan. 9, 1892.

490,807. Electric Locomotive. Alexander Philipsborn and Max Schiemann, Berlin, Germany, assignor to Siemens & Halske, same place. Filed April 14, 1892.

490,597. Conductor System for Electric Railways. Raphel Hayden, Fairmont, W. Va. Filed April 13, 1892.

DYNAMOS AND MOTORS.

490,290. Electric Motor. Julius W. Hansen, St. Paul, Minn., assignor of one-half to William H. Elmers, same place. Filed Sept. 25, 1891.

490,376. Armature for Dynamo-Electric Machines or Motors. Elihu Thomson, Swampscott, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed July 10, 1892.

490,449. Dynamo-Electric Machine. Robert Lundell, Brooklyn, N. Y., assignor of two-thirds to Edward H. Johnson, New York, N. Y. Filed June 21, 1892.

490,460. Dynamo-Electric Machine. Charles Wachtel, Newark, N. J. Filed June 13, 1892.

ELECTRIC LIGHTS AND APPLIANCES.

490,605. Electric Lamp Socket and Tap. Alexander F. Vetter, New York, N. Y., assignor to J. C. Vetter & Co., same place. Filed May 20, 1892.

TELEPHONE AND TELEGRAPH APPARATUS.

490,534. Support for Telegraph Cables. Frederick Le B. Bedwell, London, England. Filed Sept. 26, 1892.

MISCELLANEOUS.

490,279. Electric Meter. Oscar Frolich, Berlin, Germany, assignor to Siemens & Halske, same place. Filed Nov. 16, 1892.

490,292. Cut-Out for Electric Circuits. Michael Leavy, Pittsfield, Mass. Filed June 16, 1892.

490,302. Insulator. Louis McCarthy, Boston, Mass. Filed July 8, 1892.

490,327. Electric Annunciator System. Henry Van Hoevenbergh, New York, N. Y. Filed March 24, 1892.

490,353. Electric Mat. William G. James, Harlem, Ill. Filed Sept. 29, 1892.

490,358. Electrical Musical Instrument. Anacleto Montanelli, Portland Ore. Filed May 31, 1892.

490,363. Electric Switch. Albert L. Lohrer, Lynn, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed March 17, 1892.

490,477. Electrical Connecting Device. Joseph Hutchinson, New York, N. Y. Filed Sept. 16, 1892.

490,479. Electric Show-Case Alarm. Rudolph C. Kruschke, Duluth, Minn. Filed July 9, 1892.

490,545. Elevated-Railway System. Charles Drill and Henry J. Schmitt, St. Louis, Mo., said Schmitt assignor to said Drill. Filed Feb. 18, 1892.

490,560. Insulator. Auguste J. Hauty, Saltsburg, Pa., assignor of one-third to John Burke, same place. Filed Aug. 29, 1892.

490,626. Railway Signal. Ira L. Green, Kittanning, assignor, by direct and mesne assignments, of five-sixths to James M. Patterson, Sharpsburg; George M. Fox, Wythington Reynolds and Christopher C. Shadle, Kittanning, and Marcus D. Wayman, Ford City, Pa. Filed Jan. 9, 1892.

490,630. Electric Conduit. Ernest L. Ransome, Oakland, Cal. Filed April 5, 1892.

ELECTRICITY.

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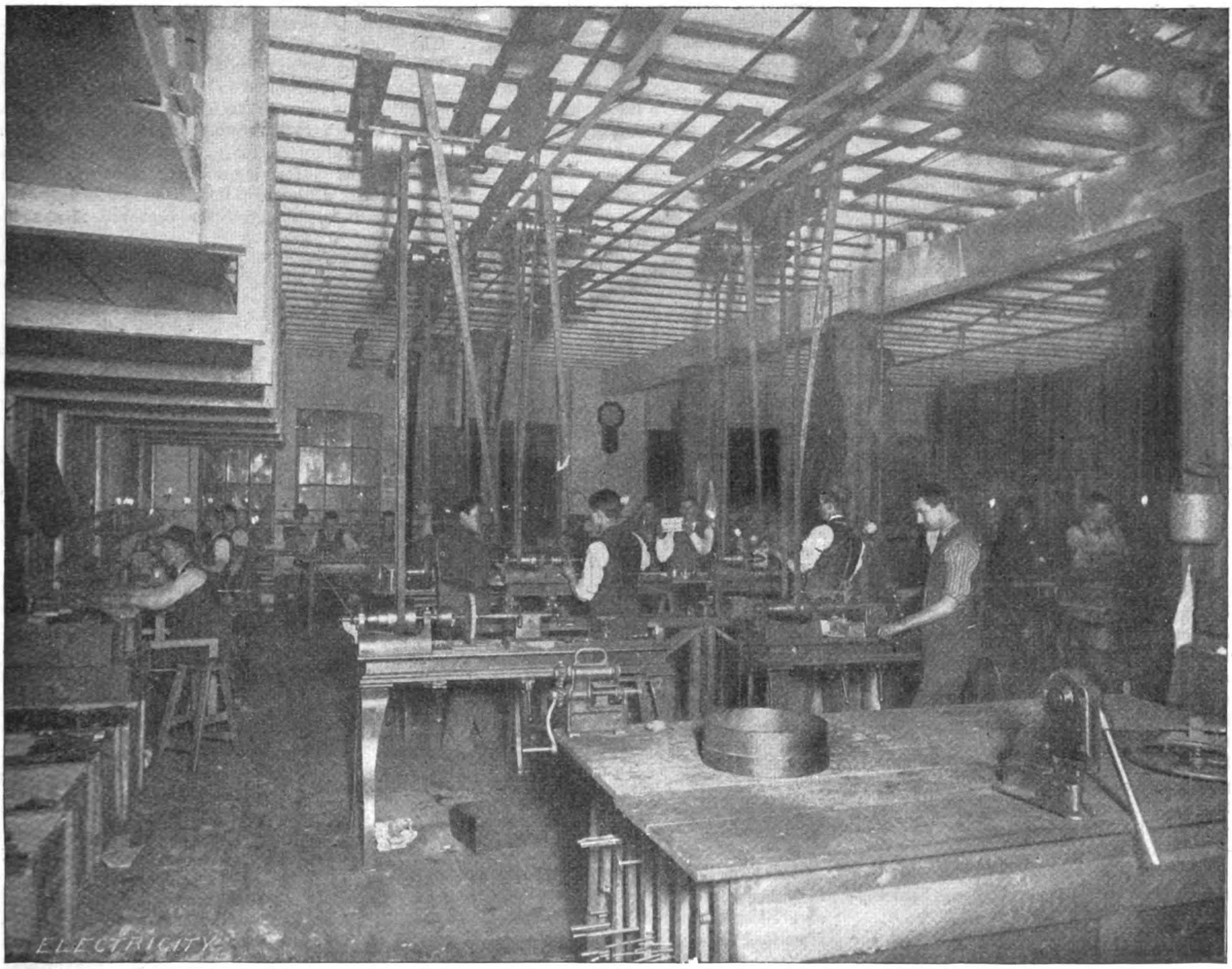

MACHINE SHOP.—ELECTRIC GAS LIGHTING COMPANY'S FACTORY, BOSTON. (SEE PAGE 38.)

A Boston Enterprise.

A Scrap of Electric Gas Lighting History.

Largely owing to the fact that the two most important and best known departments of electrical science—lighting and railroading—have each made phenomenal progress during the last decade, the amount of capital invested at the present time in the business footing up to well nigh the substantial sum represented by $1,000,000,000, many persons have arrived at the conclusion that these two departments include about everything of importance or consideration in the electrical field. Such is not the case by any means, for the electric current has become quite ubiquitous. It may be said to have conquered the world, and if we may be pardoned for using the simile, this subtle force, like Alexander the Great, is awaiting the discovery of "other worlds to conquer."

COL. L. W. BURNHAM.

It is hard, indeed, to find many forms of human service to which electricity is not adapted. No man of progressive ideas, and for the matter of that, woman either, thinks of building a house or business premises without the now all necessary electrical equipment, every section or branch of which ensures the sweetening of human tempers, together with the lengthening of human life. The feminine section of the community nowadays insists on the family sewing machine, the baby's cradle, the ventilation of the house, and many other domestic duties being relegated to the never complaining care of the electric current through the medium of fans, motors and other handy and efficient devices.

And what is true in the foregoing allusions is doubly true when we include in our estimate the inconveniences of darkness, to say nothing of its dangers, a perfect horror of which all women naturally entertain. To overcome that dread in the feminine mind, as well as to add to "all the comforts of home," various inventors, backed by capitalists, went to work in the early days of applied electricity, and were not long ere they produced something which supplied what, in hackneyed phraseology is termed "a long felt want." This "something" was an electric gas-lighting device, the early pioneers in the exploiting of which, after several futile attempts had been made and failed, were men whose names and acts we propose to enumerate, in the belief that our readers will be interested in learning something of what has been attempted and by whom accomplished in making electricity a very important factor in the domestic life of this and other countries, while building up a business that any-one ought to be proud of.

It was in August, 1880, at Bath, Me., that the initial step was taken in the direction of organizing the National Electric Gas Lighting Company, and in that city the movement was consummated by the incorporation of a company under the above title with a capital of $500,000. A board of directors was at once elected and one of Boston's most popular ex-Mayors was made president. At first, and for some little time, the enterprise "made haste slowly" through lack of means and owing to poor management, until September, 1881, when Mr. Louis W. Burnham was induced to accept the dual position of president and manager, several personal friends at once entering the board of directors and furnishing capital sufficient to begin business on a practical scale.

A number of very valuable patents were purchased, and parties who were known to have been infringing these patents speedily received attention and were brought to terms. The new president-manager soon realized that the company had not been satisfactorily handled, while its methods were somewhat irregular. In view of this condition of affairs a new company was organized under the title of "The Electric Gas Lighting Company," with a capital of $250,000. The incorporation was made at Portland, Me., in April, 1882. All the property and franchises of the old company were purchased and new directors elected.

The board included Mr. John N. Barbour, Dr. W. C. Cutler, Mr. Alvan A. Sweet, Mr. John Hopewell, Jr., Mr. W. H. Dyer and Mr. Louis W. Burnham, the last named also being elected president and Mr. Barbour treasurer.

At once contracts were made with a manufacturing company in Connecticut for the construction of a regular line of electric gas-lighting apparatus. Under these contracts goods unsuitable for the trade were made after over a year's delay, when a change was deemed necessary. The Western Electric Company then undertook to manufacture the goods—this was in February, 1885—continuing to do so until the following July, when that company removed its Boston business to New York City.

The Electric Gas Lighting Company thereupon determined to manufacture its own goods. In November of that year, factory rooms, machinery and power were leased from the New England Manufacturing Company, in Hamilton street, Boston, and operations were begun with about a dozen men. It was but a short time before these facilities were outgrown, and a new factory was secured and leased at 173 Devonshire street and from that time on the business has constantly grown.

In May, 1885, Mr. Joseph S. Fay, Mr. E. G. Byam and Mr. Jacob M. Haskell, of Boston, and Mr. Francis C. Foster, of Cambridge, all well-known business men, were chosen as the company's directory in place of Mr. Dyer and Dr. Cutler, resigned. New funds were added to the enterprise, and Mr. Fay was elected president in December, 1885, Mr. Louis W. Burnham becoming vice-president and continuing general manager.

This proved to be the real starting point from which the company's success dates. From a business aggregating sales valued at $15,000 in 1885, it expanded until at the close of last year, 1892, it had done a business of $150,000 in that single year.

During the first five years of its existence this company evidently had an uninterrupted hill to climb. Having been organized to engage in a strictly electric gas-lighting business, its patents were constantly being infringed and its business interrupted by unscrupulous firms, until it found itself, for its own protection and well being, compelled to abandon the original idea of making and selling electric gas-lighting apparatus exclusively. So in 1886 the company branched out into a general domestic electrical business, and at the present time is entitled to rank as one of the leading and most extensive companies of its kind in the country.

The more clearly to convey some idea of what it is doing to-day, we publish herewith a series of cuts illustrative of the new factory which has been leased for a term of years, being 240 Dover street, Boston, where its multitudinous devices and specialties are manufactured by a large corps of expert electricians and mechanics who are kept constantly employed by virtue of their skill and the high class work they can turn out.

The factory building is of brick, six stories high, well lighted on both sides, having a spacious entrance, with freight elevator almost large enough to accommodate a freight trolley and pair of horses.

The cut forming our Frontispiece shows the interior of the main floor which is largely covered with machinery of the best and most modern types, including screw machines, die presses, stamping machines, lathes, drills, shears, punches, magnet winding machines, emery wheels, polishers, buffing wheels, indeed every kind of tool necessary for turning out large quantities of all kinds of metal work. As will be noted, there is little spare room on this floor which is occupied by nearly forty artificers.

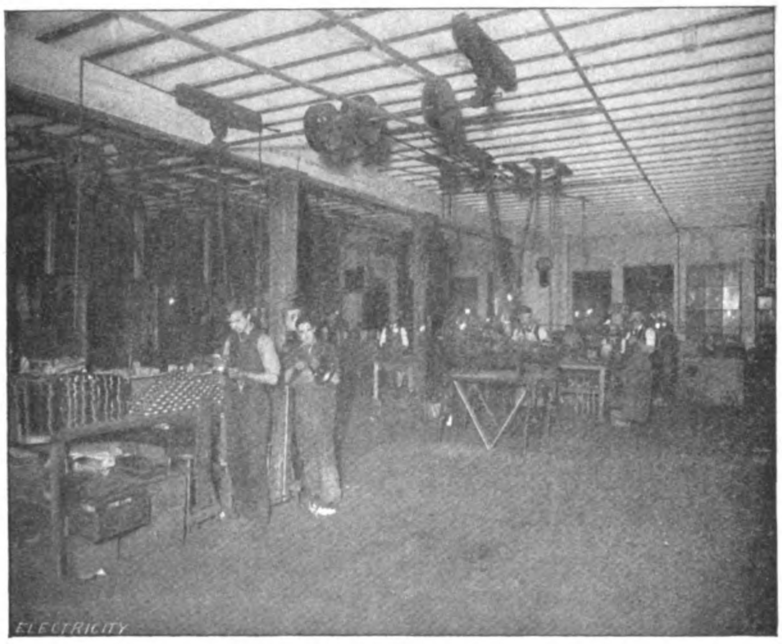

FIG. 1.

The second cut shows the department where magnet winding is in progress and the assembling of the various devices from the many parts large and small made in the other part of the factory is going on, in other words, where the articles are put together.

The third cut is another view of the factory where raw material is being rapidly transformed into almost every conceivable shape and size requisite for completing one or another of this company's special line of goods.

The fourth cut shows a view of the extensive stock room wherein is kept constantly on hand a large and valuable stock of material, including iron, brass, steel, copper, platinum, mother of pearl, bronze, wires of all sizes and qualities, covered and bare, etc., etc.

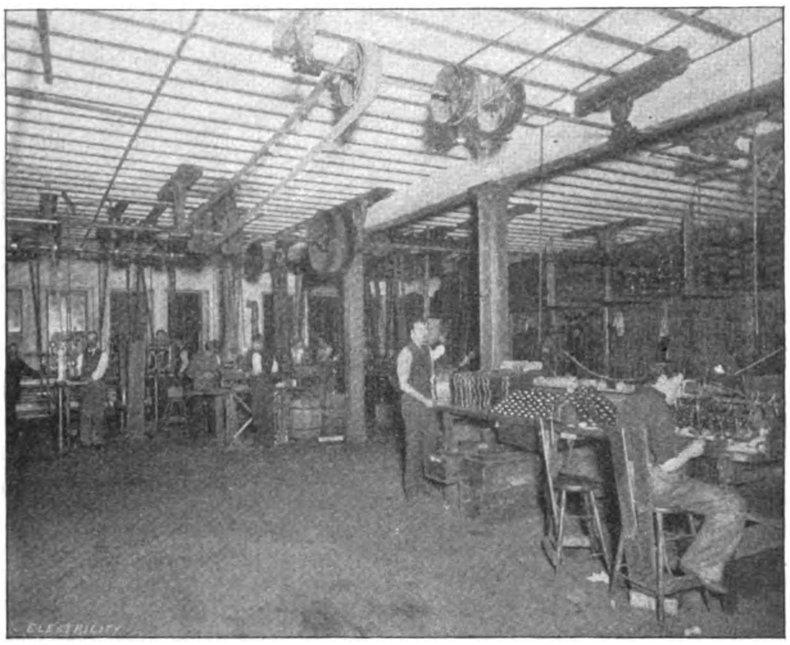

FIG. 2.

The factory office is shown in this cut. In addition to the factory as shown there is a separate room devoted to the exclusive purpose of manufacturing the zincs for the famous "Samson" battery, on which a special corps of men is kept constantly at work, the output of this specialty alone amounting to nearly nine thousand monthly. Then there is the electroplating room, where, with the aid of a complete and extensive plant, every kind of gold, silver, copper, bronze, nickel and other plating is done under the supervision of one of the leading experts in this department of business.

Adjoining the plating room is the polishing room, where, with the aid of several buffing and polishing machines, the finest work is done by first-class men only.

Not only is the floor of this large factory fully utilized, but even the space overhead along each side of the factory from front to back has had to be utilized for the storing of polished wood and fibre goods, such as cases, frames, etc., for annunciators, bells, push buttons, alarms and other appliances.

So complete and efficient is the staff of men employed that little has to be done outside. From the handling of crude brass, copper, iron, steel or platinum, to the finishing in paint, gold or varnish, men are employed to do it all.

It need hardly be stated that for the regular and orderly administration of the manufacturing business of this company every department is controlled and operated in a most precise and methodical manner. Waste, extravagance, irregularity of any kind is impossible. Superintendent Lane and Foreman Galbraith, both men of wide experience and fine ability, take care that everything shall run smoothly, and the interests of the company and its employees are alike carefully watched and secured. It may incidentally be stated here that the special tools used in the business are made by men specially employed for that purpose.

As will be perceived, the foregoing is a description of the factory only; the sales, shipping and clerical departments of this prosperous company being on Devonshire and Arch streets, where an immense and complete stock of electrical goods is carried and where, cosily ensconced when he is not on the road somewhere between the beginning of creation and the day of judgment, hustling after business, may be found Mr. Louis W. Burnham, the genial and enterprising general manager, whose portrait, at the opening of this article, will be quickly recognized by his many friends in the electrical business.

Mr. Burnham enjoys so wide a circle of acquaintance and has achieved so marked a degree of success that we feel tempted to close this article with the briefest allusion to his life and its varied activities.

As he has informed the writer, young Burnham was born at Canterbury, Conn., in 1831, where he remained with his parents until he was nearly eighteen years of age. Up to that time he had busied himself in many ways, working at various employments when he was not adding to his fund of knowledge at school.

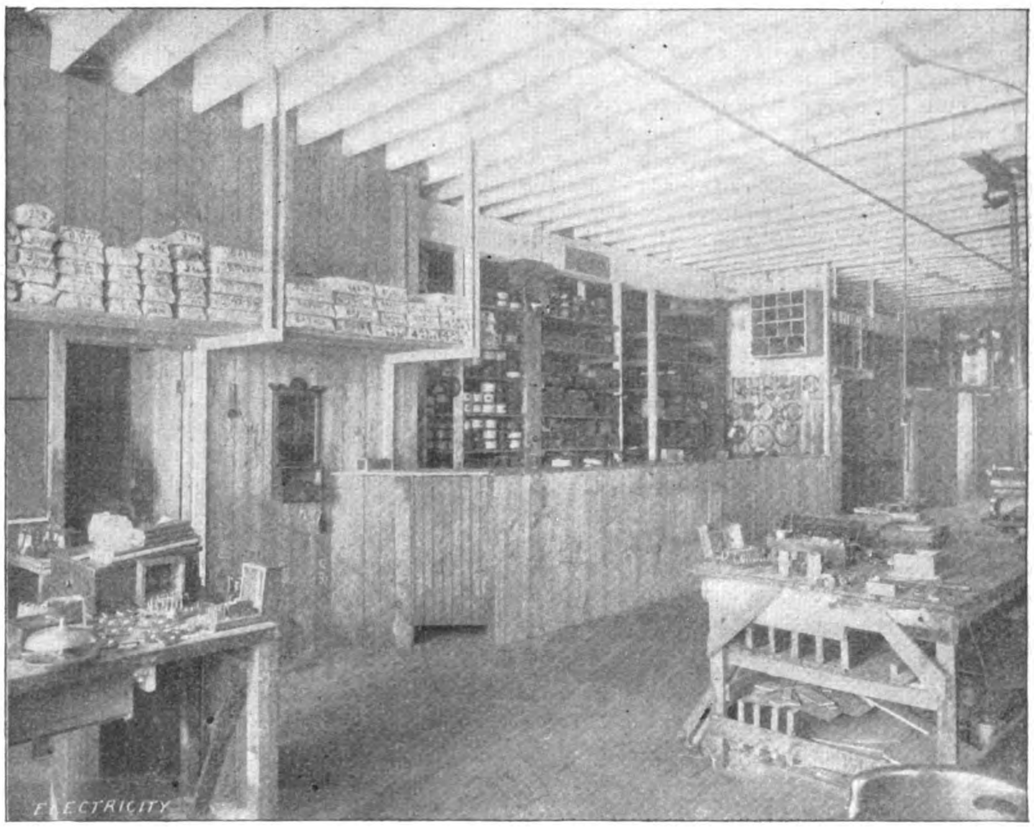

FIG. 3.

His earliest experience in commercial pursuits was gained at West Brookfield, Mass.

As an expert penman he travelled through the Eastern and Middle States conducting classes in writing with great success.

He subsequently held appointments in leading seminaries and academies, at some of which he taught large numbers of pupils. For a time he studied law; went West in 1855, engaged in Commercial College work, and became a prominent citizen and city clerk of Rockford, Ill., during the years 1856-57. The West not suiting the health of his family, he returned East in 1863, and established a very successful business college at Springfield, Mass. But the arduous labors attending the management of a successful institution of this kind undermined his health, and he had to abandon what was otherwise a most congenial and profitable enterprise. After recuperating for some time, Mr. Burnham assumed management of the New England department of a New York Life Insurance Company, which under his enterprising care expanded rapidly. He assumed this position in the spring of 1868, and continued in it until 1881, when he was appointed president and manager of the company with which he is still identified, a company whose phenomenal growth under his sagacious management we have endeavored to outline in the early part of the present article.

The Steam Equipment of Modern Central Stations.

BY ALFRED A. HUNTING, M.E.*

The first consideration in arranging a central station is location. It should be near the centre of distribution of powers. Calculations should be made of the probable growth of business in all directions, so that it shall be centrally located for as long a period as possible. If several stations are to be used jointly to supply a large district, they should be so located with reference to each other that each section will be amply provided for, and that in case a station should become disabled the others can supply the deficiency without disarranging the general service if at any time a heavy demand is made in any one section or by the whole district.

In choosing a site for a station, accessibility for delivery of fuel and disposing of ashes with the smallest amount of manual labor possible is of the greatest importance. The saving that can be made by careful planning at first will decide whether the station will be a success financially or not. The storage for coal should be so arranged that it will not have to be handled at all after it is landed from the car or ship. A receiving bin should be arranged, if coal is to be received by cars or boat, where the coal can be dumped, and from which a mechanical conveyor shall carry it to bins situated higher than the boilers. Each bin should have its own scale, and all coal weighed. A shute to land the coal in front of each boiler if they are stoked by hand, and to deliver to the mechanical stoker if the stoking is done mechanically. The weight of the coal should be recorded when each bin is filled, and each draught for a boiler should be charged to the boiler served; this not only checks the weight of the coal, but also shows just what each boiler is using, and will help to quickly determine at any time the duty each boiler is performing.

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*Read before the Thomson Scientific Club, Lynn, Mass. Thursday, January 26, 1893.

If the ashes cannot be dropped so as to be delivered to cars by gravity, they should all be dropped to a central bin, or bins, and from there be carried by mechanical conveyors to cars. The saving in manual labor will be the interest on a large investment. The power to be used should be carefully estimated, not only what the first demand will be but what the development of the future will call for. Accurately lay out and measure for the whole plant, and build the building to accommodate the machinery, and not first build the building and then make the machinery adapt itself to the building. The building should be set on heavy foundations, and as near fireproof as it is possible to make it, with plenty of light and air. In arranging for foundations where piling has to be done be sure and cut the piles well below high water mark. There is constant change of water level where the land is back from the immediate water front. This was shown plainly to the writer about one year ago. The foundations of a building in Boston that had been built some years began to settle, cracking the walls and piers. The attention of the owners was called to the matter, as was the building inspectors. An investigation was made by digging down around the walls and piers. It was found that the water had changed its level, and that the caps of all the piles was about five (5) feet above high water. The piles were oak and of good size, but because of the water not getting to them properly dry rot had set in causing them to be so bad that pulling them apart with the fingers was an easy matter. What caused the water to change its level?

First, there have been large sewers put in the neighborhood.

Second, buildings that have been built since have had their foundation walls carried down deeper, which kept the water back; and since the foundations of the old buildings were changed the water level has changed again to about one (1) or two (2) feet lower. This was caused by a large building being put upon the side the pressure came from. The result is, the old building must come down in the near future. Quicksand is bad to put foundations on, but there are worse things than that to contend with. A large section of land in the vicinity of the Boston Post Office is a quicksand at a level where foundations should begin. There has been a constant settling of the Boston Post Office ever since it was started. A building on an opposite corner from the Post Office was built on very bad quicksand. The earth was excavated until the "*live*" sand became too bad to handle. Concrete was made of broken stone and French cement, to the thickness of about six (6) feet. This cement hardens to a consistency of stone. Here was a floating foundation. It has always remained plumb and has never settled. Screw piles have done good service in quicksand. Every situation where the substrata are not known should be bored in numbers of places to be sure of just the conditions to be met. Even rock foundations must be carefully examined, as in places where there is considerable dip to the rock, and there is water between the earth and rock foundations, they are apt to slide, especially where there is much vibration. In such cases anchors should be put in, by cutting deep into the solid rock, building into them with heavy masonry strong enough to stand any thrust that may be put upon them.

The machinery should be so arranged that those in charge will not have to go up and down more than is absolutely necessary to get at the different working parts. Arrange so that hoisting apparatus and travelling cranes will be available at every point for facility in handling material in cases of inspection or for repairs. Also remember to arrange that the different machinery can be taken down if occasion requires, and with as small expense as possible. This matter is often never even thought of.

The chimney should be carefully studied; the height and area must all be calculated with accuracy. If the chimney is to be of great height, it is a matter of the greatest importance that the foundations shall be of the best possible construction. Time and money spent in foundations pay. The shape is a feature of more than passing importance, as wind and weather are constantly deteriorating the material. There are few tall chimneys that are plumb.

The best form is the round chimney and one with but little ornamentation at the top. All projecting parts are simply levers for the wind to act upon.

The force of wind at

50	miles per hour is	12.300	lbs. per sqr. foot.
60	" " "	17.712	" " " "
70	" " "	24.103	" " " "
80	" " "	31.488	" " " "
100	" " "	49.200	" " " "

This gives a chance for racking and straining that does not appear at the first thoughts given to chimney construction. The draught of the chimney is of great importance. When the temperature and density of the air inside the chimney is equal to that of the outside air there will be no tendency to produce motion, the air inside the chimney being heated, consequently becoming of less density than the outside air, the excess of pressure exerted by the outside air will force the column of air inside the chimney upwards; this pressure of draught is equal to difference in weight of the two columns of air. The volume of atmospheric air is increased in the ratio of one (1) to one and three hundred and sixty-five thousandths (1.365) in rise in temperature from 32 degrees to 212 degrees F. under constant pressure; and where the volume is constant the pressure is increased in the ratio of 1. to 1.3665. The expansion under constant pressure is uniform and is at the rate of $\frac{1}{493.2}$ part of 32 degrees F. for each degree of rise of temperature, say the fraction $\frac{1}{493.2}$. At this rate of contraction the absolute zero of the Fahrenheit scale, or point of no heat, is $(493-32) = 461$ F., or 461 degrees below zero on the scale. This is the coefficient of expansion of gases on the Fahrenheit scale.

It has been found in practice that the best results in the draught are obtained when the density of external atmosphere is to the density of the gases in the shaft as two (2) to one (1), or when the temperature of the escaping gas is about 580 degrees Fahrenheit. Above this there is no practical gain in the draught and a great waste of fuel takes place. It is also very injurious to the bricks and mortar. It is also found that with a lower exhaustion than one-half inch of water pressure it is difficult to keep a good fire without constant stirring, which is waste of fuel and produces smoke. Syphon water gauges are commonly used to take draft off chimneys, the exhaustion being given in inches of water. A cubic foot of water at 60 F. weighs 62.5 lbs., therefore the density of air is $\frac{1}{817}$ that of water. If W equals the theoretical draught of shaft in inches of water pressure, H the height and V the velocity, then

$$W = \frac{H \times 12}{817} \text{ and}$$

$$V = 66\sqrt{W}.$$

In building a chimney an allowance of say 25 per cent in the power of the chimney should be made for future additions. It is next to impossible to determine the actual velocity of the gases in a given chimney, as the conditions affecting the draft vary from day to day; the direction of wind, barometer, coal and care in firing each have a share in the actual results.

The boiler should be selected with great care. Much care should be given to all details in locating. Accessibility to all parts must be had for repairs and inspection. Give plenty of head room, and make the boiler room as light and airy as possible. Comfort for the firemen should never be omitted. They can do much more work, their health be better, and everything more satisfactory where these points are looked after. All foundations and settings should be done in the best manner; so much is hidden that much poor work can be done and not show if inspection is not carefully carried on at all times in construction. High pressure and high evaporation duties are what will accomplish the results that engineers are looking for. The Committee of Judges of the Centennial Exhibition to whom the trials of computing boilers at that Exhibition were intrusted adopted the unit—thirty (30) pounds of water evaporated into dry steam per hour, from feed water at 100 degrees F. and under a pressure of seventy (70) pounds per square inch above the atmosphere, these conditions being considered to represent fairly average practice. The quantity of heat demanded to evaporate a pound of water under these conditions is 1110.2 British thermal units, or 1.1496 units of evaporation. The unit of power proposed is thus equivalent to the development of 33.305 heat units per hour, or 34.488 units of evaporation. The unit of evaporation is taken as a certain weight, preferably unit of water evaporated "from and at" the boiling point under atmospheric pressure. The now accepted unity of boiler power in the code constructed for the American Society of Mechanical Engineers is the equivalent of the Centennial standard, and in all standard trials the commercial horse power is taken as an evaporation of thirty (30) pounds of water per hour from a feed water temperature of 100 degrees F. into steam at seventy (70) pounds gauge pressure, which is equal to thirty-four and one half ($34\frac{1}{2}$) pounds of water evaporated from a feed water temperature of 212 degrees F. into steam at the same temperature. This standard is taken as the equivalent of 33.305 thermal units per hour. A boiler rated at any stated horse power should be capable of developing that same power with easy firing, moderate draught and ordinary fuel while exhibiting good economy; and the boiler should be capable of developing one-half ($\frac{1}{2}$) or one-third ($\frac{1}{3}$) more than its rated power to meet emergencies at times when maximum economy is not the most important object to be attained. Boilers in regular duty are evaporating ten (10) lbs. of water per pound of coal. If the feed water could be heated to 212 degrees F., this would be better than twelve (12) pounds of water evaporated per pound of coal. As more attention is paid to the boiler the higher will be the efficiency until we get nearly to theoretical evaporation.

The temperature of the gases should be closely watched, and not allowed to go to waste at over four hundred (400) degrees F. The difference in cost of generating steam at a pressure of eighty (80) pounds and of steam at one hundred and sixty-five (165) pounds is 2.25 per cent. in expenditure of coal, and again of over 100 per cent. in power. With a properly constructed boiler, there is no more danger in carrying one hundred and sixty-five (165) or two hundred (200) pounds of pressure than there is in carrying sixty (60) or eighty pounds in the ordinary boiler. I well remember when it was thought to be a remarkable thing to see a gauge record one hundred and five (105) or one hundred and ten (110) pounds pressure on locomotive and marine boilers; now it is an exception to find a modern locomotive or a marine boiler that carries less than one hundred and fifty (150) pounds, and some as high as two hundred (200) pounds. It is practicable to carry such pressures on locomotives and marine boilers. They are subjected to heavy strains and vibrations that stationary boilers never are or can be subjected to. There is hardly a limit to pressure that can be carried by a well constructed boiler. Pressure means heat, and heat pressure. By high pressure the latent heat is absorbed, and the theoretical power comes nearer to being realized. The engines must be selected with a view of carrying the economy to its fullest extent. When compound engines were first introduced they were not received with favor. A simple engine used condensing was good enough. The fact that long voyages by steamship were not profitable led John Elder to study into the matter. He built triple expansion engines and boilers to carry high pressure. The result enabled steamships to be built of enormous proportions and of great speed, and they *pay*. Why? Because of the great saving in coal consumption, which enables steamers to carry so much more paying freight. There is much difference between the consumption of one pound of coal per horse power per hour and the consumption of five pounds per horse power per hour. There are still engineers that scoff at new-fangled ideas of multiple cylinder engines, notwithstanding the consumption of coal per horse power per hour is lessened every year by more science being put into the construction of engines. In selecting engines, there are several things to consider. First, economy in consumption of steam. Second, strength of all parts, good workmanship and regulation. By all means avoid an engine that will run away when relieved of load. Third, simplicity, that they may have few parts, be of long life and the cost of repairs a minimum. Do not adopt an engine because it is fashionable but because of merit. If there are heavy constant loads, divide the power into as large units as possible with triple or quadruple expansion engines. In street-railroad work, the triple expansion engine is better than the ordinary compound. Speed is more uniform; it is more elastic, adapting itself to the inequalities of load with greatest ease and without shock.

There are places where condensing would be very expensive, because of the cost of water. But within two or three years even this has been overcome by pumping the circulation water to shallow tanks on the roof, the water falling from one tank to the other, until the temperature is reduced sufficiently for a cooling medium.

There have been several successful ways devised to do condensing even where water is almost prohibitory. Wherever you can, use condensing engines. When you cannot condense, compound them. For small engines, say of fifty (50) to seventy-five (75) H. P., it would not pay to put in a condenser for a single engine, but where several small engines are used, by tying them all to one condenser a large saving can be made. There is no fixed rule to go by in steam engineering; what may be admirably adapted for one case would not do as well in another. Keep well posted, and be able to judge what will be the most advantageous scheme to adopt at each station. Make careful drawings of everything, in plan and elevation; if all cannot be shown properly without, make sectional views. Every detail should be worked out. The drawings should be so carefully made that any serious defect will at once appear. It is much cheaper to remedy a mistake on a drawing than after the plant is partly erected. Too much care cannot be given to the drawings. It used to be said of John Ericsson that he scarcely ever went to look at machinery from his designs, he was so sure of his drawings that he knew the machinery would work.

In piping, avoid all abrupt turns. Put in large radius curves of bent wrought iron pipes. If the run is long, the flanges should be of steel bent on as large radius as possible, riveted to the pipes and the flanges riveted together. The expansion and contraction will be cared for by the curves in the flanges on the principle of an accordion. This avoids all slip joints and expansion joints, which should always be given a wide berth.

Where valves and fittings have to be made into the pipes, the flanges should be tongued and grooved, with heavy bodies, and ribbed. Separators should always be put in close to the engine, and after the pipe passes the separator it should be enlarged to form a receiver of a capacity of about five (5) times the fill of the high pressure cylinder. This always ensures constant pressure and saves shocks and pulsation in the steam pipe. It also saves the strain on the flanges, and the pipes will be free from leaks. The separator gives dry steam and catches any water that may accumulate in the pipes and keep it from going to the engine. It is practically a filter. There is no power exerted by the water in passing through the engine other than to do damage. Whatever per cent. of water is in the steam is so much power taken from the steam and wasted, and the pressure of water in the steam acts as a condenser, which makes the per cent. of water grow larger in long pipes. All steam pipes should be covered with the best non-conductor possible. It keeps the pipes of nearly a uniform temperature, avoiding condensing of steam, reduces the expansion and contraction of the pipe due to cold draughts and other causes. All piping to be in duplicate, so that if by chance any part of it gets disabled the engines will not have to be stopped. There should be good broad walks running beside each run of piping, accessible by easy means; where, as in many places, the pipes are high up, a small, quick running elevator would prove of great service not only to be used to get up quick but to carry up any needed tools or materials. Everything should be easy to get at. It may be of inestimable value some time when least expected.

The pipes between condensers and engines should be of ample size, for the place the vacuum is needed is in engine cylinder not in the condenser. Ample condenser, ample pipe, with as few bends as possible, give best results. I have seen twenty-six (26) inches of vacuum on gauge at the condenser, and only two inches vacuum in the engine cylinder. Cause, small piping. A heater should be put in between the engine and the condenser; it will give all the heat due to vacuum carried. After passing through the first heater, an auxiliary heater should be put in, steam from pumps passing through that. The result will be water at about 207 or 208. This helps largely in economy of fuel. The drips of the engine should all be connected with the condenser. By so doing, a quick start can be made at any time. Simply open drips; the condenser takes the cold air out and steam being admitted to the cylinder the waiting to slowly warm up is avoided. After engine comes to speed, shut drip and you are all right.

There are few uses that an engine can be put to that the load will be so uneven as in street-railway service, especially if there are heavy grades. Consequently the engines must be built purposely for such work, and should be much heavier than for ordinary service. These engines must be ready at all times for service, as a call for extra power may come at any moment. Extra engines should be put in so that the maximum load can be carried at all times.

All jack shafts must be large, with bearings long and close together, the foundations for the bearings so placed that vibration shall be reduced to a minimum. Bending and vibration of a jack shaft causes friction, which is so much taken from the power. When a jack shaft and friction clutches are to be used, a quill relieves both shaft and friction clutch. The shaft runs in its own bearings, the quill has bearings of its own. There is no heavy weight of pulleys and clutch sagging the parts running dry and heating. A friction clutch should be of as few parts and simple as possible, the running balance true. This will save vibration and add to the security and life of the plant.

There should be a log kept, showing just what each man does, giving in detail everything that happens, amount of all material used of whatever kind, time of coming and going of every man connected with the engineering department. By this you will be surprised to see how quickly faults and causes of accidents can be located. Each man will have an interest to do well. You will soon find the personal of the employees to be high. Each man will have a personal responsibility and know that his record can be seen by all the others at any time. Avoid complication, simplicity is the great success of engineering. In drawing specifications, do not use ambiguous terms or ask for impossible things. Be sure what can be done; ask for, and see that it is.

Manufacturers of steam engines and boilers who are up with the times know what will give best results as to detail and construction. Put the responsibility on them. Do not try to outdo some one else in fertility of invention, then, by robbing the machinery of its symmetry, smoothness in working and efficiency. If you have a rea invention, try it first where it can do no harm it does not work at the first trial. Few engineer are asked or paid to invent. They are paid assemble the best ideas of others and put them in shape to obtain best results for their clients.

ELECTRICAL COMPANY ELECTIONS.

Missouri and Kansas Telephone Company, Kansas City, Mo. President, John R. Mulvane; secretary, W. W. Smith; treasurer, N. R. Ferguson; directors, John R. Mulvane. T. B. Sweet and Edward Wilder of Topeka; C. E. Yost and A. Burt of Omaha; A. G. Fuller of Chicago, J. E. Hudson of Boston, S. A. Walker of St. Joseph and J. S. Chick of Kansas City.

Boulder Electric Light Company, Denver, Col. Dr. I. L. Bond, president; J. H. Nicholson, secretary; George M. McClure, treasurer; directors, Dr. I. L. Bond, J. H. Nicholson, George M. McClure, B. M. Williams and Dr. Renel Bartlett.

Jersey City Electric Light Company, Jersey City, N. J. President, Horace H. Farrier; vice-president, George B. Wilson; secretary and treasurer, Geo. H. Farrier; superintendent, W. W. Titzell; directors, Horace H. Farrier, Geo. B. Wilson, H. C. Adams, C. T. Friend, C. G Foye, G. V. Bartlett, Hiram Wallace.

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GEORGE R. METCALFE, - - - EDITOR.
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"Electricity," under its present ownership, has never solicited the advertising patronage of the General Electric Company.

The Goebel Lamp.

During the past week the unusual interest attaching to the strong defense submitted by the Beacon Company in the injunction suit brought by the General Electric Company has been raised to the highest pitch by the seemingly incontrovertible evidence adduced by the defendants to establish the fact of the priority of invention of the incandescent lamp by Heinrich Goebel and thus invalidate the claims of the Edison incandescent lamp patent.

The character of the evidence submitted at the first hearing of the case was such as to arouse the deepest interest of the electrical profession and to turn the tide of popular opinion in favor of the newly discovered inventor, and the additional evidence introduced during the past week has been more than sufficient to confirm this opinion in the minds of the laity.

At the present writing the question appears to resolve itself into one of scientific import, as the number of the defendants' witnesses, amounting to fifty or more, practically precludes the possibility of error or fraud in regard to the time when Goebel's work in this field was prosecuted. Aside from the question of priority, however, the defendants' case presents a formidable array of testimony as to the practicability of Goebel's lamps; and the exhibits offered in evidence conform to the commercial type of lamps in use today far more closely than does the lamp for which Mr. Edison took out his patent now in litigation.

This similarity will be manifest to the least technical observer, and reference to the diagram of the Goebel exhibit, page 43, will serve to confirm its remarkable conformity to electric lamps of present manufacture.

The filamentary bamboo carbon, platinum inleading wires, glass chamber and vacuum are all in evidence, and are authenticated by the testimony of numerous witnesses; but beyond this similarity, the methods of manufacture adopted by Goebel appear to have anticipated many supposed recent inventions, and point unerringly to the careful study which Mr. Goebel must have given to the subject in order to attain the successful results which he achieved at that early date.

That his scientific researches were carefully conducted is evidenced by the fact that at this late day his assertion concerning the different effects produced upon copper by pure and impure mercury could only be verified by the experiments of an expert.

The accurate scientific knowledge, and the habits of minute observation of Mr. Goebel, combined with his manual dexterity, make his case the more probable, and it is noteworthy that all who have come in contact with him have been impressed by his simple straightforward manner.

It must be remembered, however, that the establishment of Goebel's claims would not necessarily detract from the originality or value of Mr. Edison's work in this line; and as new facts are brought to light in the course of this litigation, it becomes more and more apparent that the invention of the incandescent lamp was rather in the nature of a gradual evolution than the result of an entirely novel conception. The patent records of England show that this method of illumination was the subject of a patent granted to Augustus King in 1845. J. W. Starr and Dr. W. H. Draper were also known to have experimented with incandescent lamps at about the same date. An illustration of one of these lamps shows an arrangement analagous to the present lamps except that the globe, instead of being sealed, was constructed at the top of a barometer tube. However, as the inventor mentions the use of these lamps for fishing at night by lowering them into the ocean, it is evident that such lamps must have been sealed. The adaptation of these lamps to commercial purposes constitutes the real invention, and in this respect the evidence of Mr. Goebel presents the validity of his claim in the strongest light.

* * *

A Patent Suggestion.

There have appeared from time to time a number of criticisms concerning our patent laws, and the pertinence of these complaints is emphasized at present with special force by the litigation both in this country and in England which has involved several of the most important electrical patents in use, and which in several notable instances has only been concluded within a few months of the expiration of the patents. The cases of the Brush storage-battery, the Hopkinson three-wire system in England, and the Edison lamp patents have been called prominently before the public during the past few months and clearly illustrate this point, as well as the fact that the same conditions prevail in other countries. The *Electrical Review* of London in a recent editorial ascribes this condition to the delay which has characterized the efforts of a large number of patentees to establish their claims and to proceed against alleged infringers.

In default of such proceedings, the purchasers of infringing apparatus are naturally led to the conclusion that the failure of the patentee to take any action against the infringer implies a tacit acknowledgment of the latter's right to manufacture the article in question, and in this way large interests have been built up, continued unmolested for years, involving in some cases enormous investments, which eventually may prove worthless when contested by the patentee.

An obvious remedy for this abuse is suggested by our contemporary, viz., "Let the validity of the patentee's claims be settled at the outset of the career of the patent"—an effective remedy, but one probably difficult to apply. It appears equitable that a reasonable limitation should be prescribed by law, however, during which any action either to uphold or invalidate the patent must be commenced, and after which any laches must resolve against the delinquent party.

Another abuse of the patent right which is entirely foreign to the spirit of the law is the purchase and suppression of a patent by those whose interests would be opposed by its use.

This abandonment of patented inventions is largely in vogue, particularly in the electrical field, and should constitute the ground for annulling a patent if continued beyond a reasonable limit.

It has always been the policy of the United States Government to interpret the rights of patentees in the most liberal spirit possible, and to construe every doubtful point in their favor. It is only justice that inventors should be enabled to reap the full reward which inures from a patent, but it seems equally fair that it should not be used solely to obstruct the science to which it appertains.

The fundamental idea in granting patents is to *advance the progress of science and the mechanical arts*, and to this end a limited monopoly is secured to inventors to stimulate work in this direction. A patent being in the nature of a contract between the Government and the patentee, ought to imply some obligation as to the use of the article, for if it be an important one and contains fundamental claims, failure to prosecute deceives the public, while suppressing its manufacture impedes rather than advances the progress of the art to which it relates.

* * *

THE charge made by Mr. Frederick P. Fish, that the entire defence made by Messrs. Witter & Kenyon for their clients, the Beacon Company, was fraudulently manufactured, is amusing to the public, but we doubt if it was regarded in this light by Judge Colt.

Mr. Fish should remember that Mr. Witter was a reputable and respected counsellor when he (Fish) was wearing knickerbockers and playing marbles—and cheating, doubtless, whenever he got the chance.

A Mechanical Theory of Magnetism.

Mr. Leon J. le Pontios, of the Westinghouse Company, gave a lecture before the Pittsburg Electric Club on January 14 in which he discussed the theory of magnetism and the possibility of the direct conversion of heat energy into electric energy. He predicts the possibility of utilizing the vibratory molecular motion called heat to generate and destroy instantaneously magnetic properties of a body, the heat being absorbed in the mechanical work of magnetization and demagnetization; and after prosecuting numerous researches in this direction he concludes that the great analogy existing between these phenomena implies that they should be submitted to similar bases of calculation. The theory of magnetism and electricity enunciated by the lecturer is as follows:

Instead of considering magnetic and electric phenomena as different modes of vibration of the intangible and mysterious fluid known as ether, which is supposed to be diffused throughout all space, these phenomena may have a much more material origin and simply be caused by modifications of the vibratory cadence which is supposed to constitute the permanent state of matter.

These perturbations may be caused by the presence or contact of bodies whose atomic conditions are so different that the equilibrium resulting from the universal atomic vibration is practically destroyed. The atoms strike each other until certain of them are destroyed, and this atomic battle may be called chemical reaction. A new state of equilibrium is formed out of which arises heat or electricity.

In other cases heat or electricity may be generated by a mechanical destruction of movement, like a shock, or by friction between certain bodies. The lecturer demonstrated mathematically that our world, under existing conditions, causes universal vibration as a necessary consequence.

He believes that what we call the state of rest is constituted by a certain movement of matter, and that every atom of a body which does not seem to move goes to and fro striking the next atom, thus limiting its motion and regulating the atomic distance, that is to say, the volume, of the body.

It seems paradoxical at first to reconcile rest and motion, but we must consider that the atoms are infinitely small, while the amplitude of their vibration is so extremely short itself that the vibrations in each direction take place practically in the same moment for us, whose existence is comparatively long, while our sensations in proportion to our longevity are unable to analyze these phenomena, so instantaneous is the going and return of these atomic vibrations. It could not be the same for a microbe, and he establishes this principle, that a being is not able to notice a vibratory movement if its duration is not in a certain proportion to his longevity. As an illustration of this idea, suppose an express going from Pittsburg to New York and coming back—the movement of the train would be a vibratory movement for the conductor, because he could distinctly appreciate the two phases of the vibration, while for a being whose longevity should reach a million years, the motions would be of such short duration that he could not perceive them. This real vibration would be for him a state of rest.

Under certain circumstances the movement takes a regular cadence, and according to the rhythm of this cadence heat, electricity or light is generated.

The lecturer distinguishes between the atomic vibrations, which are limited by the atoms constituting the body having the same mass and same velocity in striking each other. The undulatory movement characterizes the phenomena—acoustic, caloric, electric and magnetic waves. In this kind of movement an excess of speed imparted to an atom of the body is successively transmitted by the vibratory movement to all the atoms constituting the body. These peculiar vibrations create the phenomena in which the two phases differ from each other by a change of mass, or by a change of speed, simultaneously imparted to the atoms going in the same direction.

A bell vibrates—the medium surrounding its vibration, solid, liquid, or gaseous, undulates. The sun vibrates—the intersidereal matter undulates. A magnet vibrates—the medium placed in the proximity of its pole undulates more or less according to its atomic constitution. A conductor charged with static electricity vibrates—a battery in closed circuit undulates. The field magnets of a dynamo vibrate—the conductor cutting the lines of force at right angles undulates.

The lecturer in analyzing attraction and repulsion claimed that if they have for their origin a peculiar vibration of atoms constituting the magnet, this vibration must be such that one of the phases of the vibration differs by an excess of speed from the other phase.

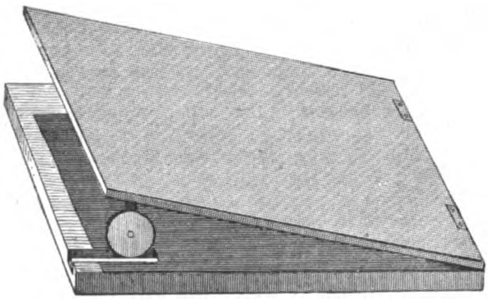
He also claims that with such conditions the result of this peculiar movement tends to cause a rupture of equilibrium between the magnetic bodies.

Analyzing the ordinary battery, Mr. le Pontois shows the atoms of the liquid, two superposed atoms of oxygen and hydrogen in a state of perfect equilibrium.

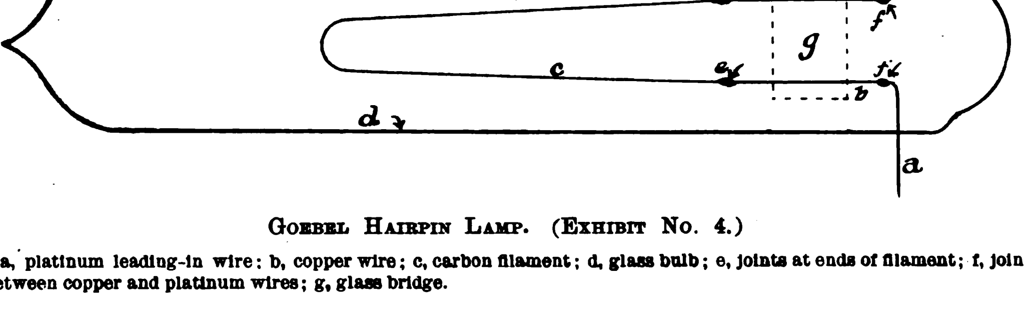
The zinc plate is introduced and immediately a great disturbance occurs—the harmony is destroyed, water is decomposed on account of the great difference of the atomic interval and weight of the atom. The two superposed atoms of hydrogen and oxygen cannot vibrate in harmony with an atom of zinc: a battle occurs in which they are divided, the atom of oxygen going to the zinc, hydrogen to the carbon. A new vibration takes place in which an atom of zinc superposed on an atom of oxygen vibrates against an atom of H_2O. In the shock an excess of speed is given the H_2O, and an undulation starting from the zinc and going to the carbon takes place in the battery; and if the conductor connects the electrodes, the undulation affects successively the atoms of the conductor, and this undulatory movement is nothing but the electric current.

Then, considering a wire surrounding a soft iron, the lecturer analyzed the forces involved, and demonstrated mathematically that if an undulatory movement of said electric current flows through the wire, the undulation has the effect of disturbing the atomic vibration in the iron and to establish a new mode of vibration, in which one of the phases differs from the other by a difference in speed.

M. le Pontois briefly applied his theory to the dynamo, and explained that in like manner an undulatory movement takes place in a conductor moving in a magnetic field. In the case of the thermo-electric battery he says: When two metals under different atomic conditions, such as antimony and bismuth, for instance, are soldered together, if the soldered point receives a vibratory caloric movement this vibratory movement creates an undulation in the metals, and if they



GOEBEL FILAMENT PLANER.



GOEBEL HAIRPIN LAMP. (EXHIBIT NO. 4.)

a, platinum leading-in wire; b, copper wire; c, carbon filament; d, glass bulb; e, joints at ends of filament; f, joint between copper and platinum wires; g, glass bridge.

are connected by a conductor an undulatory movement known as electric current takes place in the conductor.

The electromotive force, that is to say, the speed of the undulatory movement, is equal to the difference between the coefficients expressing the variations of the conductivity of the metals multiplied by the difference of temperature between the soldered point and the coolest point of the circuit.

He also showed how the Thomson and Pelletier effects can be explained by the atomic theory, and in conclusion gave a general outline of his thermo-electric generator.

In this he heats and cools simultaneously two neighboring points of the circuit, softening one of them and hardening the other, and an electric current takes place in the circuit, going from the softest point to the hardest point through the external circuit.

This principle is applied in practice in the following manner: A gas turbine is mounted on the same shaft with a blower supplying cold air, the outlets for the heated gases resulting from the combustion and the cold air furnished by the blower are placed in alternate positions on the circumference of a cylinder, and this apparatus revolves at a very high speed inside a cylindrical cavity made by a succession of laminated rings separated by a space of $\frac{1}{32}''$ and insulated each from the other. These rings themselves are divided in sectors, having a suitable coating to absorb the heat and at the same time to prevent oxidation.

The different points of each sector may be simultaneously affected by the discharge of hot air and cool air escaping from the nozzles, and the sectors are made of such shape that the currents generated circulate around an iron core placed inside each series of sectors; the iron cores, made of laminated sheets, are coiled at their extremities. The undulatory movement generated in the sectors changes the atomic vibration of the core and magnetizes or demagnetizes it. Hence are induced currents in the coils which may be connected in order to obtain the required voltage.

The principle advantage of this disposition of the parts lies in the fact that a large metallic surface is exposed in a very short time to a great variation of temperature, and the inventor demonstrated mathematically that the greater part of the energy furnished by the heat is utilized in the work of magnetization and demagnetization.

The experiments already made by Mr. le Pontois have given very encouraging results, and seem to indicate that the efficient conversion of heat into electricity is not impossible, and the practical results he has obtained are attributed by him to the application of his mechanical theory of magnetism.

Discussion of the Paper on Micanite Read Before the American Institute of Electrical Engineers.

(Continued.)

Prof. W. A. Anthony—I am very much interested indeed in this material, and the company for which I have been working for the last few years has been making some use of it in the construction of machines, and has found it a very excellent material in a great many places. I agree with Mr. Steinmetz that the measurement of the insulating power of the material is no test of its value in the machine. The effect of this high insulation, of course, is good. But the important fact is, that it will stand a great deal of mechanical wear and tear and a very high temperature without breaking down in insulation; and you may even have something of a short circuit without burning through it, while almost any of the other insulating materials are at once burnt out and destroyed by any short-circuiting.

Prof. Francis B. Crocker—I think that what Mr. Steinmetz said about tests of insulation at different voltages is the keynote of the problem. But I think he went a little too far in saying that the usual test of insulation showed nothing or showed next to nothing. It seems to me that although a test of insulation resistance is not conclusive I would much prefer to run a dynamo or a system of conductors, or any other electrical apparatus or system, when it showed 100 megohms insulation than when it showed 100,000 ohms insulation. In fact if it showed 100,000 ohms insulation I should be afraid to start up. If it showed 100 megohms I should have considerable confidence that it would run all right. It seems to me that the best way to do is to test the insulation at the voltage at which you intend to work. That covers both points. You test the insulation, which has been the customary thing to do for some decades now, and you also subject it to a potential, or power to break down, which Mr. Steinmetz rightly considers very important. There is no objection to it except the practical difficulty of getting a potential of whatever is necessary—one or two thousand volts, or whatever it may be. But Mr. Williams showed us at the last meeting an electrostatic method of doing that, and for some months past I have been making tests of insulating materials at several thousand volts with a direct current dynamo machine without any difficulty whatever. We pass the current from the dynamo machine through the given insulation and the galvanometer according to the ordinary direct deflection method well known to all of us, and observe the insulation resistance—the old-fashioned insulation resistance which Mr. Steinmetz thinks amounts to nothing—and at the same time we test the power to withstand disruptive discharge. It seems to me that that kills two birds with one stone. We get a quantitative result and also a test of the power to withstand the stress, and that stress of a potential which is applied to actually break down an insulator is very similar to a mechanical stress. It is a good deal the same kind of a stress as a point would exert resting on the centre of a pane of glass—at a certain pressure it will break through. That, of course, is simply an analogy, but it is quite close.

In testing the disruptive resistance or the breaking, Mr. Steinmetz said very truly that we ought to put it on the same basis as all other engineering problems, and that is to make an actual breaking strain test. In mechanical or civil engineering we simply take a test piece and subject it to a breaking test. Now, we can do the same in electrical engineering, and I think it should be the custom—I know it has been in the practical work that I have been engaged in—to subject machines intended for 500 volts to 1,500 volts test pressure. That is no more than is proper. It is simply a factor of safety of 3. If you raise the factor of safety to 5, so much the better. Electrical engineers should have their factor of safety and should consider it part of their work just as much as civil or mechanical engineers.

A dynamo machine or electrostatic machine can easily be obtained which will give any reasonable voltage from one to five thousand. I have a small machine that gives 5,500 and will run all day long at 5,000 volts. Such machines can easily be obtained. Why not subject any insulation to such a test, and at the same time pass the current through some galvanometer or other device to show quantitavely the insulation resistance at the same time that we test its power to withstand the potential? In regard to the galvanometer, I will point out one difficulty due to electrostatic disturbance, that is, the needle of a galvanometer connected to a dynamo or electrostatic machine giving 5,000 volts, or anything approximating that, will be acted upon just the same as a pith ball in the vicinity of an electrostatic machine—it will fly around and you will get a false deflection. That is quite confusing sometimes and very difficult to eliminate. The proper way to overcome this seems to be either to ground the terminal of the source connected to the galvanometer so as to reduce the potential to zero or else to make the potential of the coils equal to that of the needle by connecting the needle to the coils by a little wire passing down into a bath of sulphuric acid, or something of that sort. The electrostatic disturbance will be much greater than the current effects in a great many cases. Mr. Williams uses purely electrostatic means—an electrometer—and observes how long it takes to discharge at a given charge. But it seems to me that purely electrostatic strain is not so severe on a given insulator as the current from a dynamo machine. I think that 5,000 volts applied from a dynamo machine is a more severe test than 5,000 volts applied from an electrostatic source. There is some power behind in one case, and nothing behind in the other. That sounds a little absurd. But I think there is something there that we are not quite familiar with. So far as my experience goes, a potential applied with the backing of a dynamo machine, so to speak, is a more severe test than a simple electrostatic potential without any dynamo.

The Chairman—It seems to me that the remarks of Professor Crocker upon backing up the insulation tests with the current from the dynamo, and the remarks which Mr. Kennelly made relative to the using of this material and its advantage over mica and other expensive substances, *i. e.*, that it can be not only formed but that it has the great advantage of being considerably less in cost, are very pertinent; and I think from the remarks of Professor Anthony and of others here, and from statements made to me by the gentlemen who presented these samples to-night, that this material is not in an altogether experimental stage, that it has been worked commercially and on a considerable scale for a number of years. I would like to ask Mr. Thompson if he can give us a little information as to the relative cost of this material, taking any particular size or sizes, as compared with mica.

Mr. Thompson—Mr. Brooks or Mr. Kingsley, I think, would be better able to give figures on that. They are posted on the business points better than I am.

Mr. Lewis W. Kingsley—I would state that on sizes, say six by eight, the cost would be one-half that of mica. In very small sizes it costs more than small mica, but with large sizes it costs one-half, and you can get, of course, any size much larger than you can obtain it from the mine.

Mr. Steinmetz—I do not want to be misunderstood with regard to my opinion about insulating resistance. I do not mean to say that insulating resistance is of no value whatever. It has some value. It shows whether everything may be all right or whether something may be wrong. We are all familiar with the insulating resistance of materials, and know what resistance we have to expect, and where we find exceedingly low insulating resistance we must suspect something is wrong. Very often we find that the insulating resistance becomes all right by a couple of hours' sojourn in the steam box, especially where fibre or asbestos paper was used. Hence the low insulating resistance is a good hint to look things up and see whether everything is all right. But it is no reliable test of the safety of the machine.

Then with regard to exposing all the materials to a breakdown test, that is what we have done for several years and found it very reliable. But if we want to combine it with the resistance tests, then the only safe way would be to make the tests at a potential considerably higher than the normal, because as long as we have inductances in our circuit we cannot avoid occasionally a sudden rise of potential beyond the normal value, as in breaking circuits, etc., and we have to take this in account because this insulating resistance, especially of air, does not vary as a continuous function of the potential, but is infinite up to a certain point, and then suddenly drops to zero, practically. So we have to make the insulating tests considerably above the normal potential.

I am glad to see Professor Crocker propose the same factor of safety as we have used a long time, testing 500 volt machinery by 2,000 volts.

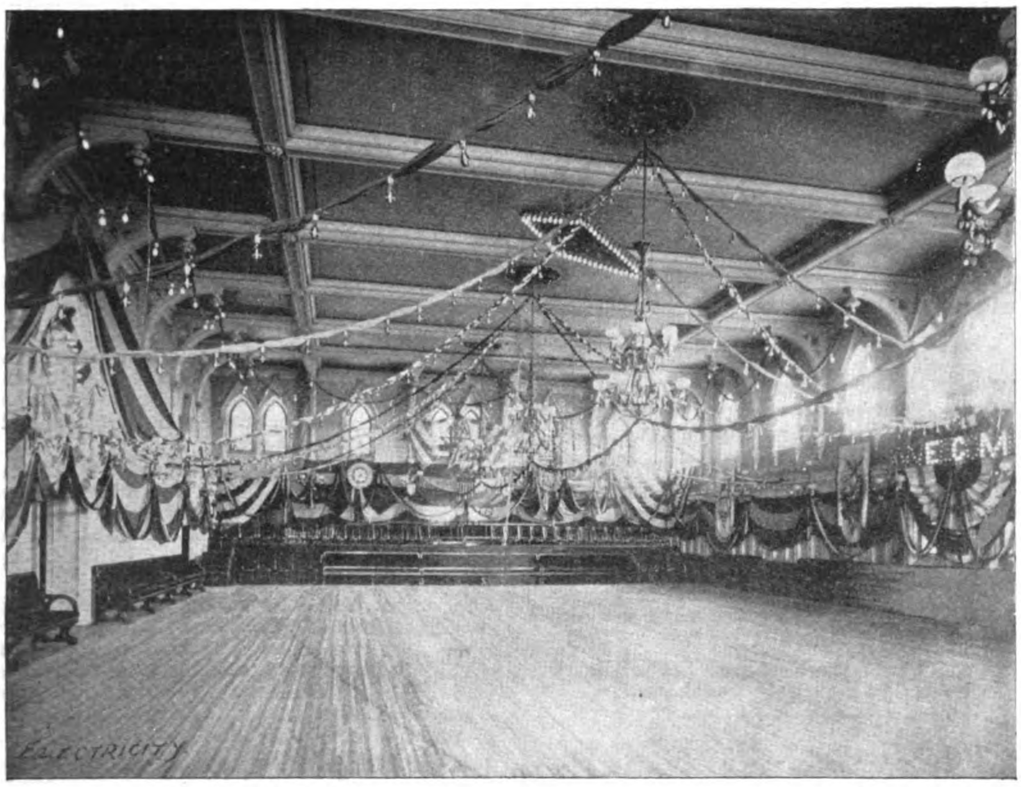
But with regard to the source of these testing potentials, I do not think we need to bother much about continuous current dynamos. For what purpose do we have the alternating current transformer? From ordinary 50 volt mains we can obtain any potential difference, of 2,000 volts just as well as of 3,000 volts, and I even think the alternating potential test is more reliable, because alternating stress is more severe than continuous electrostatic stress. Lately I looked up the literature for tests about disruptive discharges through the air and found quite a disagreement of that kind, so that I am almost inclined to believe that the disruptive strength of air is less with alternating potentials and decreases with increasing frequency. So if we use a frequency of 150 periods and 2,000 volts, we are sure the insulation will break down if it is liable to break down. *Power* indeed must be behind the *potential.*

With regard to micanite I can only say that I found it very reliable—superior to all the other insulating materials except genuine mica, but it is not absolutely fireproof, so that I prefer to keep it away from the arc.

A Brilliant Gathering.

Third Annual Ball of the Massachusetts Electrical Engineers and Mechanics' Association.

Rarely if ever since the introduction of electricity to commercial use has there been assembled so large and brilliant a gathering as that which filled Odd Fellows' Hall, Tremont street, Boston, Monday evening, January 30, the occasion being the third annual ball of the Massachusetts Electrical Engineers' and Mechanics' Association. This organization dates from a small meeting held in the dynamo room of the Boston Post Office in the spring of 1890, which meeting was adjourned to the press room of the Boston *Herald*, where, on April 1, it was determined to organize an association of electrical workers for mutual benefit, instruction and assistance, which it was felt could be best attained by such an association. Before that meeting adjourned officers were chosen and an executive staff appointed.



A Brilliant Gathering.—Electrical Decorations.

From that time forward the Association has grown in interest, importance and numbers until at the present time there are nearly two hundred enrolled members, having new and elegantly-appointed quarters, where meetings are regularly held, in the William Parkman Hall, Boylston Place.

One attractive feature of this prosperous Association from its inception has been the annual ball held in the large and handsome white marble building known as Odd Fellows' Hall. The first of these successful balls was held on January 26, 1891, the third a week ago Monday.

To say that each succeeding ball has eclipsed its predecessors is to put it mildly, for probably the third annual gathering, of which we now write, surpassed in the uniqueness and brilliancy of its illuminations anything previously attempted in any ball-room.

In describing these illuminations, which form the subject of accompanying cut, it may be stated that the entire exterior of the seven-story block was illuminated by a number of arc lights, the globes of which were of differently tinted glass, on the roof being placed two powerful search-lights, the flashing rays of which, combined with the rainbow hues of the arc lights, produced a *tout ensemble* that was striking and admirable.

In the hall itself were arranged nearly two thousand vari-colored incandescent lamps, ranged in groups along the sides of the large ball-room or hung along the sinuous length of streamers reaching out from the centre of the ceiling at various angles to the side or end walls, corners or windows. Prominent at the middle of the ends and sides of the room were designs most artistically wrought out in these colored lamps, the various tints being so blended or placed in such juxtaposition that many beautiful chromatropic effects could be readily produced through the aid of an elaborate switchboard that was made expressly for the occasion.

As will be noted from a glance at the accompanying illustration, over the platform occupied by the orchestra were two stars having five rays each, each ray being composed of incandescent lamps of a certain tint, but no two rays being alike in color. These stars were so attached to an electric motor that they were kept revolving the entire evening in different directions, the gyratory motions producing optical effects. Opposite the main entrance was the word "Welcome," composed of colored lamps and surrounded with a border of gayly-colored bunting.

At the opposite end of the hall from the orchestra were a huge crescent and star, the lamps composing which shed their effulgent rays through the entire length of the room. Over the entrance the large clock was encircled with an electric halo of lamps artistically arranged.

Pendent from the centre of the ceiling, as will be noted, were the bright outlines of a huge kite—typical of Benjamin Franklin's discovery—the kite itself being outlined in frosted white lamps, while the tail was composed of ruby lamps.

Close by the entrance to the hall room, or the landing, was shown a complete model plant, consisting of a small Edison dynamo connected in circuit with about a dozen miniature lamps brilliantly shining, the intention being to give the visitors a complete idea of the Edison underground system of lighting.

The festivities opened with a grand concert by a large orchestra at eight o'clock, the grand march taking place at nine. From that hour on until four o'clock Tuesday morning dancing was continued with an intermission at midnight for supper, which was quite a *recherché* repast. During the progress of the terpsichorean exercises the operator in charge of the switchboard caused great diversion, consternation and admiration by suddenly cutting out all the lamps of a certain color, thereby completely transforming the entire color of the room and its gayly-dressed occupants from a normal tint to a deep ruby, a green, blue, yellow, amber, white, mauve, gold—indeed, about any color desired. These sudden, startling and weird changes were closely akin to the weirdness of Henry Irving's "Walpurgis Night" or the scene of the Brocken in the opera of "Faust."

Of course, evergreens, gayly-colored bunting, and the stars-and-stripes added gayety to the scene.

But the most noteworthy attractions were the many pretty young ladies with their handsome toilettes, accompanied by their good-looking electric beaus, the entire assembly numbering nearly sixteen hundred persons.

That every feature of this celebration should be *en suite*, even the dance orders were artistically got up in true electrical style, every dance in the ball room and every tempting viand on the supper table being essentially electrical.

The souvenir was a handsome volume, the covers being printed in colors, the design including three medallion portraits—of Mr. Edison, Prof. Thomson and Prof. Bell—while Benjamin Franklin in the picturesque attire of the eighteenth century was shown flying his now historic kite, the antics of which revealed to the famous philosopher the presence of electricity in the atmosphere.

It is a noteworthy fact that every part of this elaborate installation even down to the minutest detail was worked out with mathematical precision before the first step was taken in the work. Plans, drawings and specifications were prepared, and every man engaged in the undertaking made use of the blue-print working drawings. Nor was outside help sought. So bent on achieving success were the members that each one assumed his share of responsibility and work, and all did their part in the most praiseworthy manner. The carrying out of the entire celebration was assigned to various committees, and where all did their very best and achieved such unquestioned success, it would be difficult to make a single invidious distinction.

During the evening many distinguished electricians and city officials took part in the festivities, thereby manifesting their deep interest in and encouraging by their presence the praiseworthy efforts of the officials and members of the Association.

It was an occasion that will long be remembered by all who had the good fortune to be present.

Prof. Bell.

The following description of Prof. Bell as he is is from a late number of the Boston *Advertiser*: "A large, strongly built man, who looks as though he enjoys life, is Prof. Bell, of telephone fame, who was at the Parker House last evening. He has a most contagious smile. The long, curly hair which clusters around the massive head is gray, and that shade predominates in the heavy beard, but his figure is as erect and his step as firm as those of many men twenty years younger. He merely stopped in Boston en route from his farm in Nova Scotia to his home in Washington."

A notable incident connected with the opening of the Liverpool Electric Railway line was the starting of the engines by Lord Salisbury, who subsequently entered a train, accompanied by the Earl of Latham and Lord Kelvin, the Mayor of Liverpool, and the directors of the road, and enjoyed the ride. The train ran smoothly at the rate of twenty-two miles an hour. Crowds of spectators thronged the route.

Canadian Electrical Association.

The second annual meeting of this association was held on Wednesday and Thursday, January 25-26, at which a number of papers were read and discussed. The reports of the officers and committees showed the growth and prosperity of the association to have made material increase during the past year. In calling the meeting to order President Wright said that since addressing the former meeting of the society several changes of importance have taken place in the aspect of this industry, and new departures have been made that will have considerable influence on the future of electrical business in Canada. The adoption of electricity as a motive power on suburban railroads and the conversion of horse tramways has developed in a manner that for rapidity is without a parallel in the history of modern civilization. While this is the case, and it is undoubtedly a fact that solid and substantial progress has been made by conservative management of electrical enterprise, a word of caution may not be out of place to investors in securities based upon electrical speculation. There is a danger that the fact of this solid progress may be made the means of ultimate injury to the concerns identified with it. It has caused a growth of schemes having electricity as a basis to spring up as thick and fast as mushrooms.

The inevitable failure of many of these will discredit, to a certain extent, legitimate enterprise and profitable business.

After acting on the various committee reports the convention listened to the various papers which had been prepared, among which were "The Incandescent Lamp," by R. G. Black; "Underground Construction," by W. A. Tower; "Probabilities as to the Success of Distribution of Power at Considerable Distances by High Tension Currents of Electricity," by E. Carl Breithaupt; "Free Wiring," by J. M. Campbell," and "Electrical Measurements," by Geo. Black.

Boston Notes.

The impromptu talk given by Mr. A. A. Hunting, M. E., on "The Steam Equipment of Modern Central Stations," a full report of which we publish in another column, before the members of the Thomson Scientific Club on Thursday evening, was a great success. Mr. E. Wilbur Rice, Jr., Superintendent of the General Electric Company's factories, presided, and the large room and adjoining corridors were crowded with members and friends.

The Edison Illuminating Company and the Boston Electric Light Company behaved most generously in connection with the third annual ball of the Massachusetts Electrical Engineers and Mechanics' Association. The former loaned all the wires, lamps, fixtures, etc., for the interior decorations, while the latter loaned and installed the arc and search lights that illumined the exterior of the building. Nor was the General Electric Company lacking in interest, for from its stores were loaned the switches, cut outs, etc., used on the unique switchboard built specially for the occasion.

When Mr. Fish, the accomplished and energetic counsel for the General Electric Company, appeared in court Wednesday to meet Judge Colt, who was to receive certain briefs and additional affidavits in the now famous lamp case, he made an appeal which might almost be characterized as "pathetic" for the issuance of an injunction, but his characterization of the new and startling evidence did not have the much-desired effect, hence all must await the Judge's decision.

His Honor Mayor Matthews' message or report on the subject of city lighting, which was sent to the City Council on Tuesday, was a most exhaustive document, and has been pretty well discussed by the daily press. His Honor has much to say on the high prices paid for gas and electricity, and strongly favors the City Fathers' going to the State Legislature for authority to build a municipal lighting plant as the only equitable way of solving the problem which has been agitating the public mind for years. The report is a most business-like document and is not likely to be quietly shelved. Public opinion is strongly in favor of some decided action being taken, and it may be the city will take advantage of the Municipal Lighting Act which became law about two years ago and under which more than one town in Massachusetts has erected its own plant.

The Ninth Annual Banquet of the Electric Foremen's Association, which is composed of gentlemen connected with the General Electric and allied companies, took place in the Revere House, Boston, last Saturday evening and was a most enjoyable occasion. There were nearly one hundred present, consisting of members and invited guests. Mr. A. L. Rohrer, the genial and popular president, who now resides in Schenectady, N. Y., presided on this festive occasion, his presence proving to be a pleasant reunion for the time being between that gentleman and his many old and tried friends. A splendid repast was partaken of, after which Mr. Rohrer, in his usual facetious manner, introduced the various postprandial speakers, each of whom contributed his quota to "the feast of reason and flow of soul." Professor Elihu Thomson, Mr. E. Wilbur Rice, Jr., and Mr. I. F. Baker were among the invited guests. The various impromptu addresses were characteristic of the occasion, including jest and story intermingled with startling facts bearing on the continued growth and expansion of the electrical business. Everyone present greatly enjoyed the occasion, which also included the election of officers for the coming year, these being W. H. Knight, president; J. P. B. Fiske, vice-president; A. C. Day, secretary and treasurer; J. T. Broderick, historian; W. P. Hill and E. H. Howe, executive committee. Special cars leaving Boston at 1:15 A. M. conveyed the party back to Lynn at the close of the proceedings.

Chicago Personals.

W. A. Kriedler, editor and publisher of the *Western Electrician*, was married last week to Miss Nettie A. Preston, of Chicago.

P. C. Ackerman, of the American Electrical Works, called on his many customers in Chicago last week.

G. W. Baumhauf, of St. Louis, was doing some purchasing for the Lindel Electric Road among the Chicago supply houses.

J. R. Chapman, of Grand Rapids, was also a Chicago visitor.

J. F. Barry, of the New York firm of Barry & McTighe, was in the city last week.

General News.

What is Going on in the Electrical World.

New Orleans.—The Carrollton electric railroad is completed and the cars are in successful operation.

Plattsburg, N. Y.—Investigations are being made as to the construction of an electric railway in this city.

New Milford, Conn.—An electric railroad from New Milford to Waramaug Lake, a pretty summer resort, is proposed.

Wichita Falls, Tex.—L. R. Morrison and associates have been granted a franchise to put in an electric light system.

Ashbourne, Pa.—Surveys are being made for an electric railway to connect Ashbourne with Cheltenham and other villages.

Mobile, Ala.—The Mobile Street Railway Company have received from council permission to use electricity on their lines.

Grand Rapids, Mich.—The franchise of the Reed's Lake Electric Railway Company has been annulled by a decree of the Supreme Court.

Boso, Japan.—The street car companies of Boso recently decided to construct an electric trolley line to replace the present horse car system.

Roanoke, Va.—The city council has awarded to the Roanoke Electric Light and Power Company a contract for lighting the streets of the city with electricity.

Des Moines, Iowa.—The Capital City Electric Company are said to be negotiating for the purchase of the entire plant of the Water Power Electric Company.

Carthage, Mo.—The Bartlett Company has obtained the franchise for building an electric railway in this town. The franchise calls for first-class equipments.

Cleveland, Ohio.—The Cleveland City Cable Company has received the permission of council to equip the St. Clair line and any other line which they control with electricity.

Charleston, W. Va.—An ordinance providing for the ownership of water, gas and electric light works by the city is to be voted on by the citizens at the next municipal election.

Fonda, N. Y.—The Fonda and Fultonville Electric Railroad Company has been organized at Fonda. Electric cars are to be run from Gloversville to Fultonville and connect with the West Shore road.

Chambersburg, Pa.—The council are considering plans for the erection of an incandescent light plant, as the right of the borough to manufacture electricity for commercial purposes has been affirmed by the court.

Peoria, Ill.—The proposed route of the Peoria and Pekin Electric Railway's new road between the two cities will be under ten miles, but the company expect to build six miles of track in Pekin itself if they obtain the franchise.

Woodbury, Conn.—Prominent citizens of Woodbury, in Litchfield County, have declared their intention of applying to the Legislature for a charter to build an electric railway line from Woodbury to Pomperaug Station on the New York and New England road.

Little Rock, Ark.—The Atlantic Trust Company of New York and the United Electrical Securities Company of Massachusetts have joined with the Thomson-Houston Electric Company in the application for a receivership for the City Electric Street Railway.

Mauch Chunk, Pa.—The work on the power house of the proposed electric railway, suspended because of the extreme cold weather, will be resumed at once, and as soon as the weather permits the construction of the railway through the Mauch Chunks will begin.

Wilmington, Del.—Capt. Chas. H. Smith, late superintendent of the Wilmington City Electric Railway Company, who is about to leave the city for his new field of labor at Scranton, Pa., was treated to a jolly farewell dinner by the George Washington Fishing Club.

St. Louis, Mo.—At a recent meeting of the stockholders of the Southern Railway Company it was decided to change the name of the line to "The Southern Electric Railroad." Hon. Thomas L. Johnson will continue as the company's president and Edward Lovejoy as its secretary. It is proposed to extend the line.

Canandaigua, N. Y.—The president of the Canandaigua Electric Light Company, M. D. Munger, has purchased water-power rights at Littleville, with the intention of constructing an electric light station at that place and ultimately transferring the local plant to Littleville. Power for the street railroad will be supplied from the new station.

Beverly, Mass.—The legal voters of the city at a recent election to decide the question whether the citizens were in favor of allowing the trolley system to be introduced have deposited 706 ballots for to 182 against the proposition. "The victory for the electrics," says a local paper, "was received with demonstrations of joy all over the town."

Buffalo, N. Y.—A new electric road is proposed that will connect Blasdell, Woodlawn Beach, Bay View, Windom and the Lake Shore, as well as the village of Hamburg and the vicinity of the Erie County Fair Grounds, with Limestone Hill and the city of Buffalo. Daniel W. Allen is at the head of the syndicate that is interested in the project.

Chicago.—Mr. Edison has been granted a concession by the ways and means committee of the Exposition to place 150 kinetographs at points he may select in the Fair Grounds. The kinetograph is an instrument which photographs the gestures of a speaker while at the same time his words are recorded by the phonograph. It is Mr. Edison's latest invention.

Cornish, Me.—Walter P. Perkins, John F. Jameson and others have presented a petition to the Legislature asking for a charter for an electric road to run from Cornish depot in Baldwin through Cornish village and Parsonfield to the Little Ossipee River. The road is to be equipped for transporting freight and passengers and the company also ask permit to furnish power, light and heat.

Pittsburg, Pa.—The Mt. Washington Electric and Cable Traction Company has decided to commence laying the tracks, stringing the wires and erecting the poles at an early date. The route will include Grandview, Boggs and Southern avenues and Sycamore street. The power on the hill streets will be electricity, while on the steep grade to the foot of Sycamore street the cable will be used.

West Chester, Pa.—The *News* says: "We have it from what seems reliable authority that a grand and final effort will be made to build the Unionville Electric Railway to West Chester next summer." — The Philadelphia and Delaware County Electric Railway Company, which has been granted charters to run its lines in Delaware County between Chester, Media and the limits of Philadelphia, will at once proceed to build its line.

San Francisco.—The Highland Park road is being converted into an electric line.—The electric light companies of the city have formed a "combine" and raised their rates nearly 100 per cent.—The Central Electric Railway system of Sacramento City has, it is reported, been sold to Albert Gallatin and H. P. Livermore, owning the controlling interest in the Folsom Water Power Company and in Sacramento Light and Power Company, which holds franchises recently granted for the building of new electric lines in San Francisco.

Minneapolis, Minn.—The Minneapolis Loan and Trust Company, as trustee, has filed with the register of deeds one thousand $1,000 bonds, given by the Minnesota Brush Electric Company, the Consolidated Brush Electric Company and the West Side Power Company, each bond bearing 6 per cent. interest. The companies together are known as the Consolidated Company, and the Loan and Trust Company acts as trustee for certain Eastern parties who are making the loan. The intentions are to extend the plant and enlarge the field of operation. The bonds are all signed by each company individually.

Newark, N. J.—A deal in electric lighting stock is reported by which about $500,000 of the stock of the Newark Electric Light and Power Company has passed into the hands of a syndicate which comprises a number of well-known capitalists. Among these are mentioned B. M. Shanley, of Newark; William C. Whitney, John N. Waterbury and John D. Crimmins, of New York, and Messrs. Elkins, Clarke and Blake, of Philadelphia. It is understood that the plant purchased will be used, among other things, in the operation of trolley cars on the Newark and Jersey City line and on some lines in Newark.

New York.—The furniture and fixtures of the Electric Club, at 17 East Twenty-second street, were sold at auction on the 31st ult. under the foreclosure of the bondholders' mortgage of $25,000. The articles sold brought very low prices, even the beautiful chandeliers and wall lamps being bid off at less than a fifth of their cost.—The Edison Electric Illuminating Company have adopted the marine or multiple expansion engine, similar to those on the swift ocean steamers, for use in their power stations because of the great saving in space occupied by that type of engine as compared with the ordinary land engine, and for other reasons.

Hartford, Conn.—A bill regulating electric railways has been introduced in the House. The bill provides that no street railroad operated by electricity shall be begun until there is a subscription of $3,000 per mile and the assent is secured of the property owners along two-thirds of the length of the road. This is also to apply to extension of roads. Bonds shall not be issued in excess of one-half the cost of construction. No extension shall be made of any road beyond the limits of a city or borough unless the Railroad Commissioners find that there is a public necessity. The bill places all electric roads in the State under the control of the Railroad Commissioners, who are to employ an electrical engineer to act with the board.

Albany, N. Y.—A bill has been introduced in the Senate by Gen. McMahon to create a State Telephone Commission. Among the provisions of the bill are the following: The Governor is to appoint three Commissioners (one Democrat, one Republican and one other), and one of the trio is to be an electrician, but no member shall be in any way interested in telephone corporations. The Commission is given full power to investigate as to complaints, prices, etc. Refusal to obey is a misdemeanor. When complaints as to cost of service are made, the Commission must within three months declare the proper price to be charged for the rental of telephones, either public or private. The rate they establish shall apply to all telephone service in the city or place for which it is made. The most approved appliances only are to be furnished by telephone companies to their subscribers. For disobeying the Commission a telephone company may be deprived of the use of a thoroughfare for its wires. The companies are to pay all the expenses of the Commission, just as the railroads do for the Railroad Commissioners.—In the Assembly Mr. Morris introduced a bill to permit villages to make a ten years' contract for their gas and electricity.—Mr. Hobbie, in the Assembly, on the 3d inst., introduced a bill to allow any electric light and power company to construct and operate a street surface railroad, and also to hold 2,000 acres of land and improve and sell the same and erect buildings thereon.

Philadelphia.—The Supreme Court rendered a decision last week of importance in connection with electric railways. The decision reverses the judgment of the lower court giving damages to Robert Winter, the owner of a team of horses that were injured by an electric car. On a dark evening in April last, Winter drew up his team in front of a business house in Pittsburg, to unload a safe. His horses were across a track on which electric cars ran on a descending grade. A car came down this grade, the gripman was unable to stop his car in time, and the team was injured. Winter sued the company and recovered a verdict. In his decision Judge McCollum, of the Supreme Court, says: "Now that rapid transit is recognized and demanded as essential to the prosperity of and the transaction of business in our large cities, the use of streets for individual convenience is necessarily qualified so as to make that transit possible, and to minimize its dangers. The substitution of cable and electric cars for the horse car and the omnibus is a change which renders impracticable and dangerous certain uses of the streets which once were permissible and comparatively safe. It introduces new conditions, the non-observance of which constitutes negligence."—The Ridge Railway Company have asked for the authorization of Councils to use the trolley electrical system on their line.

Electrical Display Advertising.

A unique invention in connection with display electrical advertising in street cars operated by electricity has been made by H. T. Richards, advertising manager of the *Electrical Review*, New York.

In the space usually devoted to advertising in street cars this new electrical invention is to be operated. Mounted along this space, on both sides of the car, will be placed in neat frames glass of any shade, ground on one side, cut in the usual size of the street car advertising panel.

Concealed behind this glass will be placed one or more incandescent electric lamps. Behind these lamps, in some cases, will be placed reflectors of suitable material.

The advertising copy to be used with this invention will consist of sheetiron, tin, cardboard or any opaque substance. That which corresponds to type, trade-marks or designs in the present street car advertising sign will be letters, trade-marks or designs cut out of sheetiron, tin or cardboard, which will admit the rays of the electric lamps to shine through, thereby forming the advertisement. If the advertiser chooses to use such copy as is at present used in street cars, viz., copy composed of colored letters, etc., he can do so, as lamps placed behind said copy, the red letters will show red and the blue letters will show blue. These panels or advertisements will be placed behind and against the ground glass in the said frames by nice adjustment, and will not take up any more room in the car than the present cardboard signs.

The strongest feature of this invention, from the advertisers' standpoint, is the fact that only one advertisement is illuminated at a time.

Fig. I.

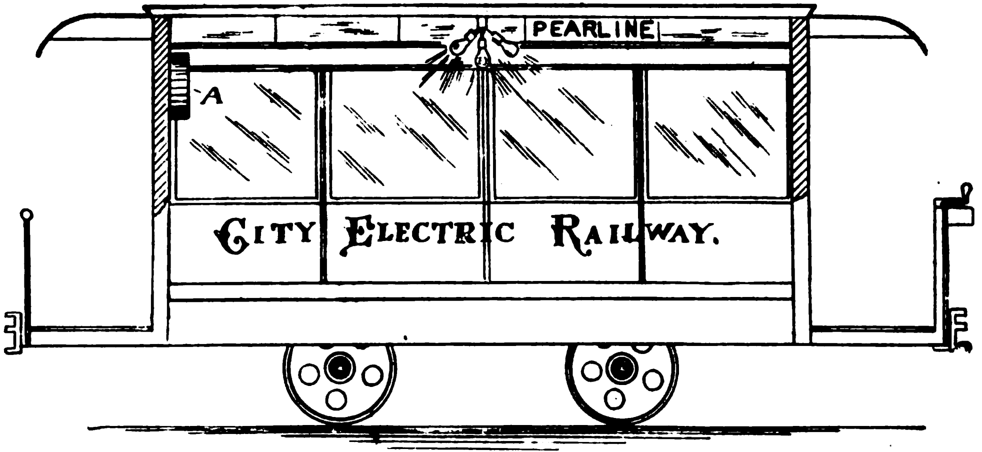


Fig. 2.

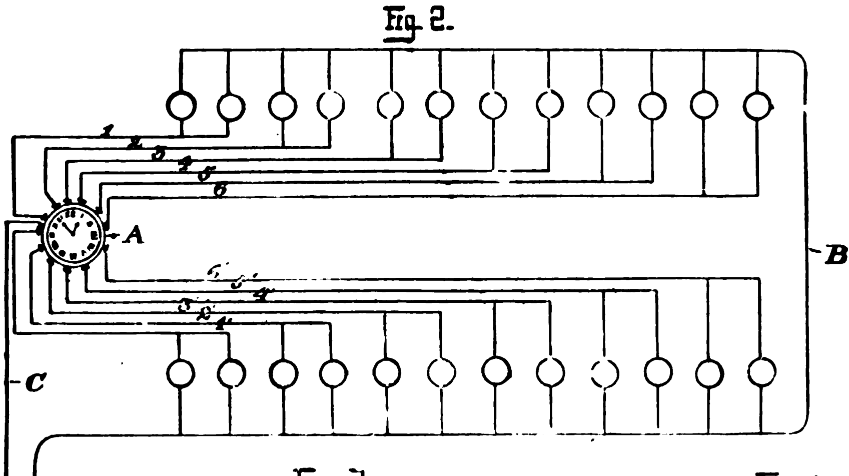


Fig. 3.

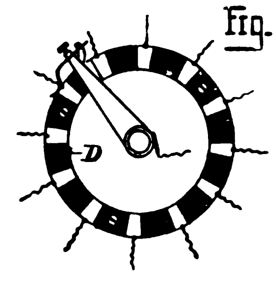
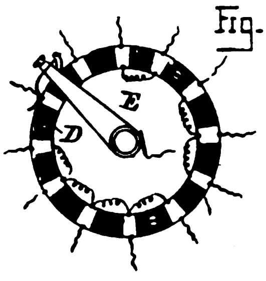


Fig. 4.



COMMERCIAL PARAGRAPHS.

The Chicago Electrical Manufacturing Company owing to an increase in their business have been obliged to seek larger quarters. Their new address is No. 41 South Jefferson street.

The railway department of the Electrical Supply Company report the sale of supplies for 150 miles of overhead railway for the extension of a new electric road.

George Cutter is sending out a blotter on which his smiling countenance greets his friends. He also informs the public that a catalogue of his electrical specialties is in the press.

Queen's Portable Photometer.

Queen & Company, Incorporated, Philadelphia, report a steady demand for their portable photometer, which instrument accurately measures the candle power of incandescent lamps, and can be used wherever desired.

It is very important from an economical standpoint for a central station manager to use lamps that give the greatest illumination for energy consumed. and this convenient apparatus enables comparisons of different types to be quickly made. When a customer complains of poor light, an impartial test will settle the dispute much more quickly than words, and there is no appeal.

The makers issue descriptive circular No. 295, which gives further particulars. Interested parties should ask them for a copy.

The Diamond Transformer.

A carefully compiled pamphlet has just been issued by the Taylor, Goodhue & Ames Company of Chicago, descriptive of the Diamond Transformer manufactured by them. In designing these machines it is assumed that the best transformer is not necessarily the one which has the lowest leakage or magnetizing current, nor the one which regulates most closely, nor yet again that which is the lightest and most easily handled, but is that transformer which combines as much of each of these desirable properties as is practicable with the best service.

In comparing various types of transformers it is therefore claimed necessary to begin with a realizing sense of the fact that the same laws govern all types as to design and performance, and that extraordinary excellence in one respect is necessarily obtained at a sacrifice in others.

The Diamond Transformers are designed so that the two objectionable losses of energy, viz., iron and copper losses, are reduced to the very smallest possible quantity.

The average efficiency between no load and full load is proportional to the watts output and the watts supplied to the primary coils, and this ratio is increased in the Diamond Transformer by the adoption of a low induction. Insulation is also among the points of greatest importance, and the materials available for this purpose are limited in number since they must be substances not readily affected by heat or cold and at the same time must present the maximum possible resistance to high voltage and lightning discharges. In the Diamond Transformer such insulations as mica, porcelain and asbestos are used, together with a special insulating varnish that does not deteriorate with age. The insulation resistance is not only very high but is permanent

Besides this, the questions of repairs, ventilation, fuses, and other important points are carefully considered, and the change of the secondary pressure from 50 to 100 volts is readily made by only one change in the connections.

The pamphlet also gives a simple formula, which will be found useful in calculating wiring for distributing leads:

$$\text{C. M.} = \frac{21.21 \times \text{C} \times \text{D}}{\text{E}}$$

C. M. = Area of wire in circular mils.
21.21 = Constant for two mil feet of copper wire.
C = Current in amperes.
D = Distance in feet to lamps.
E = Volts loss in conductor.

This company offers the following guarantee for its transformers: "We will guarantee the Diamond Transformer for the period of one year against damage by lightning, or electrical disablement of any kind not directly due to fire or carelessness and mismanagement on the part of the user, and will replace any that are so damaged free of charge, F. O. B. cars at our factory, upon receipt of the disabled transformer at factory with freight charges prepaid. Should the primary coil be burned out, we will express a new coil without charge, which may be inserted by the central station without delay or expense."

The Iron Nancy Hanks.

The Empire State Express is the Nancy Hanks of the rails. On Thursday she left Rochester for Buffalo and for ten miles kept up a speed of ninety-five miles an hour. This was done under unfavorable conditions, the road having at that part the heaviest grade on the whole Central system. The entire distance from Rochester to Buffalo, sixty-nine miles, was made in seventy-one minutes.—*Troy Budget.*

INCORPORATIONS.

Philadelphia and Delaware Street Railway Company, Chester, Pa. Capital. $150,000. Directors: Joseph H. Hinkson, G. P. Denis, Dennis Howarth, Ward R. Bliss, Chester; John J. Ryan, South Chester. The road will be twenty-five miles long and will be operated by electricity. It will begin at a point in the Island road where the road crosses Bow creek in Tinicum township, and extend to Chester.

The Reed Re-Cut File Company, Waterbury, Conn. Capital stock $2,500. Incorporators: H. W. Reed, R. L. Andrews and George Robbins, all of Waterbury. The object is to recut files and taps by an electric current.

A certificate of incorporation of the Enamel Electric Manufacturing Company has been recorded in the office of the County Clerk at Newark. Edwin A. Jeffrey and William H. Fancher, of Jersey City, and Thomas Erving, Jr., of Yonkers, are the incorporators The capital stock is $10,000. East Orange. N. J., is to be the place of business, and the company proposes to manufacture all kinds of electrical machinery, apparatus and appliances.

The Florence Rapid Transit and Power Company, Florence, Col. Capital stock, $100,000. Directors, J. A. McCandless, H. C. Topping, J. M. Hanks, J. F. Collins, J. W. Work and J. M. Aurner, of Florence; J. D. Phillips and J. H. Gillen, of Rockvale; E. S. Easton and George Wilson, of Coal Creek, and William McNeil and A. P. Easton, of Williamsburg. The purpose is to build and operate an electric motor line from Florence to Williamsburg, Rockvale and Coal Creek.

Straight Line Meter Company, Syracuse, N. Y. Capital stock, $40,000. Directors: Charles M. Warner, James M. Ellis, Duncan W. Peck, William D. Hawley and Henry C. Allen. The meter is intended for water, electricity and kindred uses.

A bill has been introduced in the Alabama Legislature to incorporate the Wetumpka Falls Electric Power and Manufacturing Company. M. B. Houghton, F. M. Billing, H. L. Williams, Peter A. Buyck and John H. Parker are the incorporators. The capital stock is put at $100,000 and may be increased to $1,000,000. The company is be empowered to build at or near Wetumpka an electric power and light plant and to supply any person, corporation, village, town or city in Alabama with electric light or power.

Fond du Lac Light, Power and Railway Company, Fond du Lac, Wis. Capital stock, $100,000. Incorporators: Elihu Colman, Joseph W. Hiner and Louis Marion, the present superintendent. Directors: H. A. Odell, Frank F. Reed and E. R. Gillman, Chicago; R. S. Munger and O. H. Simmons, Duluth, and W. G. De Celle and H. S. Cole, St. Paul.

The Electric Railway and Development Company of Staten Island has been incorporated under the laws of the State of New Jersey, capitalized at $200,000. The company will immediately build and equip with electrical apparatus nine miles of railroad from Lenollanville to Port Richmond, Staten Island. The officers of the company are Percy Thompson, 80 Broadway, president; Joshua Brown, 18 Wall street, vice-president; T. T. Greene, secretary, and F. A. Ware, treasurer. The principal offices of the company are located at 80 Broadway, New York.

Lakeside Street Railway Company, Shenandoah, Pa. Capital stock, $50,000. Incorporators: John F. Finney, president; O. A. Keim, secretary; S. W. Yost, treasurer; John Grant, R. J. Yost and H. C. Boyer, all of Shenandoah. The company has been organized to connect the several towns in Schuylkill. Luzerne and Carbon Counties with the popular summer resort Lakeside.

The Electrical Supply Company of Ansonia, Conn., has been granted permission by the Supreme Court to change its name to Ansonia Electric Company.

George R. Bradford, Loring Grimes, H. N. Woods, Eben G. Abbott, John Tufts, F. Scripture, Zeno A. Appleton, Nathaniel Richardson, James P. Merriden, Amos Rowe, William R. Parker, Edwin Turney, J. L. Woodfall, C. S. Rogers, Edgar Knowlton, T. T. Harwood and others have petitioned the Massachusetts Legislature to be incorporated as the Rockport Electric Street Railway Company, with capital stock not less than $25,000 or more than $50,000.

The State Department at Harrisburg, Pa., has granted a charter to the Montgomery County Passenger Railway Company, the line to run from Bridgeport to Conshohocken. Capital stock, $50,000. Incorporators: Cornelius Gallagher, New York; Edward S. Perot, Yonkers; John M. Dettre, Norristown; Daniel A. Holland, Daniel Stewart, Jr., James A. McGrath and Phillip J. Crimean, Conshohocken.

The Phœnix Power and Illuminating Company, Phœnix, Ariz., is preparing articles of incorporation. The capital stock of the company is put at $100,000, and the following are said to be among the incorporators: F. G. King and L. C. Kilham, of Rochester, N. Y.; D. D. Mallory, of Baltimore, Md.; J. H. Tracy, St. Louis, Mo.; E. C. Root, Denver, Colo., and E. H. Miller and Will Pilcher, of Phœnix. The object is to supply Phœnix with electric light, etc.

The Scranton, Northumberland and Bloomsburg Railway Company, composed of Hazleton, Shenandoah and Danville, Pa., capitalists, have applied for a charter. Capital stock, $500,000. The officers named are J. R. Coyle, president: H. O. Rogers and L. O. Emmerick, vice-presidents; T. H. Hutchinson, treasurer; A. T. McAllister, secretary; George A. Wilkinson, general manager. The proposed electric railroad will be built from Scranton to Northumberland, 80 miles, with branches to neighboring towns.

A charter has been granted to the Union Electric Street Railway Company to construct a line from Drifton through Freeland to Upper Lehigh, Pa. The directors are Harry E. Sweeney, Drifton, president; Horace E. Hand, Fred W. Bleckley, W. H. Jessup, Jr., and E. D. Wightman, Scranton.

The St. Louis, Kirkwood and Meramec River Railroad Company, St. Louis, Mo., have applied for a franchise. Capital stock, $500,000. Directors: Thomas Howard, James Daniels, Thomas M. Gallagher and Alexander B. Shaw, of St. Louis, and Matthew C. Orton of Chicago.

The Electric Gas Machine and Light Company, Springfield, Ill. Capital stock, $1,000,000. Incorporators: H. Clay Wilson, John G. Friedmeyer and Benjamin Knudson. The company is formed to manufacture and sell gas machines and appliances, and to acquire and deal in patent rights for the same, etc.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JANUARY 31, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

490,690. Railway-Yoke. Morris S. Towson, Cleveland, Ohio, assignor to the Love Electric Traction Company, Chicago, Ill. Filed Oct. 10, 1892.
490,975. Electric Railway. Edward W. Mitchell, Covington, Ky., assignor to the Mitchell-Thompson Underground Electric Conductor Company, of West Virginia. Filed June 23, 1892.
491,014. Trolley-Wheel. John J. Goetz, Covington, and John A. Smith, Dayton, Ky., assignors to themselves, and Harvey M. Littell, Cincinnati, Ohio. Filed May 20, 1892.

DYNAMOS AND MOTORS.

490,809. Dynamo-Electric Machine. Robert Lundell, Brooklyn, assignor of two-thirds to Edward H. Johnson, New York, N. Y. Filed April 22, 1892.
490,810. Dynamo-Electric Machine or Electric Motor. Robert Lundell, Brooklyn, assignor of two-thirds to Edward H. Johnson, New York, N. Y. Filed April 22, 1892.
490,959. Coupling of Dynamo-Electric Machines in Parallel. Albert Gay, London, England. Filed Jan. 11, 1892.

ELECTRIC LIGHTS AND APPLIANCES.

490,903. Combined Gas and Electric Light Fixture. Francis X. Garland, Philadelphia, Pa. Filed Jan. 23, 1892.
490,954. Manufacture of Carbon Filaments for Electric Lamps. Thomas A. Edison, Llewellyn Park, N. J. Filed Nov. 6, 1886.
490,992. Electric-Arc Lamp. James Sugden and Wallace J. L. Sandy, London, England, assignors to Charles Henry Freedman, Frank West Suter and Harrington Wyman, same place. Filed July 13, 1892.

BATTERIES.

490,753. Secondary-Battery Electrode. Harry G. Osburn, Chicago, Ill. Filed Nov. 21, 1891.

MISCELLANEOUS.

490,663. Electric Block-Signal System. John La Burt, New York, assignor to the Agricola La Burt Manufacturing Company, Brooklyn, N. Y. Filed Dec. 14, 1891.
490,678. Apparatus for Electrically Treating the Eyes. William A. Price, Iowa Falls, Iowa. Filed Sept. 24, 1892.
490,679. Apparatus for Electrically Treating the Ear. William A. Price, Iowa Falls, Iowa. Filed Sept. 29, 1892.
490,684. Automatic Alarm Device. George W. Schilling and John G. Haslam, Philadelphia, Pa. Filed June 18, 1892.
490,698. Electrical Time-Indicating Apparatus. Edward Weston, Newark, N. J. Filed June 16, 1891.
490,699. Recording-Ammeter. Edward Weston, Newark, N. J. Filed March 18, 1892.
490,700. Electrical Measuring-Instrument. Edward Weston, Newark, N. J. Filed March 29, 1892.
490,725. Electrical Pressure Indicator for Steam Gauges. Edward G. Smith, San Jose, Cal. Filed July 6, 1892.
490,744. Electric Time System. William F. Gardner, Washington, D. C. Original application filed Dec. 13, 1883. Divided and this application filed Sept. 4, 1891.
490,746. Electric Switch. Jacob S. Gibbs, Hartford Conn., assignor to the Perkins Electric Switch and Manufacturing Company, same place. Filed Nov. 1, 1892.
490,755. Connector for Electrical Conductors. George L. Russell, Middletown, Conn., assignor to the Schuyler Electric Company of Connecticut. Filed Aug. 12, 1892.
490,760. Electrical Measuring Instrument. Edward Weston, Newark, N. J. Filed Oct. 3, 1892.
490,761. Electric Signaling System. Adoniram J. Wilson, Port Chester, N. Y., and Wilmer W. Salmon, Chicago, Ill., assignors to the Hall Signal Company of Maine. Filed Sept 14, 1892.
490,762. Electric Circuit Breaker. Edward M. Bentley, Boston, Mass., assignor to the General Electric Company of New York. Filed Nov. 19, 1892.
490,841. Process of Electroplating Aluminum. George Wegner, Berlin, Germany. Filed May 5, 1892.
490,870. Electric Burglar Alarm. Warren H. Carr, Bath, Me., assignor to himself and James W. Wakefield, same place. Filed Sept. 22, 1892.
490,882. Telethermometer. Howard B. Payne, Chicago, Ill., assignor of one-half to David B. Van Slyke, same place. Filed May 20, 1892.
490,883. Telethermometer. Howard B. Payne, Chicago, Ill., assignor of one-half to David B. Van Slyke, same place. Filed Sept. 22, 1892.
490,891. Electric Warming-Bottle. Thomas Ahearn, Ottawa, Canada. Filed Sept. 8, 1892.
490,917. Switch and Safety Fuse. Elmer P. Morris, Boston, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Feb. 11, 1892.
490,948. Electric Belt. John W. Cummings, Gold Hill, Nev. Filed July 27, 1892.
490,953. Art of Generating Electricity. Thomas A. Edison, Menlo Park, N. J. Filed Nov. 1, 1883.
491,004. Electric Stop-Motion for Knitting Machines. Winslow M. Bell, Milton, N. Y. Filed Dec. 18, 1890.

SUPPLEMENT.

ELECTRICITY.

VOL. IV. NEW YORK. FEBRUARY 8, 1893. CHICAGO. NO. 4

NEW EVIDENCE.

THE BEACON VACUUM PUMP & ELECTRICAL COMPANY STRENGTHEN THEIR CASE.

Summary of the New Affidavits.

On Wednesday, February 1, the matter of the Edison Electric Light Company vs. The Beacon Vacuum Pump and Electrical Company came up in the United States Circuit Court, Boston, before Judge Colt.

This was the day set by the Court at the close of the previous hearing for the final filing of the printed arguments, etc., by both sides.

Messrs. Witter & Kenyon, for the defense, asked the privilege of putting in as evidence a large number of new affidavits which they had been able to get together since the previous hearing. Mr. Frederick P. Fish, for the plaintiffs, objected to this in a somewhat impassioned address of fifteen minutes' duration.

Defendants' counsel explained that in their original application for time in which to prepare their evidence, on January 18, they had asked for 30 days; that since that time they had been working night and day, and had prepared their evidence as rapidly as possible; that the affidavits which they now offered were essential evidence in the case, and could not have been submitted earlier.

Mr. Fish contended that the evidence had all been manufactured in the past six months; that the lamp alleged to have been made 30 years ago had also been made in the last 6 months; that the entire defense was one of the greatest frauds ever perpetrated upon a court. Plaintiffs had not seen the new affidavits and had no opportunity of answering them. Plaintiffs also had a great number of new affidavits but they did not desire to offer them as it would merely prolong the case.

Looking over defendants' affidavits hurriedly, Mr. Fish remarked that it was just as he had expected: all the holes made by plaintiffs in defendants' case had been filled up.

Defendants' counsel remarked that the holes were not new to his side, but that it had been a physical impossibility to offer all these affidavits at the previous hearing.

Judge Colt stated that he would accept the new affidavits of both sides unless positive protest was made by Mr. Fish, who finally consented.

Judge Colt took the papers, saying that he would take the affidavits and if he could decide the case on the evidence offered on January 25 he would do so. If the new matter was indispensable in reaching a decision, he would then reopen the whole case, giving both sides an opportunity to offer additional affidavits and answers, and would hear new arguments throughout.

Following are new affidavits offered by defendants, those of Messrs. Pope, Henry Goebel, and Vandegrift in full, the rest being condensed.

Affidavit of Henry Goebel.

From the time when, in the early fifties, I succeeded in securing an incandescent light substantially like those represented by Exhibits Goebel Lamp 1, 2 and 3, until the date, say the year 1879, I acquired constantly increasing skill in preparing each one of the various features of the lamps, as well as in connecting them together; that is to say, in the making of the carbons, in the attachment of the leading-in wires themselves, and the manner of their introduction through the glass walls, and in the general finnished appearance of the completed lamp. Before 1872, that is, before I left Monroe street, I had arrived at definite conclusions as to the best materials for the various parts of the lamps. I had settled upon bamboo as the best material from which to make the carbons, and for some time before and for all the time after that date of 1892, I never made filaments of any other material than of carbonized bamboo, except in rare cases where other things were treated chiefly for purposes of comparison. I had found and settled, prior to 1872, that the bamboo filament was tougher, less fragile, would give a better light and a more durable light; that is to say, in all these respects taken together I had. prior to that date, settled upon the bamboo filament as superior. I had prior to that date, 1872, a set of mechanical devices, consisting of four in number, for the purpose of producing a very fine and a very uniform thread of hair of bamboo for use in these lamps. On the 26th day of January, 1893, one of these devices was found in one of my tool boxes, and I have given it to Messrs. Witter & Kenyon. It is marked Goble No. 6. This or other similar mechanical devices I used for the purpose of producing a hair like piece of bamboo from before 1872 for a good many years. In or about 1886 I sold to Mr. Perkins three of my tools for making carbons for incandescent lamps. Two of these tools have been handed to me to-day, January 31, 1893, by Mr. Perkins, and I recognize them as the tools I sold Mr. Perkins as above stated. I have marked them respectively Goebel No. 7 and Goebel No. 8. The tool marked Goebel No. 6 is the first tool I used for making the strips for the burners. I made it in the early sixties, when I was living at 271½ Monroe street. It consists of a plate which I screwed to my work table. In this I had embedded a knife, the projection of which I could regulate by a screw. I hinged another plate to the same, which bore a roller engaging and pressing on the bamboo and facilitating the passage of the same between the former and the knife. This hinged plate was drawn down by foot or by hand, and returned to its position after the pulling through of one piece of bamboo by the action of a spring, and was then ready for the next operation. I had a screw on the same by which its descent could be regulated. This tool I made for the express purpose of preparing the bamboo strips for the burners of my lamps. It was used pretty constantly by me from that time down to about the time I stopped making lamps, a few years ago. It has never been used for any other purpose; it could not be. When I made carbons for the American Company, in 1881, I made use of this tool. The tool was constructed by me so as to enable me to make the strips smaller and more even than it was possible to make them by hand. The tool marked Goebel No. 7 was made by me before 1870, and I think as early as 1865. The first tool did not plane the strips as small or as even as I wanted, so I made this second tool to cut the strips smaller and more accurately. This tool has been changed in three respects since I sold it to Mr. Perkins. When I sold it it had a different knife in it, although it was one of substantially the same shape. It had flat springs under the hinged plate instead of round springs; a new spring or catch has also been put in to catch in the cogged wheel at the top of the regulating screw. The old spring or catch was substantially the same in form as the one now in it.

The tool marked Goebel No. 6 is the third one I made. It is finer in its adjustments than the others. It is just as it was when sold to Mr. Perkins. About the same time I made a fourth tool. It was for planing the sides of the fibre to have them all one width as well as one thickness.

I pulled the bamboo strips through all of these planes by taking them at one end by a pair of pinchers and pulling them through.

These tools were all used constantly by me in making my filaments.

About 1886 Mr. Perkins asked me whether I would let him have some of my tools, and I then gave him the tools marked Nos. 7 and 8, and the fourth tool, which I understand Mr. Perkins still has in his possession. Before I left Monroe street, in 1872, I had for a long time gas in my house, and had made for myself glass blowing apparatus much superior to that which I had used in producing the glass part of the Goebel lamps Nos. 1, 2, and 3. Moreover, I had been practising the art of glass blowing in other glass work, not merely in connection with these lamps, but in other matters, including hundreds of barometers and thermometers, Geissler tubes, etc., to such an extent that I had acquired quite a high degree of skill in the use of the blow pipe.

In making the connection between the leading-in wires and the carbon I very early arrived at the conclusion that, all things considered, stove polish was the best material for effecting the puncture, and from before 1872 that was the material which I uniformly used for that purpose. Prior to this date also I had settled upon the use of platinum leading-in wires for the reason that when I used iron or copper the glass part of the lamps would sometimes crack and thus impair the vacuum. I should have used platinum in every one of my lamps, except that platinum wires were more expensive and not so easily accessible as iron or copper wire. The greater proportion of the lamps made with platinum leading-in wires made a better incandescent lamp and light than those used with iron or copper. After I had settled fully in my mind upon the superiority of the platinum leading-in wires, almost all of the lamps that I made from long prior to 1872 onward in both my places in Grand street were made with platinum leading-in wires. I had as late as 1890 in my possession a number of such lamps of an earlier date than 1872 that were made with platinum leading-in wires. One of these lamps with platinum leading-in wires, I sent to the counsel connected with this case at about the time I gave them Goebel lamps Nos. 1, 2 and 3, and I told them at that time that this lamp had been in my possession from before 1872; that is, with others like it, was made prior to 1872. This lamp is marked Goebel No. 4. Lamp marked Goebel No. 4 I have had in my possession ever since before moving from Monroe street to Grand street in 1872. I made it and burned it a good many times both before and after I left Monroe street; it burned well and gave a good light. I took especial pains with the glass part of this particular lamp, and it was because the glass part was so well done, giving the lamp such a beautiful and finished appearance, that I always kept it, bringing it out from time to time to light up or to exhibit. I kept it in my possession until I sent it to the defendants' counsel in the case. The lamp and all its parts are the same as they were when I made it prior to 1872, in material and in all other respects, except such changes as may have occurred from my use of it, handling it and mere lapse of time. If it does not burn to-day it is because it has been in some way injured by handling or lapse of time.

When, in about the year 1881, the people came to me from the American Company, I instructed one of their glass blowers to introduce the platinum wire from opposite sides of the glass globe. He said they couldn't do it, or that it couldn't be done; and to convince him that it could I explained how I did it, and showed him this identical lamp, Goebel No. 4, as proof that it could be done. Thenceforward, at least for a time, the American Electric Light Company adopted that plan, and I produce a lamp marked Goebel No. 5 which is an old American Electric Company lamp with the leading-in wires sealed by that method.

I have recently been informed that an expert for the defendants, Mr. Pope, has given a reason or reasons why he did not think this lamp, Goebel No. 4, was made by the Torricellian process of producing a vacuum, namely, that there would in such case be, in his opinion, a deposit of mercury upon the surface of the copper wire, and he discovered no such appearance. But I told him that he was mistaken in so thinking, provided that distilled mercury was used in producing the vacuum, and I understand he has been conducting experiments to ascertain the facts in this connection. The mercury that I used in producing the vacuum in these lamps was carefully distilled, sometimes three or four times, before it was used, and I took particular pains to perform the process always in a very dry atmosphere, and used other safeguards, such as heating it very slightly, tending to insure a high vacuum and the absence of injurious deposits or gases.

Prior to 1872 I had employed for the purpose of producing a vacuum a mercury pump, in the use of which no mercury was present in the glass part of the lamp at all, but it was a pump having stopcocks, which made it difficult and not always sure of manipulation, so that as a rule I succeeded in obtaining as good if not a better vacuum by the Torricellian process than I did with this early mercury pump. This pump which I now speak of must not be confounded with the pumps mentioned in my former affidavits.

These lamps with the platinum leading-in wires, and some of the lamps with the leading-in wires of other material, when connected with my batteries gave a uniform, steady and continuous light, equal approximately, I should say, to an ordinary gas jet, and they were used for a number of just such uses as incandescent lamps are used to-day, and were so used prior to 1879 and from time to time from the early fifties onward.

I know no reason why these lamps were not suitable for commercial use. These lamps were ready for commerce and commercial use, but commerce was not ready for these lamps, and the reason was that there was no available source of cheap electricity, and the introduction of these lamps to a wide commercial use involved, even with an adequate source of electricity, the expenditure of vast sums of money. As compared with incandescent lamps of to-day, these early lamps of mine gave a fairly good light; an entirely practical light. They burned fairly well, and with the addition of such improvements as have been added to the modern lamp (some of which I am familiar with), they would give in my opinion just as good a light and just as durable a light as the Edison lamp of to-day. Each one of my lamps that turned out to be successful burned with a candle power equal to that of an ordinary gas jet, and maintained that power with some few exceptions of accident until the battery power gave out, or until it had obtained a length of life very comparable with that of the incandescent lamp of 1880.

By the expression "that turned out to be successful" I mean that sometimes the carbon was not perfect, sometimes the glass was not perfect, sometimes the junction of the various parts was not perfect, and in such cases the lamp was not what I considered a successful lamp. But that has always been true in the manufacture of incandescent lamps, and is true even to-day notwithstanding improvements that have been added to the lamps and the process of making the lamps.

The Goebel lamps Nos. 1, 2, 3, 4 and 5 show for themselves partially the advance in nicety of workmanship which I acquired from time to time in the manufacture of these lamps, though not as fully as such advance would be shown provided I were able to produce a larger number of lamps identified as belonging to later and later periods of time.

I never put any devices on my electric lamp to conduct heat away. I never used any thermal regulators on my lamps. There was no need for such appliances; the wires that ran into my incandescent lamps would not get warm, nor would the base of the lamp become heated. The wires that I used, running from the battery to the lamps, were of the ordinary size used in batteries of the size and kind I employed. They were not very thick, but were like ordinary copper wire. In using my lamps with electric batteries I usually connected only one lamp with a sufficient set of battery cells. Sometimes, however, I connected two or even three lamps to the same set of battery cells. In this case I would use more cells.

One of the very earliest of my efforts to make an incandescent lamp was by using a platinum wire or hair as the illuminating part. It was two or three inches long, and was very fine; about as fine as No. 80 or 100 cotton thread. I used a vacuum with this platinum lamp, and used copper leading-in wires sealed in the glass. The fine platinum wire heated up and became incandescent, and gave a good light, but in a few minutes it got too hot and melted and fell onto the glass and the glass broke. I did not try platinum again, but turned to vegetable carbons. I knew from the arc light I had made first that carbons would not melt, and I thought that in a vacuum where there was no oxygen it would not be consumed and would last; and I discovered that it did last.

I have not received any money nor anything of value for the affidavits I have given in this suit, or for anything I have done for the defendants herein, and I have not received any promise from anyone of money or anything of value, and I do not desire or expect to receive any. I have given my evidence in this case reluctantly and only after considerable urging. I have no interest in the result of this case. I bear Mr. Edison no enmity and do not desire to injure him in any way. I do not own any stock of the defendant corporation, or in any electric lighting company, and have no interest of any kind in that business, and not only have no interest whatever in the defendant company, but I do not even know any of the officers or anyone connected with it.

After the American Company sent a dynamo to my shop at 468 Grand street, in about 1882, I used it to light up my shop for a sort of exhibition, and in that lighting I used old tube lamps that I had had on hand for a number of years. There were eight in number, as I remember, of these lamps so exhibited; whatever the number was, they all had platinum leading-in wires. I do not remember whether Goebel lamp No. 4 was one of them or not. A partial garbled notice of this display of my lamps was printed in the New York *World* of May 1, 1882, reading as follows:

> Mr. Henry Goebel gave an exhibition of his electric light last night in a room back of his store at No. 468 Grand street. Mr. Goebel claims that he has been at work on electric lights for 31 years, and that 29 years ago he arranged one on the top of his house at No. 271½ Monroe street. The lights were seen from the Essex Market bell tower, and an alarm of fire was given which brought out a number of engines. He himself was arrested, but Judge George Woods released him. When he returned home he found that his neighbors had demolished all his instruments and apparatus. The light exhibited last night was clear and steady, and one could see to read by it with great comfort and ease. It is about eight inches long and about as thick as a candle. The vacuum is obtained by a pump similar in principle to the Geissler pump, and can be operated by unskilled hands. The carbon points used are made of reeds which are heated in a retort by electricity. The lamps cost twenty-five cents apiece, and Mr. Goebel claims that he can furnish light as cheap, if not cheaper, than gas.

I had nothing to do with the preparation of any notice or with putting it in the newspaper.

Affidavit of Franklin L. Pope.

I have heretofore made an affidavit in this case. At the time of making my former affidavit I felt doubtful whether the date of the lamp marked Goebel No. 4 could have been as early as Mr. Goebel and his son Henry always asserted it to be. They have both asserted from the beginning of my acquaintance with them, about two weeks ago, that this lamp was made before they removed from Monroe street in 1872. My doubts in the matter have arisen from the circumstance that the joint between the carbon and the copper wire appears to have been made in part by electroplating, and my own experience in such matters led me to entertain the opinion that if the lamp had been first filled with mercury, and then exhausted by inverting the tube, in one of the ways which Mr. Goebel says he practised, the mercury would have united with the surface of deposited copper and some traces of it would probably have remained; and as no such trace appeared to be visible in this lamp, I was led to believe that it must have been exhausted upon a vacuum pump and not in the manner before referred to. I was instructed by defendants' counsel to investigate the matter from the scientific point of view most exhaustively, and to make any necessary experiment for that purpose, which I have done. Upon my first questioning Mr. Henry Goebel on this matter, he at once told me that he used heated chemically pure mercury in his work, and that he took care that the exhaustion was performed in dry weather and not in moist weather, and he also stated that when chemically pure mercury was used it would not unite with the copper. In order to test the truth of this statement I at once procured some chemically pure mercury from Hegeman & Company and electroplated two pieces of copper wire in a saturated solution of sulphate of copper acidulated with sulphuric acid. This was on January 26, 1893. After a sufficient coating of fresh metallic copper had been deposited upon the wires, I immersed one of them in the chemically pure mercury, and the other for half an inch in depth in some ordinary commercial mercury which I had on hand and which contained, as is frequently the case with ordinary commercial mercury, traces of sulphuric acid. The result was that the chemically pure mercury did not adhere to the copper, thus absolutely confirming what Mr. Goebel had said, whereas the impure mercury formed an amalgam with the copper on the surface, leaving an evident and discoverable trace of its presence. I submit herewith the two samples of wire with which the test was made, marked with my name and date of their affidavit. This conclusively disproved and explained the only doubt that had arisen in my mind from my most careful scientific and practical examination of the lamp, and conclusively demonstrated that the lamp Goebel No. 4 might have been exhausted by the Torricellian process of filling the same with mercury and then inverting and emptying it, without necessarily leaving any traces of mercury or mercury amalgam on the copper interior parts. The result of this experiment removed the only reason for doubt which had previously existed in my mind as to the probable date of this exhibit. I reported the final results of my examination to defendants' counsel on January 27, 1893. Of course if the lamp No. 4 had been exhausted by means of a mercury pump, not involving the presence of mercury in contact with the interior parts of the lamp, my objection would have had no force. There is nothing inherently improbable in the doing of glass work of the kind and character exhibited in the lamp Goebel No. 4. In 1872, and for several years before that date, I remember that at least as early as 1868 Geissler vacuum tubes were made and sold in considerable numbers in Boston by Ritchie, and that they had been imported from Europe and publicly exhibited in this country several years earlier than 1868. Some of these Geissler tubes had platinum wires sealed into the side of the exhausted glass tube in the same manner as the wires are sealed into the Goebel lamp No. 4. I have tested this lamp for its resistance. I can get no current through it, which shows that the current is somewhere broken. I have carefully examined the carbon filament with a microscope, and also the joint or connection of the carbon filament with the supporting copper wires, and can discover no visible sign or indication of a break. I am of opinion that the break is not in the carbon, but is somewhere along the length of one or other of the two interior copper conductors or of the two platinum leading-in conductors that should continue the copper ones, or in one or other of the joints between the copper and the platinum. I estimate that the luminosity of the lamp Goebel No. 4, if this break did not exist, would be approximately 10 candle power with the proper current. Such a current was readily obtainable in 1872 and long before that time, and by means of the appliances and in the way described by Mr. Goebel as possessed and used by him in 1872 and before. The Goebel lamp No. 4, with the hidden break repaired, would be entirely capable of practical use, exactly as incandescent lamps are used to-day, and the same thing is of course true ef the lamps said by Mr. Goebel to have been made and used by him in 1872 and before and after exactly like the Exhibit No. 4. Barring accidents, which occur now and then with all styles and grades of work in this art because the structures are so delicate and fragile, I am of opinion that the length of life of lamps made exactly like Goebel Exhibit No. 4 in all details of construction and of workmanship, and made exactly in the way and with the tools and appliances referred to by Mr. Goebel as used by him in his Monroe street house in making these lamps prior to 1872, would on the average be not less than 150 to 200 hours, and perhaps more. And I mean by that with the ordinary rough usage that lamps meet with in commerce and burning with the sustained brilliancy and power of a modern incandescent lamp of ten candle power. An incandescent lamp of that candle power is entirely commercial to-day, and are sold and used both in this country and in Europe. The lamp Goebel No. 4 was shown me in connection with Exhibits 1, 2 and 3 at the time I made my former affidavit; and upon such examination as I then had time to make, and my opinion was based on the assumption that the lamps had all four been exhausted by the simple Torricellian process, I entertained the doubt above stated and reported the same to defendants' counsel. I was not before aware, and did not suspect until Mr. Goebel informed me, that if the mercury were distilled, that is, were chemically pure, no trace of the same would be left upon the surface of the copper wires, especially if care were taken to perform the operation in a dry state of the atmosphere, which Mr. Goebel said he was always very careful to do. Returning to the lamp Goebel No. 4, and after the most careful investigation of every part and detail within and without—carbon joints of carbon to copper, copper to platinum, platinum leading-in wires and their sealing, the glass work generally, the glass, the mounting of the whole—I am clearly of the opinion that there is no reason discoverable in the lamp itself, or in the account of how it was made, why that particular lamp and lamps in all respects like that lamp might not have been made by Mr. Goebel as early as before 1872 and long prior to 1879. The lamp No. 4 represents an advance in the care and skill of making and putting together the various parts of the lamp, and especially in respect to the workmanship and finish of the enclosing chamber, just such as I should naturally expect a man of Mr. Goebel's ingenuity and delicacy of manipulation would make. I am familiar with the appearance and construction of the lamp marked Goebel No. 4. It has an arch-shaped or hair-pin filament of rectangular cross-section made of a thin strip of carbonized indigenous wood which I believe to be bambo, and its cross-section, as near as I can judge is about .006 by .012 inches. The luminous part is about 2.5 inches long. The leading-in wires are thin and flat and are of platinum. Between the platinum and the carbon a piece of copper wire is interposed and the joint between the copper and the carbon appears to have been electroplated with copper, as there is a superficial deposit of copper upon the wires. I can see no traces of mercury within the lamp. The circuit through the lamp is now broken but the oxydized appearance of the filament indicates that it has been kept for some time at incandescence. I can observe no indication of hydro-carbon treatment upon the filament. I have had the lamp tested by an induction coil and find it still maintains a vacuum.

The workmanship of the lamp shows a considerable degree of skill, especially the mounting of the carbon. The seal is more than a quarter of an inch in length and similar to that used in the early forms of vacuum tubes, such for instance as those shown in the fifth edition of Du Moneel's work on the Ruhmkorff induction coil, published in Paris in 1867, particularly in Figures 44 and 45 on page 123; in Figures 71 and 72 on page 210, and Figures 74, 75 and 76 on pages 221 and 222. With a fairly good vacuum I have no doubt that this lamp might burn several hundred hours—three or four hundred at least. Goebel lamp No. 5, made for the American Electric Light Company in 1881, as I understand, I have most carefully examined. This lamp is substantially the same as those now in general use. It has a pear-shaped globe 2¾ inches in diameter at its largest point and 6 inches long. The filament is of carbonized indigenous wood, of rectangular cross section, and is very similar to the filament of lamp No. 4, except that it is thicker. I estimate the filament to be about .012 by. 025 and its light-giving portion 4½ inches long. It is secured to copper wires which are twisted into coils at the ends, into which the ends of the filament are thrust, and the joints are covered with a cement which looks like an alloy of mercury and gold. The leading-in wires are of platinum and round, and are sealed into the sides of the glass chamber in the same way as in the Goebel lamp No. 4. The glass work of this lamp is of the same style as No. 3, but the finish is better. The resistance of this filament cold is 133 ohms and would be about 66 ohms when hot. It does not appear to have been treated by hydro-carbon process, but looks as if it had been burned. It is a good commercial lamp—I think as good as any that were made in 1881, and could have been made at that time, as Goebel states in his affidavit. Comparing the construction and workmanship of Goebel lamps 1, 2 and 3 with Goebel lamp No. 4, and that with Goebel lamp No. 5, I find a steady progress shown in matters of detail of construction and workmanship. This is particularly the case with the glass work, which in the early lamps is crude and unskilful, showing a lack of familiarity with the material and with the management of the flame. The carrying of the wires through the end of the lamp with a thick mass of glass formed around them increases the liability to leakage and fracture. Nos. 1, 2 and 3 are all crude in workmanship; No. 4 is very much better, being, in fact, nearly or quite as good in every respect as the commercial lamps in general use in 1881 and 1882. The filament is uniform in thickness, having apparently been shaped by a machine. Copper wires with a cross bridge of glass are placed between the filament and the platinum wires, as in modern lamps; the seal is elongated and thereby made more secure, and the leading-in wires are made of platinum, very thin, and carried through the side walls of the chamber, thus largely reducing the liability of leakage and fracture. These improvements are just such as would naturally result from increased experience and skill gained by continuous practice of the art.

In my opinion, Goebel lamp No. 4 and the lamps made like it in 1872 and before and after embody the invention of the second claim of the Edison patent in suit, as the same has been construed in the prior adjustications, having all the elements of that claim combined and operating as there set forth. Referring to the question of iron leading-in wires and the practicability of sealing them in glass so as for a longer or a shorter time to make and maintain an air-tight joint suitable for the purpose of an incandescent electric lamp, it is a fact that iron of all the metals is the one which stands nearer to platinum in the matter of the approximation of its coefficient of expansion and contraction to that of glass, so that its use for that purpose is the next best thing to the use of platinum. It is also a fact that glass of one quality differs from another in its liability to fracture. It is again the fact that the thinner the wire in either case the less is the danger. In my opinion, while platinum is superior for the purpose, and so superior that in manufacturing on a commercial scale where the percentage or average of failures is required to be very low, platinum has heretofore had to be used. Still, I believe it to be possible to make perfectly operative lamps, capable of practical use, with iron leading-in wires. It would require more care in the sealing in than is required where platinum is used and there would be more lamps fail in every dozen made, but the lamps that would not fail at once would, some of them, burn as well and as long as would be required in a commercial lamp for some purposes. Again, the use of platinum leading-in wires fused in the glass was not only known generally in the art prior to October, 1879, and prior to January, 1880, but it was known in the art of electric lighting and all its advantages. To the best of my knowledge and belief, the art of sealing platinum wires into the walls of an exhausted glass chamber for the purpose of conveying electricity through the said walls was known as early as 1860. I have tested the lamp Goebel No. 4 for vacuum by charging it with high tension electricity from an induction coil in a dark room. It has a fairly good vacuum, enough in my judgment to keep it running two or three hundred hours. The color af the luminosity indicates that there is no oxygen in the lamp and hence that no leakage of air into the lamp has occurred since it was made.

Affidavit of Charles R. Cross.

I have to-day for the first time been requested to examine critically two incandescent lamps marked "Goebel Hairpin Lamp, H. Goebel No. 4," and "Goebel No. 5." I have been asked to compare them with the incandescent lamp set forth in the second claim of U. S. patent No. 223,898, issued to Thomas A. Edison. Both of these lamps contain a filament of carbon enclosed in an all glass globe. The filaments of both the lamps from their appearance seem to have been kept in a state of incandescence for a certain time, from which it follows that there must have been a vacuum within the glass vessels in which the filaments are enclosed.

In my opinion both of these Goebel lamps resemble the invention set forth in the second claim of the Edison patents referred to as that claim has been construed by the Circuit Court of Appeals. So far as I can judge from their appearance both of these lamps are capable of being practically operated to give light for purposes of illumination.

The leading Goebel lamps Nos. 1, 2 and 3 possess iron or copper in wires. Lamps Nos. 4 and 5 possess platinum leadings in wires. That platinum is much the best material for any purpose in which a conducting wire has to be sealed into glass was pointed out half a century ago or more by Faraday.

The introduction of leading-in wires at the sides of a glass vessel instead of through a heavy piece of glass at its base, was a well known process in the art prior to the date of the Edison patents in suit.

So far as the structure of any and all the various Goebel lamps is concerned, I see nothing in the construction of any part of the apparatus which would make it improbable that it was constructed prior to the date of the Edison patent in suit, or at the date assigned by Goebel. There is no detail in the process of manufacture as described, or in the furnished product so far as I can observe, which would forbid its having been employed at the time at which Goebel asserts his lamps to have been made.

There are at least two manifest advantages of construction in which the Goebel lamp is superior to the lamps specifically described in the Edison patent in suit.

In the first place the Goebel filament is made of the carbonized fibre of bamboo, a material which the Edison Company has itself employed as the best material available, and which is far superior to the tar, putty and other filaments specifically set forth in the patent.

In the second place, the filament specifically described in the Edison patent is carbonized with the supporting wires in place, the intention being that the filament shall thereby remain adherent to these during and after the act of carbonization. In my opinion there would be a great liability to a defect in the joint between the supporting wires and the filament in consequence of this mode of production unless some further process of uniting the two, not set forth in the patent, were introduced. The Goebel lamps, as I understand it, were not made in this way, but the carbonized fibre was attached to the supporting wires subsequent to its carbonization.

Affidavit of James A. Vandegrift.

James A. Vandegrift, being duly sworn, deposes and says as follows:

I have been handed by W. H. Kenyon, Esq., an incandescent lamp marked "Goebel No. 4," and requested to make certain tests and report upon the results of them. I have made the tests desired, and have arrived at the following results and conclusions: There is a fair vacuum in the lamp, sufficient to enable the carbon to last between one hundred and two hundred hours when burning at normal temperature. An average life of between one hundred and two hundred hours was a good length of life for a commercial lamp in the year 1880. I find that the filament has been made from a piece of coarse bamboo, its structure when compared with a piece of fine bamboo differing from it only in degree but not in nature. The filament has been carbonized. It shows evidence of having been burned for some time, and seems to be slightly oxidized upon its surface, but it is not so far as I can see materially injured. The indication of the oxidation of the surface of the carbon filament is not peculiar to this lamp or unusual.

I have noticed it in respect to modern commercial lamps containing untreated filaments. This effect is shown by a long and continued use with a good vacuum, or by a shorter use with a lower vacuum. There is a broken circuit through this lamp, but I have not been able to discover that the break occurs in the carbon. This would seem to locate the break at the junction of the wires. The leading-in wires are of platinum. The supporting wires connecting with them and with the filament are of copper. I see no reason why this lamp could not have been made as early as 1872, or earlier.

The glass work in some respects seems to be an adaptation of a mode of sealing which I understand to have been practised earlier than that date, for example in the Geissler tubes. The platinum and copper wires are fully large enough to carry the current when the lamp filament is heated to incandescence, judging from the size of the latter. I find no indication from examination of this lamp that hydro-carbon treatment has been applied to the filament, and my best judgment is that it has not. In respect to the quality and appearance of the carbon and the quality of the glass work, and the workmanship of the lamp generally, this lamp, in my opinion, would have as good a commercial life as the lamp described in the Edison patent here sued upon, the only question determining the number of hours of its life being the degree of vacuum.

Affidavit of Detlief Christian Voss.

The Goebel lamps referred to by me in my previous affidavit, and which I saw frequently, burned at from 8 to 13 c. p. A great deal depended upon the battery. Some of the meat-saw lamps burned at about 8 or 10 c. p. Some of the hair pinlamps burned at a higher c. p.—I should say 12 to 13 c. p. I have seen Goebel's store lighted with three electric lamps alone when the gas was turned off, and the light in the store was a nice brilliant light of, I should say, from 8 to 10 c. p. to the lamp.

I remember the Edison lamps put upon the market about 1881. Some of these lamps were in the factory of the American Electric Light Company for the purpose of testing them. We found some of these lamps of not more than 12 to 14 c. p. The light given by the best Goebel lamps compared favorably with these.

Affidavit of David A. Hall.

Mr. David A. Hall, a manufacsuring jeweller, who sold Goebel jewelry about 1872, testifies that from 1872 to 1886 he was in the habit of calling on Goebel at the latter's store. Saw lamps frequently during the entire period in Goebel's store. Some of them had a straight carbon burner like Exhibits 1, 2 and 3, and others had the burner in the shape of a hairpin as in exhibit No. 4. I am positive that I saw them prior to May, 1873, because Mr. Goebel gave me a lamp just like Goebel hairpin lamp No. 4 as a present or keepsake ; I took this lamp home and remember showing it to my father, who then lived next door to my house. I remember his wondering what it was. My father died in May, 1873. I have a number of times, I should think as many as a dozen times, seen Goebel's store lighted entirely by these lamps. These lamps gave a very good light, brighter than a gas jet. In fact I used to think it too bright a light, and I have told Mr. Goebel that I thought it was too strong. The light was very steady.

I have often called on Mr. Goebel socially. Sometimes these electric lights of his would burn all the time I was there. Some of them would burn continuously for hours at a time.

I was very well acquainted with Mr. Goebel for many years. He was and is a man of the highest reputation for honesty and veracity. I would place the utmost confidence in any statements he might make.

I remember noticing that the wires that went through the glass of Mr. Goebel's lamps were white metal, and of asking Mr. Goebel what the wires were made of, thinking they might perhaps be silver. He told me they were made of platinum, and gave me a reason at that time for using platinum instead of some other metal, which I do not fully remember, except that the platinum and glass were affected alike by the heat and the glass would not crack ; they expanded alike.

Affidavit of Edward E. Cary.

Edward E. Cary, being sworn, deposes and says : I am twenty-seven years of age, reside in Boston, Mass., and am superintendent of the defendant company. I have been engaged since 1885 in the commercial manufacture of incandescent lamps with the United States, Westinghouse and the defendant company since July 1, 1891. I am thoroughly skilled in the manufacture of incandescent electric lamps.

I have been asked to consider a report on the statement of Prof. Thomson and two others in this case that lamps with in-leading wires of iron or copper are for that reason incapable of any practical use. I have been aware from my own experience for several years that it was quite possible to make entirely practical and operative incandescent lamps with iron in leading wires sealed in the glass—lamps fully capable of practical and long-continued use.

To test this matter practically I present two incandescent lamps made by me within the last two days with iron leading-in wires. These lamps have been used as in ordinary commercial use as long as I have had time to use them since making them.

Affidavit of Mr. A. D. Kenyon.

Mr. Alan D. Kenyon, of counsel for defendant, testified that Goebel's hairpin lamp No. 4 came into possession of his firm a short time before January 16 last; that it was not offered in evidence at the hearing on that date because Mr. Franklin L. Pope, the expert for defendants, had expressed a doubt after examination as to whether the lamp was made at the early date given by Mr. Goebel. This doubt was based on the absence of any appearance of mercury on the copper surfaces inside the glass tubes, such as appears on the copper surfaces of the lamps marked Goebel lamps Nos. 1, 2 and 3. They did not wish to present to the court any lamp as to which there was a doubt.

(This matter is fully gone over in the affidavit of Mr. Pope.—Ed.)

Henry Goebel, Jr., testified in his affidavit that the majority of the lamps made by his father in Monroe street were made with platinum wires running through the glass; those with iron and copper leading-in wires were the earliest lamps made. Goebel, Sr., became satisfied quite early that with platinum leading-in wires more of his lamps were good lamps. Almost all the lamps from Monroe street time down had platinum leading-in wires.

Additional affidavit, of the following named persons were submitted. They were in their nature corroborative of the others, many of them bearing upon the high reputation borne by Mr. Goebel for the past 40 years as a man of veracity and irreproachable character :

Thomas Conroy, Henry Crawley, Peter Schelleus, Edward J. Kenny, Peter H. Fox, Anna Mary Huebsch, Louisa F. Stark, George Paboch, Johanna Paboch, Benj. F. Chambers, Wm. H. Williams, Edward J. Hogan, Wm. Newman, R. H. W. Baker, Charles Forschner, A. T. Cross, Theodore S. Copeland, Henry Grinnell, Charles G. Perkins, Edward E. Mulligan.

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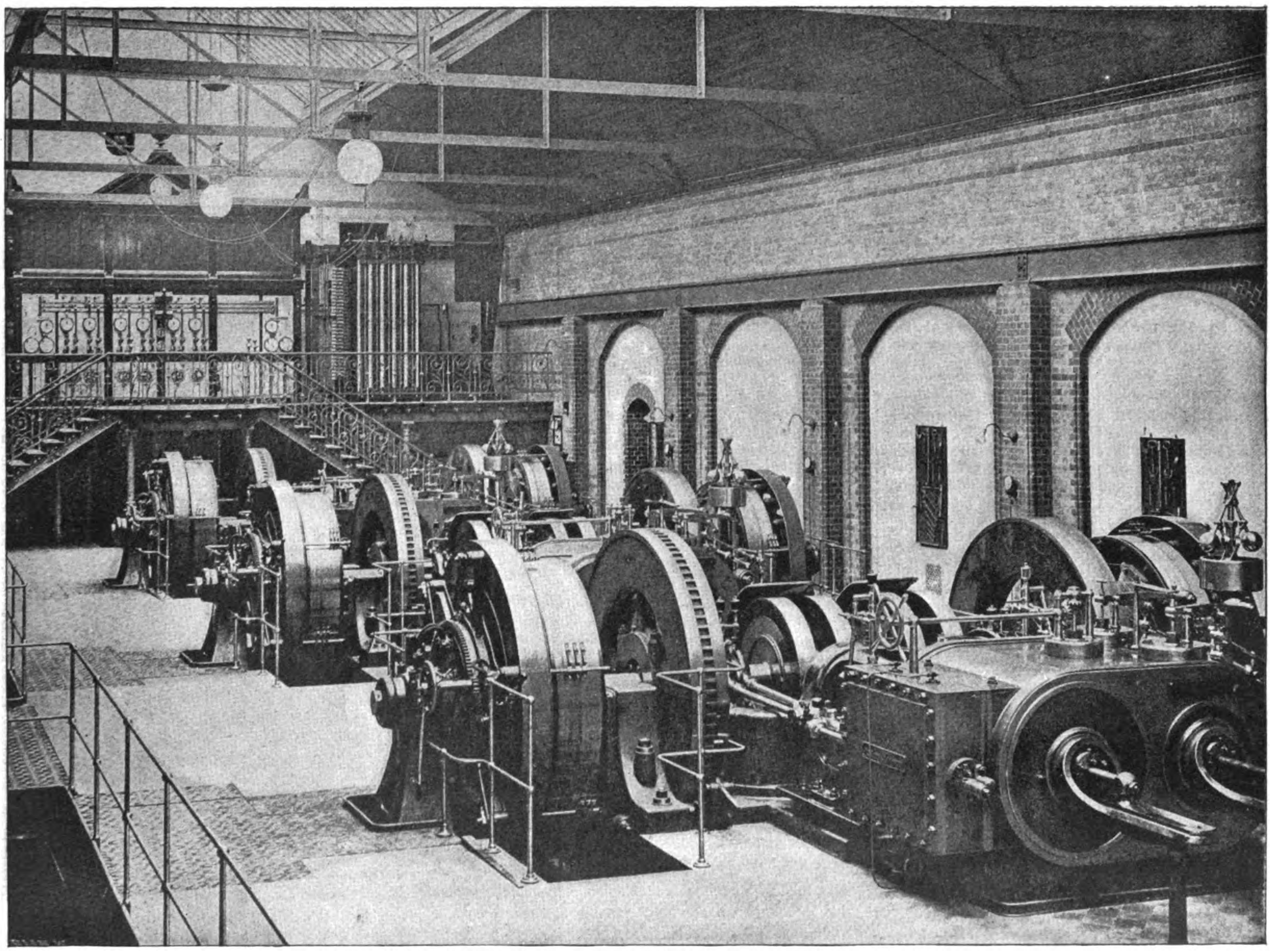


A SIEMENS & HALSKE CENTRAL STATION.—BRESLAU, GERMANY. (SEE PAGE 54.)

The Breslau Municipal Station.

In May, 1889, the city government of Breslau, Germany, having decided to install a municipal plant gave an order for the same to Siemens & Halske, of Berlin, who completed the installation in July of the year following. Our Frontispiece represents the dynamo and engine-room of this plant. The current is distributed on the three-wire system, the pressure on each side being 110 volts. Continuous current machines are employed.

The steam plant consists of three boilers of the Heine type, which work at 150 pounds pressure, manufactured by A. Börsig, Berlin.

There are three horizontal engines, each of a capacity of 250 H. P. running at 150 revolutions per minute, and each drives two direct coupled dynamos. The engines were manufactured at Görlitzer Machine Works and Iron Foundry. The engines are run with condensers.

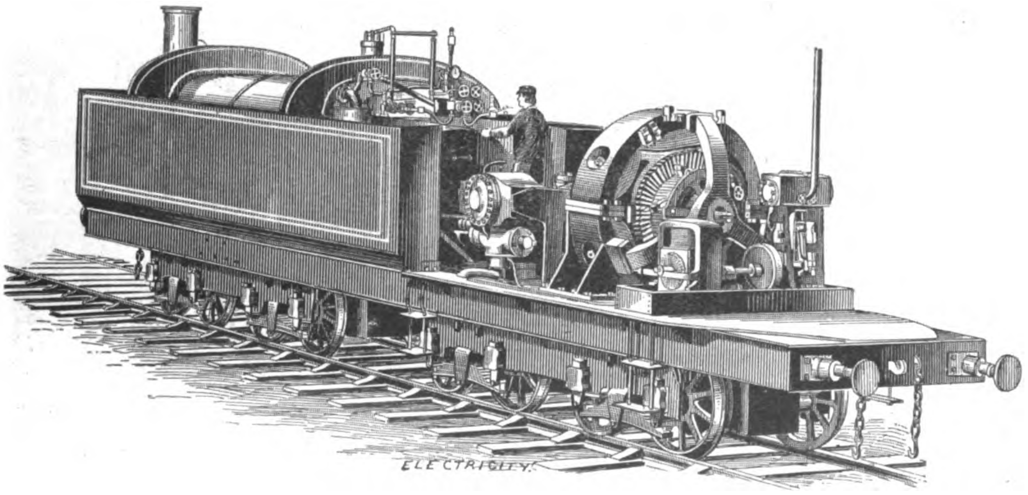
The dynamos, manufactured by Siemens & Halske, are six in number, and are connected directly to the engine shafts. These machines have a capacity of 605 amperes at 130 volts. In parallel with the dynamos is placed a battery of accumulators of the Tudor system. These have a maximum discharge of 304 amperes and a capacity of 220 H. P.

The total capacity of the station using the engines and batteries together is equal to 970 H. P., and was designed to run about 8,500 16 C. P. lamps.

An Electric Locomotive.

In a recent number of *L'Illustration* there appears an account of a new electric locomotive invented by Mr. J. J. Heilmann, and which is about to be tested by the French Government with a view to its adoption on the Government roads.

The accompanying illustrations give a general view of the locomotive and also the disposition of the machinery on the car. The novelty in this case lies in the fact that the current is generated on the car instead of being obtained from stations along the route. The boiler and steam engine, of the Brown type, are placed on the rear of the car, the engine being directly coupled to the dynamo, which is a separately excited machine. The current is led to four motors, each of the axles of the locomotive being driven by a separate motor.



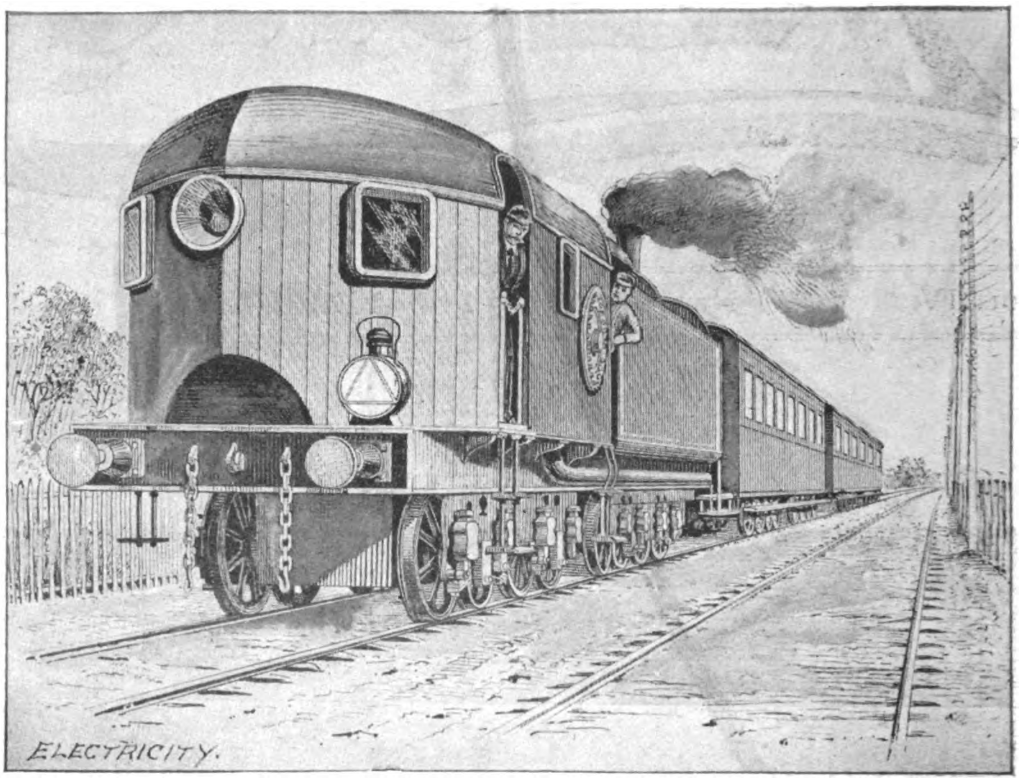
Heilmann Electric Locomotive.

The advantages claimed by the inventor for the use of a dynamo and motors instead of driving with a steam engine direct are the absence of reciprocating motion, which will permit much higher speeds to be attained, and the automatic regulation of the motors, which permits the heat spent in the furnace to be more efficiently utilized than when the steam is applied directly to the locomotive pistons.

The experimental machine illustrated is not yet definitely arranged as to details, which will be largely determined by the trials to which it is to be subjected, and which will be watched with the greatest interest.

World's Fair Notes.

The Engineering Department has started a large corps of men at work drawing the electric light cables in the conduits. These circuits will be known as the patrol circuits, and will convey current to the double carbon arc lamps which are to burn all night.



Heilmann Electric Locomotive.

The Director of Works has issued specifications and calls for bids for furnishing the necessary motors for operating the machinery in the Mines and Mining Building.

The Westinghouse Electric Company have placed eighty of their new stopper lamps in the Building of Arts. The lamps were put in position not so much as a test as to show their effect in lighting up the space to be occupied by the pictures and other works of art.

Although very few of the exhibits for the Electrical Department have arrived at the park, a good beginning has been made by a number of the largest electrical manufacturing concerns in the country. The new cranes in Machinery Hall are in daily use unloading electrical apparatus.

The heavy rains during the past week have caused considerable damage to several of the Exposition buildings. The large amount of snow which had gathered on the roofs of the Manufacturers' and Liberal Arts and the Machinery Hall buildings absorbed the rain to such an extent that the extra weight broke through in small sections of the annexes. The roof of the Electricity Building escaped any damage on account of the slant given to the arches.

The large number of hotels being erected in the vicinity of the World's Fair grounds has created a good demand for electric lighting apparatus. In nearly all of the fifty or sixty new hotels in the course of erection the contracts specify for a complete electric light plant. The promotors of the hotels make a special point in their advertising matter of calling the attention of their prospective customers to the fact of their hostelries being lighted by electric light.

The method of illuminating the largest of the World's Fair buildings—the Manufacturers' and Liberal Arts—has at last been definitely decided upon. The problem was a serious one and required considerable thought on the part of the electrical engineering department. The arrangement to be adopted is to have a large electrolier, seventy-five feet in diameter, occupy the central portion of the dome, on which will be mounted over one hundred arc lights of 2,000 C. P. each. The electrolier will consist of a large platform from which the curved lamp posts will rise and extend over the side. The electrolier will be suspended one hundred and forty feet above the floor of the building, and will be reached by a spiral iron stairway. Besides the large electrolier there will be four smaller ones to illuminate different portions of the building.

The Western Union and the Postal Telegraph Companies are making great preparations to supply their customers with a means of rapid communication from the Exposition grounds to almost every large city in the country. The Western Union will have at least forty wires and the Postal will supply about thirty more.

The Postal Telegraph Company will have sub-offices located in the Machinery Hall, the Casino, Mines and Mining Building, Manufacturers' and Liberal Arts, the Electricity, the Illinois and the New York State buildings. The Western Union will occupy positions in nearly all of the other buildings. It will also furnish the time for between 200 or 300 self-winding clocks.

Master in Chancery L. W. Winchester reported his decision in the case of the Babcock & Wilcox Company vs. the World Columbian. The bill sustains the Babcock & Wilcox Company, and orders the Exposition authorities to allow the company to carry out its contract by placing its boilers in the unoccupied space of the main boiler house.

Dr. Allen Hornsby, assistant chief of the Department of Electricity, gave a lecture last Tuesday evening before a large audience assembled in the Baptist Church on Oakwood Boulevard. His subject was How to Study the Exhibits in the Electrical Department of the World's Fair.

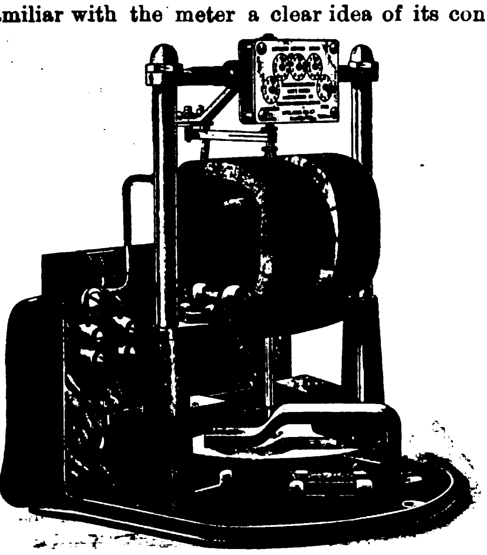
One of the largest tower clocks that have ever been erected in the West will be placed in the centre of the Manufacturers' Building. Electricity is to be used both in regulating the clock and in ringing a number of chime bells.

A concession has been granted to Thomas A. Edison to install 150 of his kinetographs in the different buildings of the Exposition.

The Thomson Recording Wattmeter.

BY P. J. M'FADDEN.*

In this paper on the Thomson Recording Wattmeter I have endeavored to give briefly a description of its physical characteristics and the electrical principles underlying its design, and have avoided any discussion of its abstract mathematical equations, as my instructions from your Literary Committee were to prepare a paper that would not take long in its reading and yet would give those of you who are not familiar with the meter a clear idea of its construction and application in commercial practice.



Thomson Recording Wattmeter.

In designing this meter several essentials had to be strictly observed: First, the meter must be theoretically correct in principle. Second, it must be of the simplest possible construction. Third, it must be easy to install and to maintain in operation. Fourth, it must be accurate throughout its range. Fifth, it must be automatic. In addition to these requisites it was the aim of the inventor that the meter operate with equal facility and accuracy on circuits of either direct or alternating currents, and it was his opinion that such a meter should be a motor meter; that is to say, it should be actuated by the same energy which it measures, avoiding, for instance, the necessity, as in clock meters, of winding up the mechanism at stated intervals.

Briefly, then, this meter consists merely of a simple skeleton motor having no iron either in armature or field. The fields, which consist of two coils, one on either side of the armature, are connected in series with the lamps or motor whose absorption of energy they are to measure, all the current in use passing through these field coils. The armature, which is of the Siemens drum type, is hollow and is made of a fibre cylinder over which the coils are wound. On the end of the shaft of the armature is a silver commutator, on which rest flexible bronze brushes provided with silver contact pieces. The armature is shunted across the circuit in the manner of a lamp, and to cut down its current a high resistance of fine wire is connected in series with it, the whole forming a pressure coil whose current varies with the voltage of the system.

It will readily be seen, therefore, that as the field varies with the current, and the armature with the pressure, the speed of the motor will vary directly with the energy or watts in use, which is of course the ideal method of measurement.

Friction would, however, seriously affect the accuracy of those results were it not compensated for. This is accomplished by taking off the armature circuit beyond the fields. Thus there is a slight constant field, independent of that created by the current flowing to the lamps, caused by the flow of the armature current through the field coils. On very low loads, where friction is a strong factor, this "shunt," or constant field, forms a comparatively considerable percentage of the total field and torque. thus nicely balancing the meter against friction, whilst on medium and high loads both friction and the shunt field become so insignificant a percentage of the total load and torque that their influence cannot be detected and may be neglected.

Another essential feature of the meter deserves description, namely, the slowing mechanism or means for loading the meter. The necessity for this retarding mechanism is too apparent to need explanation, and has been fully appreciated by all makers of recording motor meters. In the Thomson meter this is accomplished in the most simple and satisfactory manner by placing on the shaft a thin disc of copper, some little distance below the armature. This disc rotates between the poles of three permanent magnets, as shown here.

The fields of these magnets generate Foucault or eddy currents in the disc, thus forming a considerable drag or load on the motor, which is constant and proportionate in its action. Thus it will be seen that, neglecting friction, which, as we have noted, is compensated for, the meter is proportionate throughout, for torque is directly proportionate to the product of current in armature and fields, which equals amperes × volts—that is, torque is directly proportionate to power or watts passing the meter. Speed is directly proportionate to torque, and the retarding effect or generation of current in disc is directly proportionate to speed. Therefore, the theory of the instrument is consistent and correct throughout.

Another good feature of the meter exists in that the drag or load is considerable, hence friction, which is the only varying quantity, forms, even on light loads, but a small proportion of total retarding effect.

The indications of the meter are shown in watt hours on the dial, the first wheel of whose train engages with a worm on the shaft, thus connecting it with the revolutions of the armature. The five dials of the whole train will record up to 10,000,000 watt hours, that is to say, approximately 200,000 lamp hours, and it is only then that the dials all come back to zero. This for the smaller sized meters without constants. The largest sizes will register as high as 360,000,000 watt hours before reaching zero again.

By an examination of this dial it will at once be apparent that the friction absorbed in actuating the recording mechanism is so small as to be negligible, as the power required is so slight that it is scarcely possible to move with the finger the first gear which engages with the worm on the shaft so slowly as not to see the first dial hand move, and yet when the meter is running at full load this motion of the dial hand is not discernible. Here then is one of the two possible chances for friction reduced practically to zero.

It is essential that a motor meter have a slow rate of revolution so that no possible resistance can be introduced by reason of friction of the gears of the train or on the lower and only bearing. To accomplish this and still to use the same recording mechanism on all meters, the larger size meters are made of such electrical dimensions that their rate of revolution will be one-half, one-third, one-sixth, etc., slower than their normal, thus keeping the revolutions of all meters down to about sixty revolutions per minute at full load, and consequently lengthening the life of the meter. In such cases the corresponding constants of 2, 3, 6, etc., are marked on the dial and by which the readings are to be multiplied. These constants are uniform throughout any given sized meter.

The only other point in which friction might appear is at the bearing on which the lower end of the vertical armature shaft rests. This again is reduced practically to zero by having the shaft's point hardened, very carefully ground and highly polished, and in having the bearing made of sapphire. This jewel is inserted in the end of a brass screw which passes through the bed plate of the meter.

If the jewel should, by reason of a continual vibrating or pounding of the shaft upon it, become cracked, the point of the shaft would become worn and the meter run slow. To prevent the occurrence of this, the jewel setting is mounted on a small spiral spring contained in the hollow screw, and this permits of the bearings following every motion of the shaft and presents no rigid surface upon which the vibrating shaft can deliver a sufficient blow to do any damage. The calibration of the meter is readily and effectively accomplished by moving the poles of the permanent magnets towards or away from the periphery or centre of the disc, thus increasing or decreasing its speed until it become synchronous with the standard instrument.

We have seen by the description just given that the theory of the Thomson Recording Wattmeter is necessarily mathematically correct, save from that slight error which is induced by friction on the lower loads. We have also seen that this error is reduced to an almost negligible quantity by connecting the armature into the circuit in such a manner that the current passing to the armature passes first through the field coils, thus giving a certain initial torque which is present at all times and which on low loads forms a considerable portion of the total torque, this initial torque being so proportioned as to almost absolutely balance friction, the meter being in fact poised when entirely free from load.

It may have occurred to some that as the size of the meter increases so would the number of turns in the field decrease, and therefore a meter of 100-lights capacity would not have the same amount of initial field due to the armature current passing through the series coils as would a meter of small capacity. Strictly speaking, and were no provision made for it, this would be quite true, but in cases of this kind the initial torque is maintained by the insertion of what is termed the shunt field coil, wound inside of one or even in some cases of both the series field coils. In cases of this kind the current passing through the shunt field, acting in unison with and in the same direction as the series fields, and then through the armature, maintaining approximately the same number of initial armature field turns and the same initial torque to counterbalance friction.

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* Paper read before the Chicago Electric Club.

It is this nicety of construction which enables the Thomson Recording Wattmeter, even in sizes as large as 100 amperes, actually to give a registration on loads as small as one lamp.

No difficulty is experienced in adapting the Thomson Recording Wattmeter to all purposes. Its theory and its construction is good alike for use in all connections. Thus, there being no iron whatever in the frame, in the armature, in the field or cover of the meter, its accuracy remains unchanged with the same calibration whether it be installed on alternating or direct current, and this being true it is, of course, obvious that no variation in frequency can in any way affect the accuracy of the meter.

It may be well here to say a few words as to the watt hour as a unit of measurement. In the watt hour we have what may be very honestly termed a universal unit. No matter what variation of voltage the meter may be subjected to, no matter whether operating upon power or upon light, whether being used to measure the output from a station or to measure the total input of electrical energy into a house having but three lamps, the watt hour means the same thing.

It has been customary with many manufacturers to adopt the ampere hour as the unit of measurement, but the ampere hour, while a very good thing for ampere meters, is in reality no measurement whatever of the energy used except at one fixed potential. It is a recognized fact that a recording ampere meter, except at the potential for which it is calibrated, does not accurately record the power passing through it; and so an ampere as a unit designates only half of the question. It indicates how much current has been used, but to obtain results as to the amount of power used it is necessary to assume or determine the voltage and multiply the result.

By a fortunate coincidence the basis of charge dependent upon 1,000 watt hours found a parallel in the familar basis of charge for gas. That is to say, experiment has shown that 1,000 cubic feet of gas will give about ten times the illumination of an incandescent lamp consuming 1,000 watt hours, and if a customer has been paying $2.00 for 1,000 cubic feet of gas, he would, if he were to be charged at the same rate for his illumination, pay twenty cents per 1,000 watt hours for his consumption of electricity.

The Thomson Recording Wattmeter is made for lighting or power circuits of all commercial voltages, and for primary circuits of alternating current stations for measuring the total output from an alternating machine, and for measuring the output of direct current of light or power stations in sizes from 10 ampere to an instrument as high as 600 ampere capacity, one meter thus being capable of measuring the output of some of the largest generators now made.

These meters are also made to record on a single dial the summation of energy from both sides of an Edison three-wire system, and to measure the power consumed by an electric car, to check the wastefulness or economy of the motorman; in fact, they are made in about fifty-five different forms, varying in voltage, amperage and in construction according to the uses for which they are intended.

I trust that these brief notes have sufficed to convey to you an idea of the main features of this meter, and perhaps to have suggested to your minds some other points which, in the limited space afforded me, I have not been able to touch upon, in which case I will be pleased to answer any question I may be able to touching the subject.

Mr. Wirt—Mr. Chairman, I did not have time to prepare a paper for this evening, but I will make a few remarks upon the meter question. I have brought with me an Aron meter. I had a little experience with this meter in the laboratory at one time, and was very much interested in it. It is familiar to most of you, and the mechanism is very simple. It consists simply of two pendulum clocks, each being run by a spring, capable of running thirty days at one winding. Each clock has a pendulum of the same effective length, giving synchronous vibrations. The pendulum of the left hand clock is weighted with an ordinary brass bob. The pendulum of the right hand clock has a permanent magnet for a bob. Those two clocks are geared on the counter differently, so that when they are running properly and in synchronism the counter stands still. Any difference in the rate of the two clocks is registered on the counter. The electrical part of the meter is merely a pair of coils. In a meter for a two-wire system there is only one coil, and the bob is single instead of double as in this sample. Those coils are close underneath the permanent magnet bob and carry the main current. The current is so put through the coil as to magnetize the permanent magnet in the same sense in which it is originally magnetdized. There is no tendency to reverse or decrease the strength of the permanent magnet. The principle of operation is simply that the attraction of the coil for the magnet acts exactly as an increase of gravity and increases the rate of vibration; so the magnetic pendulum runs faster than the other, and the difference in rate is registered on the counter. That difference in rate is proportioned to the current passing; and one of the beautiful things about this meter is that it is capable of an infinitely fine rate of registration. It does not register down to one per cent. only, but it will register down to any per cent., no matter how small, of the total current.

The extremely small difference in the rate of the two pendulums on which the reading of the meter depends is rather surprising; at full load the difference in the rate is only about 0.1 of one per cent. It follows that an error in either clock work of 0.1 of one per cent. would suffice to wipe out the largest record that the meter might make. The meter working at one per cent. of the full load would give a variation in rate of only one part in 100,000.

When I took that meter to test it some years ago, the first thing I wanted to find out was if the effect of the current would not be to increase the magnetism in the magnet so as to give a rate different from the rate required theoretically. I found that the actual magnetic effect of the current was so small, and the strength of the magnets and their hardness was such, that the effect was not appreciable. The meter can be taken as strictly proportional to itself throughout its range. That makes it valuable to test other meters by. After having determined the rate of the meter it can be depended upon for a time to agree with itself, and to give readings that are proportional to the true value.

The next thing I wanted to find out was whether a short circuit or disturbance in the main circuit would not so affect the magnets as to permanently alter their value, and so cause false reading. I tried short circuits and did not succeed in making any permanent change in the magnet, but I did find that by *reversing* the current and putting it through the meter in the reverse direction, and then making a short circuit, the magnets had been permanently changed and the constant of the meter altered.

The constant of the meter which is sent out should be taken with several large sized grains of salt, and should be redetermined for each meter before it is put into use.

The mechanical part of this meter has been very well worked out. The clock work is admirable; it is not large, having very little work to do, much less work in fact than an ordinary eight-day clock has to do in moving the hands. But the design of the case and some of the other details of the meter are rather too clumsy to suit the American taste.

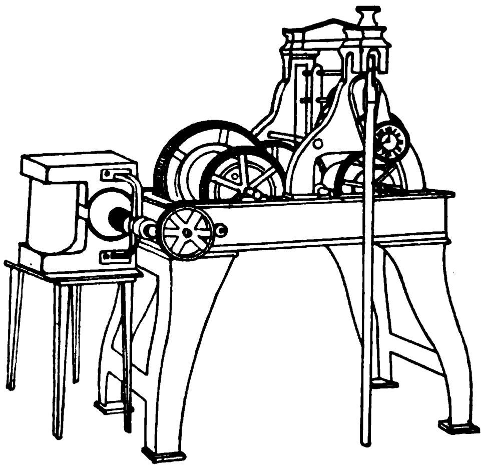
I have not had any extended experience with this meter, and I do not know to a certainty whether the magnets retain their permanency over long periods of time. The meter has never come into use in this country, probably owing to the fact that we have had good meters and that no one has seen fit to undertake the manufacture of this one here. They are largely used in Germany, and I understand with gratifying success.

I know one central station that put in an electrolytic meter, having first tested this meter and made very careful calculation as to the cost of operating both, and concluded that the cost of the Aron meter at the then ruling price would more than offset the gain in operating expense, and they put in the electrolytic meter.

Clock Winding by Electricity.

The extent to which the electric motor is being applied as a labor-saving device apparently has no limit. It has entered the home to run the sewing machine, the dental parlors to turn engines, and in the stores to run the coffee mill. Wherever manual labor is required in turning light machinery, the electric motor finds a new field for operation.

One of its latest invasions is found in the field of chronometry. Although it has been applied on a limited scale in winding ordinary clocks, the illustration given probably represents the first machine in which a large motor has been utilized for winding a tower clock.



Electric Clock-Winding Machine.

Mr. J. R. Young, of Madison, Wis., has designed and applied the motor herewith described and illustrated.

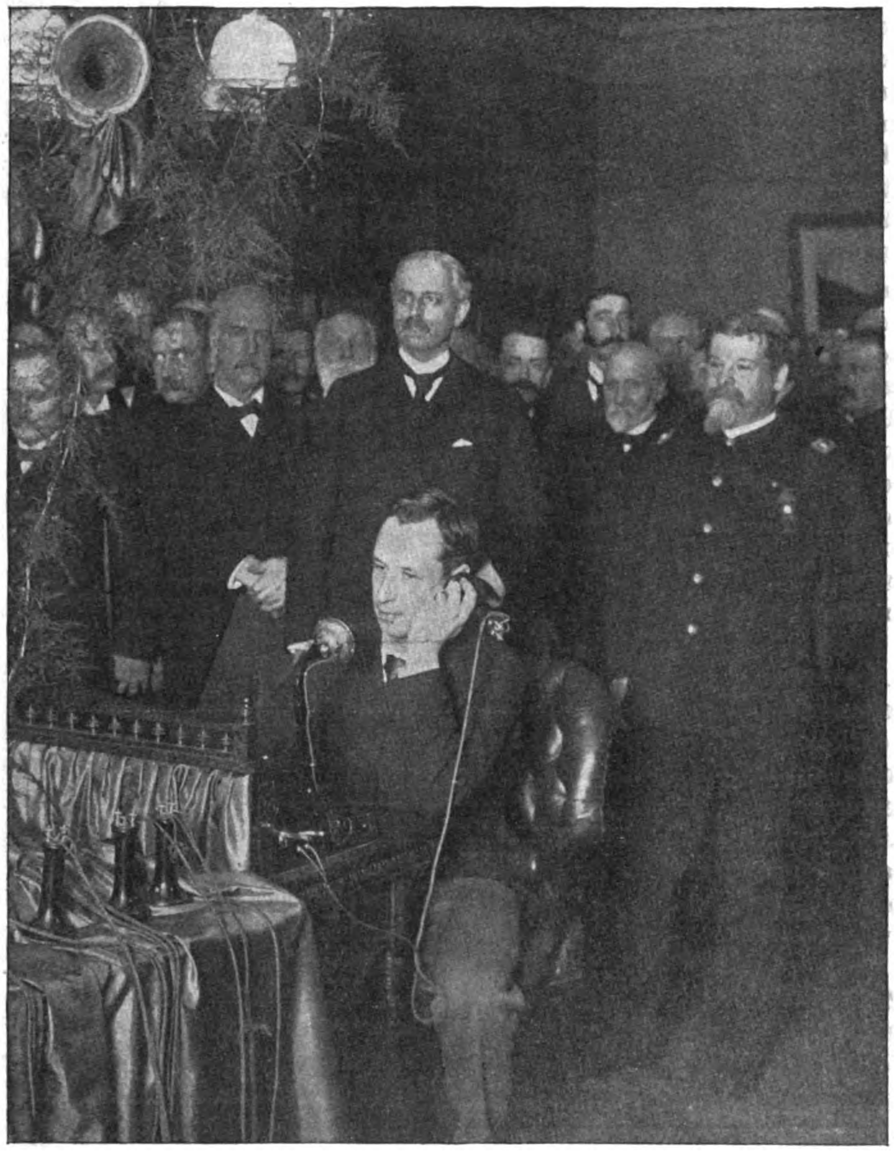
The square stem on which ordinarily the key is placed to wind the clock carries one of a series of cog wheels which are used to reduce the speed of the armature and increase winding power. The last cog wheel is mounted on the armature shaft. The motor used is an ordinary one-half horse power machine. Current is supplied from the electric light plant located in a portion of the University machine shop, 500 feet distant from the library tower in which the clock is mounted. The switches are so arranged that after the current is turned on it will be automatically cut off as soon as the winding is completed. Before this novel method was adopted it usually required the united efforts of two men for an hour to wind the clock. With the electric motor an attendant can do the same work by simply turning on a switch in the dynamo room and allowing the motor to run for ten minutes.

Linked at Last.

A Notable Event.

Boston and Chicago United by a Strand of Copper 1,200 Miles Long.

Transformed as if by magic into a tropical garden, where were growing scores of elegant and graceful palms, acacias, pampas and pines, the main rooms of the American Telephone and Telegraph Company's headquarters on the ground floor of the handsome Telephone Building in Liberty Square, Boston, presented a magnificent appearance last Tuesday afternoon on the occasion of the opening of the long-distance telephone line between Boston and Chicago. Not only is the comparative adjective "long distance" entitled to be used in this connection, but the superlative "longest" ought also to be used, for this line is undoubtedly the longest telephone line in the world; hence the event was in every sense a notable one. The tropical display lent beauty to the occasion, but the practical adjuncts necessary included elegant sound-proof telephone booths fully equipped, a switchboard for manipulating the new line that was to be opened, making connections and giving instructions to the gentlemen at the Chicago end of the line.



A Notable Event.

In the centre of the room stood a long-distance telephone set, while adjoining it was a table draped in old gold satin, from the graceful folds of which extended no less than forty wires, to the ends of which were attached as many receivers, all connected with the Chicago line. Snugly ensconced in a bower of green foliage which almost hid an electrolier overhead, was placed the trumpet-shaped long-distance receivers, likewise connected in circuit. The cards of invitation announced the opening exercises for four o'clock, and at that time many of Boston's representative men began to arrive, followed shortly afterwards by His Excellency Governor Russell, Lieut.-Governor Wolcott, Brigadier-General Dalton, chief of the Governor's staff, with other State and city dignitaries. As the Governor entered the room that fact was flashed to Chicago, and instantly a cornetist in the Chicago office struck up the popular air "Hail to the Chief," which came over the line as distinctly and loudly as if the performer had been stationed in the adjoining room. This astounding performance was received with loud applause by the two hundred or more gentlemen present.

Then the Governor took his seat at the telephone and gave the usual "Hello, Chicago!" which was instantly responded to from Chicago with "Hello, Boston!" And then having got the ear of the Chicagoan the Governor extended his congratulations as follows:

> "The Governor of Massachusetts extends his hearty congratulations, and those of the State, on the completion of this new line of communication between the two cities. Boston considers this a most important event in its history, and I feel it an honor to enjoy the privilege of conveying to you this expression of kindly feeling from the people of Massachusetts. This line will undoubtedly be the means of uniting the two cities more closely together."

At the close of this brief but successful conversation a flash light photograph of the ceremony was taken, then President Hudson, of the American Telephone and Telegraph Company, called attention to the following interesting facts anent this important achievement. He stated that the line just opened extended from that room by the most direct highway routes across Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, Ohio, Indiana, terminating in the office of the company, Nos. 105-107 Quincy street in the city of Chicago. The principal points on the main line are Providence, New York City, Newark, N. J., Harrisburg and Pittsburg, Pa., Cleveland and Toledo, Ohio, and South Bend, Indiana. In the Eastern States connecting lines reach all important points from Portland, Me., on the east to Buffalo north and Washington south. In the West branches are completed from Chicago to Milwaukee, Wis., and from Toledo to Detroit, Mich. Through these branches and connecting lines all important points to Ohio, Indiana, Illinois, Michigan and Wisconsin will soon be reached.

The Boston-Chicago line is 1,200 miles in length and is constructed in the most substantial manner.

During the proceedings the Chicago cornetist played the following selection of popular airs: "Star Spangled Banner," "Maggie Murphy's Home," "Annie Laurie," "Red, White and Blue," "Ta-ra-ra-boom-de-ay," Military Bugle Calls, and "Yankee Doodle," the assembled crowd receiving each piece with rounds of applause. Between the musical selections Mr. Wendell Baker, special agent of the Telephone Company in Chicago, kept up a facetious conversation with the forty Bostonians who held the 'phones to their ears in turn.

After the actual opening of the line by the Governor the visitors were escorted in parties to an elegantly appointed room on the second floor, where, embowered in foliage and plants, was stationed an orchestra which enlivened the time while all partook of a petite lunch which was daintily set in this room.

Then a tour of the entire building was made, the exchange or operating room of the telephone company, with its gigantic switchboard that accommodates some 4,000 subscribers and is manipulated by over ninety girls, receiving a great deal of attention.

Among the distinguished men present we noticed Professor A. E. Dolbear, Tufts College; Professor Charles R. Cross, Massachusetts Institute of Technology, and Professor Elihu Thomson, of the General Electric Company.

The entire arrangements for this interesting event were carried out by Mr. William A. Hovey, Special Agent of the American Telephone and Telegraph Company, and that gentleman was unremitting in his efforts to make it a success worthy of the occasion.

In our illustration Gov. Wm. E. Russell is seated at the telephone; at his right stands Lieut.-Gov. Roger Wolcott, and at his left Adjt.-Gen. Samuel Dalton.

St. Louis Notes.

The *Republic* states that the first electric light plant in St. Louis was installed in the famous restaurant of Tony Faust in 1878, having been imported from Paris, and that it was this plant which gave Heisler his first inspiration to engage in the business.

The *Post-Despatch* says: "The most prominent topic to come before the electricians will be the incandescent lamp question. The recent decision upholding the validity of the Edison patents strikes the interests of nearly every one in the electrical business, either favorably or unfavorably. But since every one is allied by interest with either one side or the other, a condition of intense partisanship exists and it may be prudent to rule the subject out of the convention altogether. This President Ayer will probably do. But it is certain that the matter will be the most talked-of of any that will engage the attention of the members of the convention."

The St. Louis entertainment committee proposes to raise a fund of $6,000 for the entertainment of the visitors.

ELECTRICITY.

The Popular Electrical Journal.

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"Electricity," under its present ownership, has never solicited the advertising patronage of the General Electric Company.

"Attitude of the General Electric Company."

Mr. S.D. Greene has announced over his own signature that the world is all in error as to the policy of the company of which he is the Assistant General Manager.

Mr. Greene has had some experience, and has lived probably thirty-five years. He has held an honorable though not arduous (nor dangerous) position in the navy of his country. He is a popular member of several clubs, and is, perhaps without exception, the most amiable gentleman in the service of the General Electric Company.

But Mr. Greene would have used better judgment if he had declined to assume the rôle of apologist for the insolent and infamous documents which have been mailed in thousands at the direction of his superiors.

Mr. Greene is a representative, in the tenth generation, of the ancient and honorable family of Rhode Island Greenes—a family which has contributed much to the greatness of New England and the United States. And if Mr. Greene will turn to page 36 of the "History of Warwick and Coventry," he will learn something in regard to the character of Dr. John Greene, founder of the American family, who first landed in Boston. He never sold himself to the highest bidder. His strongest characteristic was an intense and abiding hatred of hypocrisy and cant. And when he came to a realizing sense ot the humbug and injustice of the ruling powers of the early Puritan settlement, he withdrew, at great loss of money and all the comforts of life, to the then wilderness of Rhode Island, where he could at least maintain his self-respect.

We fear that the example of Dr. John Greene, the hero, has been lost on Mr. S. D. Greene, the time-serving quibbler.

* * *

THE *Electrical Engineer* is just now engaged in a perilous feat. It is attempting to run along on top of the fence where it sat for so many months, until the spikes became too sharp. By running alongside the band-wagon (in which ELECTRICITY holds the foremost seat and the reins), it no doubt hopes to create the impression that it is actually in the procession. This attempt will be a failure, and the *Engineer* would better get down immediately. There is room in the band wagon. And there is danger ahead in its present course. No man can serve two masters. The world has more respect for a journal which is honestly and courageously on the wrong side than for the one which is on neither side. It is only the museum-freak which can look two ways at once.

* * *

As an item of news we are pleased to report that one of the large supply houses in this city bought and received 1,500 lamps from the General Electric Company during the past week. Also that the same company have sold lamps for use on various new installations of machines not their own, which all goes to show that the Electric Trust has a pain in the back.

Fundamental Electric Railway Patents.

The inspired newspaper report which we noted two weeks ago, concerning the purchase of the Green trolley patents, has been verified as to the fact of the purchase. The report erred, however, in implying that upwards of $500,000 had been paid therefor, as ELECTRICITY is able to state with certainty that the price paid by the General Electric Company was $25,000 cash down, and a prospective $25,000 extra in case the courts sustain the patents. The proviso appears to point to the advent of an era of electric railway litigation for which ample rival claims exist to form the basis of a struggle not second to the incandescent lamp cases.

The list of patentees and early users of various indispensable appliances on electric railways is a formidable one, and includes the names of Van Depoele, Sprague, Edison, Daft, Adams, Finney, Henry, and numerous others whose patents have been granted during the time intervening between the application and the issue of the Green patents.

* * *

The End is Not Yet.

Pending the outcome of the litigation over the Edison patent in Boston, there are some facts which should not be lost sight of. *The General Electric Company is only in the beginning of its campaign of extinction*, whatever the result of its suit against the Beacon Company. The loss of that suit by the General Company would be a serious blów, but not a death blow.

Their *possibilities* for injury and disturbance to the trade would not be exhausted with the setting aside of the Edison lamp patent.

Their *intent* to capture *all* the business of this country may be denied in plausibly worded statements which no one but a man in his dotage can fail to estimate properly. They may, for the time being, sell a few lamps to supply houses and competing plants. But the cloven hoof cannot be hidden by so thin a covering.

"We are going to do this business; you may as well fold your tents and get out!" comes straight from the lips of Mr. Charles A. Coffin, who is a much higher authority than Lieut. Greene.

The conflict is in truth an irrepressible one, and will not end short of the breaking up and reorganization of the General Company—or else in the control of all the business by that company. This is obvious. They need *all* the business to earn interest on their watered stock; and if interest cannot be earned, the whole machine is broken up.

The lamp case is an important one, but not all important. Other patents are in reserve.

Whatever the merits of the Green trolley patents, the fact that the Electric Trust will upset and demoralize the entire electric street-railway industry during the next two years is not doubted except by fools.

And in the lighting field there will be patent suits almost without end. Suits are now being prepared claiming fundamental patents on sockets, fuses, the three-wire system, and feeder distribution. The compound winding of machines is also claimed, and we understand will be the first matter to be pushed to a finish.

Smaller manufacturers cannot stand a long campaign of litigation when attacked singly. There is a thousandfold more trouble ahead than has yet been met. And the man who cannot see this belongs in a lunatic asylum and not in business.

And what is the redress?

Mr. E. B. Weeks's paper, read at the Montreal meeting, outlines an effective method of redress for the Central Station men—a co-operative manufacturing plant.

But manufacturers and supply men have a much better one, and this is simply *a combination for mutual defense in unjust patent suits.*

The Central Station men ask for one thing, and only one—*an open market in which to buy their supplies.* With this assured they will be content.

Will the independent manufacturing and supply interests stand together for a successful fight, or will petty jealousies keep them apart, rendering them easy victims for the Trust which has aimed at their annihilation?—a Trust without principle, without any sense of honor, and with (for the present) unlimited financial resources.

* * *

To THE lamp manufacturers who have been compelled to shut down, ELECTRICITY sends greeting. They will be on deck again in a few weeks, meantime ELECTRICITY will continue to fight the battle of fair competition against monopoly. The preliminary skirmish has been won by monopoly, but the end is not yet. And when the Trust is beaten and discredited, as it is sure to be, it will not be forgotten that ELECTRICITY was the only paper to take up the fight, and to maintain first, last, and all the time that the Trust was *wrong*, and that the independent concerns were *right*.

* * *

EDISON lamps are being sold in Chicago for 42 cents, on Staten Island for 55 cents, and at points in Michigan for 75 cents.

* * *

A FEW years hence, when you wish to refresh your memory as to what caused the ruin and collapse of the Electric Trust, what paper will give you so much information as ELECTRICITY?

* * *

THE *Western Electrician* has long enjoyed an enviable popularity as an ably conducted journal. Mr. Kreidler is a gentleman whose friends in the field are only limited by the number of his acquaintances. His paper has heretofore been a highly creditable exponent of public sentiment in the West. And now that the next Convention of the National Association is to be held in his bailiwick, the visitors to that Convention will naturally look to the *Western Electrician* for an expression of the general sentiment in the West on the subject of the Electrical Trust and its treatment of its competitors and Central Stations. The crisis demands that personal considerations be laid aside, and that every honest journal do its honest duty. The eyes of the East are on you, William.

Highly Complimentary.

Uriah Heep Forgets His Humility.

The Pioneer Sneak and Hypocrite Pays Its Respects to Some of Its Constituents.

(*From the Electrical World, Feb. 4.*)

Most, if not all, of the alleged infringers of the Edison patent have contracts ahead which they feel bound and are anxious to fill; many of them also have considerable stocks on hand, and among these stocks are comprised large numbers of lamps which were made before the plan of blowing the lamps into molds was adopted. Such lamps, while equal in other respects to those blown into molds, lack the uniformity in size and shape, and for this reason have been considered somewhat off color and not readily salable. THOSE COMPANIES WHICH HAVE ALREADY BEEN ENJOINED, OR AGAINST WHOM RESTRAINING ORDERS HAVE BEEN GRANTED, NO LONGER ABLE TO FULFIL THEIR STANDING ORDERS, ARE TURNING THE SAME OVER TO THE OTHER COMPANIES AGAINST WHOM ACTION HAS NOT BEEN BROUGHT, AND THE LATTER ARE FILLING THE SAME NOT ONLY WITH THE ACCUMULATED STOCKS OF THEIR FORMER COMPETITORS, BUT ALSO WITH LAMPS OF THEIR OWN MANUFACTURE, AND WITH SUCH AS BEFORE HAD BUT LITTLE MARKET VALUE. It seems probable that no decision can be reached for some weeks to come, and in the meantime the alleged infringers will have ample opportunity of unloading their accumulated stocks and, it is feared, to the injury of the lamp business.

Such customers of the Beacon, Buckeye, Packard, Germania and Pennsylvania Lamp Companies as are readers of the *Electrical World* are thus advised precisely what kind of goods to expect.

A more disgraceful statement than this has never appeared in any trade journal in this country.

In the first place it is a lie from start to finish, and such a dastardly attempt to ruin the business of a large number of representative electrical manufacturers by maliciously impugning their business integrity serves merely to defeat its own ends and to reveal the fawning servility of this satellite of the Trust.

Not less contemptible is the imputation of incredible ignorance to purchasers of incandescent lamps, who, we are asked to believe, are unconsciously accepting unmarketable goods or makes other than those ordered by them. The different manufactures of lamps are purposely made to exhibit some characteristic feature, and no great difficulty would obtain in distinguishing them, even by the laity, and certainly not in the case of supply dealers and central station men. The section, length and specific resistance of the filaments, the method of joining them to the leading-in wires, the shape of the glass base and the sizes of the bulbs are all distinctive features which are either apparent or readily determined.

And more than all this, it is beyond dispute that the independent companies still in operation are making and selling to-day, as they have made and sold previously, lamps which are thoroughly up to the standard, and as a rule of a higher grade than the General Electric Company's lamps.

These manufacturers are not playing their last card; their reputations are still at stake; they are not going out of business whatever the outcome of present litigation; not one of them would sell lamps that were not a credit to their makers. They are selling not only good lamps, but *first-class* lamps.

The possible injury worked by this false statement cannot be estimated. But how long will this sort of thing be allowed to continue? The independent manufacturers mentioned, *and their friends*, can furnish a speedy answer to this question.

The *Electrical World* can no longer sail under false colors.

That poltroon, that sneak, that cowardly assassin, stands before all men in its true garb.

It is not on the fence.

It is conducted absolutely and solely in the interests of the Electric Trust, and is controlled by no motive except personal gain.

Secure in a handsome competency, leeched and wheedled out of the trade under false pretenses, the monumental humbug and hypocrite still extends one begging hand for support while carrying in the other a knife to stab any and all opponents of its friend and patron the Electric Trust.

It is high time that independent concerns learned to recognize the power of the press both for *good* and for EVIL.

Trust Methods.

Notes and Comments from Various Sources.

Madison, Wis., Secures Redress.

Attention was called in these columns some time ago to the shady methods adopted by the Trust in "bottling up" the town of Madison, Wis. The gas company was included in the deal. Frozen-out stockholders of the old company, it will be remembered, at once organized a new company, the Capital City, and secured a franchise. The city contract has just been awarded. There were three bidders ostensibly, but really only two: the gas company and the Four Lakes Company working of course in harmony, and the Capital City acting independently. The latter secured the contract for five years, at a saving to the city of about $2,000 a year.

The moral of this is obvious, and Central Station stockholders now considering consolidations in various cities will do well to take heed. No city will submit to be robbed.

To the organizers of the Capital City Electric Company, to the courageous press of Madison, and to the taxpayers of that town, ELECTRICITY says, Well done!

A Storm Gathering in Philadelphia.

Says the *Philadelphia Inquirer*:

"There is likely to be some forcible language used in the forthcoming annual message of Mayor Stuart to City Councils and in the reports of the heads of departments, Directors Windrim and Beitier, with regard to some of the present evils of municipal government and particularly in reference, among other things, to the operations of the Electrical Trust. The report of Chief Walker, of the electrical branch, will be of striking character.

"It is said to be the most elaborate document yet submitted by the chief, filling fifty-three closely-written pages of foolscap, and a large part of it is devoted to the proposed acquirement by the city of its own electrical plant. The recommendations in favor of such legislation by Councils are even more strongly presented than in former years, and as in the past the views therein expresssed are believed to meet with the approval in every respect of his Honor the Mayor.

"Tables are given showing the profits now derived by the companies which furnish the city with electric light, and how great would be the saving to the municipal government once they had installed their own system. The department now has its own conduits and cables, and could quickly secure the dynamos, engines and lamps necessary to conduct the all-important work.

"Chief Walker does not hesitate to point out the many evils arising from the dangerous overhead wires, but at the same time repeats his recommendation of last year that the city own, erect and maintain all the poles necessary for electric lighting, for the use of which the city would derive a revenue, while at the same time it would place it within the power of the department to *remove all wires and fixtures of those who are unsuccessful in obtaining a renewal of their contract.*"

The Mayor of Wyandotte, Mich., Has Something to Say.

There has been for some time a Fort Wayne plant in Wyandotte, under the name of the Wyandotte Electric Light Company. In August of last year the question of bonding the city for the purchase of a municipal plant was submitted to popular vote, and resulted in 709 votes in favor of the plan with only 80 against it. The resolution was adopted by Council.

Mayor Campau says:

"The committee on public lighting, out of courtesy, then waited upon the Wyandotte Electric Light Company, asking them to submit a proposition for future lighting. This the company refused to do until after the unanimous adoption of a resolution to advertise for bids for a plant to be owned by the city. To the surprise of everybody, the company then submitted a proposition to light the city for a period of five years at a cost of $80 per light per year. This was a reduction of $10 per light over the contract which it held for three years previous. The most surprising thing was to notice that many of the aldermen who had previously favored the owning of a plant by the city then turned around and advocated giving the contract to the Wyandotte company. Only the fact that I was firm in ruling the motion out of order prevented it going through. The whole matter was then referred to the Committee on Public Lighting.

"Chairman Wm. Spears, of the public lighting committee, finally submitted his report, signed only by himself, Ald. Clark and Walcott refusing to join him. The report stated that the entire question of letting the contract to private parties was illegal, and not according to the will of the citizens as shown at the elections. The report recommended that the bids submitted by other companies be opened and acted upon. The report was laid on the table. The bids of the companies, then in possession of the clerk, were ordered opened and read. The General Electric Company and the Western Electric Company were the only ones which submitted bids. The General Electric Company's was $14,785, that of the Western $13,765.

"On account of a great deal of effort on the part of State Agent W. F. Davidson, of the General Electric Company, both verbal and written, the committee was led to believe that on account of the superiority of their apparatus, the great danger of infringements upon their patents, and their resources for defending all lawsuits on account of their enormous wealth—being capitalized for $50,000,000—it would be to the city's interest to award the contract to that company.

"The report was adopted, and the contract awarded to the General Electric Company.

"To my great surprise, I received a communication from John J. Martin, of Chicago, manager of the Chicago office, and W. F. Davidson, State agent, to meet them at the Hotel Cadillac here in Detroit, which I did, and was there informed by them that their company refused to carry out the contract, as the matter had been represented to the president of the General Electric Company, Mr. Coffin, that Wyandotte was an immediate suburb of Detroit, and the selling to our city of a plant by that company would establish a bad precedent right at home, and in view of the agitation going on in Detroit by Mayor Pingree and others, it would jeopardize their large investment here in Detroit, which amounted to $400,000, and for that reason they refused to carry out the contract. They said, however, that they would use their influence with Mr. Coffin to disabuse his mind of this; but in this they failed, as a short time afterward I received a brief letter from Mr. Martin, of Chicago, declining to carry out the contract.

"At a subsequent meeting, I submitted his report from the company, which report was accepted, and in so doing the General Electric Company forfeited $500, which was deposited as a guarantee for the fulfilment of their contract. At this same meeting there was a resolution offered by a member of the Council, submitting a proposition from the local company at present lighting the city. At this same meeting there was a petition of citizens sent in, signed by quite a number of taxpayers, asking the Council to award a contract to the present company. Nine-tenths of the signers were among those who had petitioned the Council previously to submit the question to the electors for the purpose of owning their own plant, and in connection with this petition a proposition was tendered by the local company, offering to light the city at $60 per light per year, giving mercantile arc lighting, first lamp $6 per month, all after that, $4 per month; incandescent mercantle lighting at 65 cents per month, private lighting 20 cents apiece per month for 10 lights or over. The proposition from the company was laid on the table.

"Chairman Spears, of the Electric Lighting Committee, presented a resolution setting forth that as the General Electric Company had declined to carry out their contract to erect a plant for the city of Wyandotte, therefore, be it resolved, as the bid of the Western Electric Light Company was not rejected, that it be accepted as modified, the price to be $11,937, and that the Mayor and clerk be instructed to enter into a contract with said company for the purchase of the same. The vote on this resolution stood 4 and 4, and I broke it by voting for the resolution, which was accordingly carried. Next morning I went to Chicago and secured the signature and seal of the Western Electric Company to the contract.

"In the face of all the foregoing proceedings, the present local company, and no doubt backed up by the General Electric Company, have become desperate, none but themselves knowing the means by which they have secured (as they claim) a sufficient number of members of the Council to override the law of our State and the will of the people, and involve the city in lawsuits and damages, the apparatus of the Western Electric Company being now on the way to Wyandotte.

"This action on the part of the Council is surprising, in view of the action already taken by the people, and in view of the fact that the bonds have been issued and sold and the money is now in the hands of the treasurer with which to pay for this lighting plant.

"In the face of the foregoing, it behooves the citizens of Detroit to see to it that the General Electric Company's grasp gets no tighter upon them than it is at present."

We will state for the information of Mayor Campau, that the Western Electric Company is a much stronger concern financially than the Electric Trust, and is abundantly capable of carrying out its undertakings.

If the councilmen of Wyandotte, or any of them, are thieves, having taken bribes of any nature to influence their action in this matter, they should be sent to jail.

Mayor Pingree Aroused.

"Electricity's" Influence is Apparent.

(*From the Detroit Tribune.*)

Mayor Pingree was aghast yesterday when he learned that the electric light companies had invaded Lansing with a powerful lobby for the purpose of killing the bill authorizing Detroit to do its own municipal lighting. The Mayor yesterday stirred up a number of people to send telegrams of protestation to the legislators and in addition issued the following proclamation:

"One of the head men of the Detroit Electric Light and Power Company, which at present has the contract for lighting the streets of the city, is reported to have said that 'if Pingree got that bill through the Legislature he would have to have more money than we have.'

"From this it would seem that the leading men in the Electric Light and Power Company, above alluded to, consider the question merely one of boodle. The bill introduced by Mr. Moore, himself a representative business man in this community, was asked for by a large number of the leading business men of this city, by most of the heavy taxpayers, and is known to be approved of by the masses. The House of Representatives at Lansing yesterday indicated by a large vote in committee of the whole that it was ready to pass such a bill, breaking the shackles by which the hands and feet of the municipality of Detroit are now held by the local branch of the Electric Trust.

"The bill, if it becomes a law, simply empowers the city of Detroit to provide for lighting its streets, either by contract with an electric light or gas company or by the purchase or building of a plant, as it may deem wise and expedient. It does not in any way commit the city to the plan of doing its own lighting, or to the abandonment of the present lighting contract. It simply enables the people of the city of Detroit to exercise their judgment as to how their streets shall be lighted.

"How long will our people stand this sort of thing?

"Perhaps they will wait until this electric company has allied itself with the gas companies, the Standard Oil Company and all the other great corporations and trusts, which are slowly but surely ossifying the blood of the body politic and have made the people a stone and the Legislature a puppet.

"The last man who was discovered in an open and barefaced attempt to corrupt the Legislature of Michigan is now a fugitive from justice and a wanderer upon the face of the earth. Will others be warned in time that they may be saved from a similar fate?"

Startling Claim for the Edison Patent.

An Illinois Editor on the Situation.

(*From the Peoria Transcript.*)

The first effect of the legal action referred to is that the Edison Company has caused a heavy advance in prices. The globes have in the recent past been selling at 50 and 55 cents each, but the advance is one of 20 cents on each lamp.

Machines can be purchased elsewhere, but not so with the lamps. Edison has the advantage in that he holds a patent on the shape of the globe.

A vacuum has to be round or oval, and it is this that Edison has full possession of.

We have always placed a high estimate on Mr. Edison's achievements, but manifestly not high enough. If he has fundamental patents on a "round vacuum" or an "oval vacuum," it is time for all other inventors to retire.

We think, however, that the editor of our Illinois contemporary has been visiting one of the distilleries for which his town is famous, and that he has as a consequence been in a trance, during which arc-lights, pear-shaped globes, the whiskers on the moon, and the patent situation became badly mixed.

Washington Bridge.

One of the most beautiful structures of its kind in the world is the Washington Bridge.

This engineering marvel of bronze, steel and stone is one of the sights of the metropolis.

It spans the picturesque Harlem River and the tracks of the New York Central and Hudson River Railroad at 181st street, New York.

The length of the bridge is 2,375 feet, height 133.5 feet above the river. It has two steel arches, each with a span of 510 feet, supported by three stone piers and two stone abutments. The piers are 98 feet long and 40 feet thick, of solid concrete, faced with dressed granite. The abutments are semi-circular arches of masonry, each having a span of 60 feet. There are a 50-foot driveway and two footways, each 15 feet wide. It cost $2,700,000.

A photogravure etching of the famous view of Washington Bridge, taken by Mr. W. H. Jackson, the noted landscape photographer of Denver, Colorado, has just been issued by the Passenger Department of the New York Central. The *Journal* has received a copy. It is a splendid piece of work, the finest example of this style of art produced in recent years. It is the work of the New York Photogravure Company, which fact alone is a guarantee of its excellence.

A copy of this beautiful etching, 17x22 inches, on fine plate paper, 24x32, can be obtained at the New York Central ticket offices, No. 413 Broadway, No. 942 Broadway, or at Grand Central Station, New York; No. 333 Washington street, Brooklyn, or of Frank J. Wolfe, General Agent, Albany Station, Albany; W. E. Brown, City Passenger Agent, No. 127 Washington street, Syracuse; J. C. Kalbfleisch, City Passenger Agent, No. 11 East Main street, Rochester; Edson J. Weeks, General Agent, No. 1 Exchange street, Buffalo; W. B. Jerome, General Western Agent, No. 97 Clark street, Chicago; or of Carleton C. Crane, Pacific Coast Agent, No. 10 Montgomery street, San Francisco, for 50 cents; or it will be sent free, postpaid, to any address, on receipt of 75 cents in stamps or money order, by George H. Daniels, General Passenger Agent, Grand Central Station, New York.—*Albany Evening Journal.*

Overhead Electric Tramways in England.

BY F. W. N. KING.

On Saturday, December 31, 1892, the first section of overhead electric tram system was opened to public service. The line now open goes through South Staffordshire, connecting the important Black Country towns of Bloxwich, Dudley Darlaston, Walsall, Wednesbury, West Bromwich and Handsworth, and serves a population of nearly 300,000. The portion of the system which has been electrically equipped comprises about eight miles. The cars up to now have been propelled by steam locomotives of the Wilkinson type, but the permission to use steam expired at the end of last year. The directors of the company, of which Mr. Alfred Dickinson is engineer, had various methods of electric traction to consider—namely, the accumulator, the conduit and the overhead wire. Of the two former there was little to be said, as neither has, as yet, been practically demonstrated to be perfectly satisfactory, so the latter was finally adopted.

The generating station is a substantial building which does not boast of much ornamentation and comprises an engine-house, boiler-house, stores, etc. It is situated on the Walsall road at the Pleck, which is about the centre of the lines. A canal runs close beside the works, and an arm has been cut alongside the boiler-house, so that if necessary fuel can be unloaded from boats right into the coal vaults. In the boiler-house are three boilers, each being 30 feet long and 7 feet diameter. They are tested by hydraulic pressure up to 200 lbs. per square inch, and are run at a pressure of 120 lbs. The engine-house contains three compound condensing engines, each of 125 I. H. P. at 100 lbs. pressure and 100 revolutions per minute. The high pressure cylinder is 16½ inches diameter, and the low pressure 20 inches, and they have a stroke of 30 inches. Each engine is fitted with a surface condenser and a 4½-inch diameter air pump with a 30-inch stroke, the same as the engine. Canal water is used for condensing. Each condenser is supplied by a centrifugal pump, driven by belting off the main shaft of each engine. The driving pulleys upon the engines are 10 feet diameter, and are each proved to carry nine 1¼ inch diameter ropes; these in turn drive the 2-feet pulleys upon dynamos. This system of driving was adopted in preference to belting owing to the increased factors of safety obtained, as it is possible to continue working with several of the ropes broken. There are three dynamos of the Elwell-Parker type. They are shunt wound and have drum armatures, and each gives at 450 revolutions 250 amperes at a pressure of 350 volts. The switchboard is placed at the end of the engine-house nearest to the road, and upon it are placed an ammeter, voltmeter and resistance coils, and an automatic magnet cut-out switch for each dynamo. The switch is so arranged that when there is a flow of current in excess of the capacity of the installation it is automatically thrown out, thus breaking the circuit and reducing the risk of damage to the dynamo to a minimum. The whole of the buildings are lighted by means of incandescent lamps. A feeder-cable is laid out from the switchboard at the generating station underground to the roadway, whence it is run along the outside edge of the channeling, some 15 inches below the surface of the roadway, so as to feed into the trolley wire near to the points of heaviest load upon the road, connections being made to the trolley wire every half-mile by means of branch distribution boxes. From these boxes two other cables are carried up the inside of the pole and along the arm which supports the trolley wire, and are connected to the line-breakers, which divide the trolley wire up into half-mile sections. Between the cable which comes off the main feeder into the fuse box and those which run up the pole there are two fuses. These are so arranged that in case of any short circuit or ground being made on any section of the trolley wire, as would probably be the case if the wire broke, the fuse burns out and disconnects the section of the line. The trolley wire is solid hard drawn copper of 8 B. W. G. It is fastened by means of copper clips to insulators which are suspended from the arms of the poles. Every pole is composed of two tubes, a cylindrical and a tapered one, the latter being shrunk into the former. They are 30 feet long over all, a buckled steel brass plate, 2 feet square, bolted to the base of each, which rests upon the concrete foundation extending 6 feet into the ground. There are three different sizes of poles, those for ordinary single lines being 6 inches outside diameter at the base and tapering to 3¾ inches at the top, and having arms varying from 2 feet 6 inches to 6 feet 6 inches in length. In most cases these poles are fixed in positions originally occupied by lamp columns at the junctions of the roads, and these have been fitted with lamps and gas fittings to replace those removed. Sixteen cars have been specially built for this electric line; they are of a 3 feet 6 inch gauge; and have fixed wheel-bases of 6 feet, the wheels being 34 inches in diameter and specially made with rolled steel tires upon cast steel centres. These conveyances carry forty passengers—twenty-two inside and thirteen outside.

There are two pairs of carbon brushes on each motor, and they are accessible from the inside of the cars by means of traps in the floor. Each car is fitted with an ordinary quick-action brake, and also with an entirely independent emergency brake, both of which are operated from either platform of the car, thus giving the conductor an equal chance with the driver of stopping the vehicle in case of danger. The switch-boxes on the platforms of the cars each contain a lightning arrester, a controlling switch, a reversing switch and a motor switch—the latter being for the purpose of disconnecting either motor. The pressure used here is only 300 volts while in the United States it is 500.

Several hundred invited guests assembled at the generating station to witness Mrs. Carruthers-Wain, wife of the chairman for the South Staffordshire Tramways Company, switch on the current and afterward declare the line open for public service.

Death of Dr. Norvin Green.

Dr. Norvin Green, President of the Western Union Telegraph Company, died at Louisville, Ky., February 12. Dr. Green was born in New Albany, Ind., in 1818, but when only four years of age was taken by his parents to the then wilderness of Kentucky where his boyhood was spent.

In 1840 he graduated from the Medical School of the University of Louisville, but only continued in the practice of medicine for a short time, after which he served for several terms in the Kentucky Legislature. In 1853 he became interested in the Louisville and New Orleans Telegraph Company, with which business he has ever since been connected. When this company was absorbed by the Western Union, he was made Vice-President of the latter and afterwards was elected President.

Dr. Green was also President of the first Edison Company, organized in 1878, and was the first President of the American Institute of Electrical Engineers.

He combined a most genial personality with unusual executive ability, and to the latter qualification he himself attributed his success in the management of the extensive business of which he was the executive head.

The St. Louis Convention.

Transportation Arrangements.

An excursion rate of a fare and a third has been granted to St. Louis and return for delegates attending the Convention of the National Electric Light Association by all the Passenger Associations except the Western; negotiations are now pending with that body, and in all probability they also will grant this concession.

Arrangements have been perfected for a special train to carry the Eastern delegation, which will be vestibuled and electrically lighted and composed of dining, buffet, observation and sleeping cars, and will leave New York via Pennsylvania Railroad from stations foot of Cortlandt and Desbrosses streets, Sunday, February 26, at 12 o'clock noon; Philadelphia, 2:25 P.M.; Harrisburg, 4:25 P. M.; Pittsburg, 10:40 P. M. (central time); Columbus, 4:35 A. M.; Indianapolis, 10:30 A. M.; arriving at St. Louis at 5:30 P.M. Monday, February 27.

The rate for berths is $6 each; drawing-rooms, $22 each.

For the convenience of passengers taking this train from New York, arrangements have been made so that if they will remit to the undersigned the amount of railroad fare ($24.25) with the sleeping-car fare ($6.00) a receipt will be mailed them that will be honored by the railroad company for checking baggage, ferry passage, and passage through the gate at Jersey City, and exchangeable on the train for regular ticket and certificate.

The Boston Passenger Committee have declined to sell tickets at a reduced rate from Boston via New York; therefore the Eastern delegates who desire to take the Electrical Special will be compelled to come to New York, purchase tickets, and secure certificates from New York to St. Louis and return.

It is quite important that all the names of delegates who will be passengers on the Electrical Special should be known as soon as possible.

The following named gentlemen have charge of transportation matters in their various territories:

Morris W. Mead, Pittsburg, Pa.
Fred. W. Royce, Washington, D. C.
John Carroll, Montreal, Canada.
A. C. Shaw, Boston, Mass.
H. A. Cleverly, Philadelphia, Pa.
M. J. Hart, New Orleans, La.
John W. Flintham, Denver, Col.
J. Scribner, 173 Adams street, Chicago, Ill.
Louis Nahm, St. Louis, Mo.

To secure the benefit of the reduced fare returning, it will be necessary for those who do not go by the Electrical Special to be sure and state to the ticket agent, at the time they purchase the going ticket, that they purpose attending the meeting of the Association in St. Louis, and procure from him a certificate which will entitle them, when properly vised and countersigned, to return for one-third the regular fare. No reduction can be obtained without this certificate. Immediately upon arrival in St. Louis, these certificates should be left at the secretary's office, addressed to the undersigned, who will see that they receive proper attention and are returned to the owners.

C. O. BAKER, JR.,
Master of Transportation.
136 Liberty street, New York.

"Practical Electricity."

Mr. H. E. Swift, a gentleman well and favorably known in Boston, has assumed control of *Practical Electricity*, and will endeavor to give Boston and New England a local electrical paper of merit. We welcome Mr. Swift, and trust that he will follow the good example set by ELECTRICITY—*telling the truth* at all times. There is a good deal of *truth* to be picked up in Boston these days.

In connection with the International Electrical Exhibition to be held in Milan in 1894, the committee propose to offer a prize for the most important invention in electricity, more especially as relating to the transmitting of energy to distances and its transformation for industrial purposes.

Buffalo, N. Y.—It is said that Niagara Falls has offered the Stern Incandescent Lamp Company $50,000 in cash and 38 acres of valuable land if they will establish their factory there.

Real Merit Is Recognized.

(*From the "Popular Electrician," Lynn, Mass.*)

One bright and newsy Electrical Journal seems to flourish without the aid of the General Electric Company. We mean ELECTRICITY, and are glad to see one Electrical paper independent enough to stand on its own bottom. In the words of Rip Van Winkle, "May it live long and prosper."

How it Looks in Boston.

The Boston *Post* remarks:

"That General Electric is looked upon as a sale. That it is the belief that the suit now pending before Judge Colt, between the General Electric and the Beacon Lamp Company, will be decided in favor of the latter company, and that in this case the stock of the defeated company will see much lower quotations."

Legal Notes.

The mandamus proceedings begun by the Durand Land Company against Civil Justice Jeroloman, of the Eighth District Court, to compel him to entertain a dispossess proceeding against the Thomson-Houston Electric Company, came up on Friday last.

The question involved in the mandamus proceedings is whether an act of the present Legislature, passed January 24 last, applies retroactively to a proceeding begun by the Durand Land Company against the Thomson-Houston Company.

The first named company obtained judgment against the latter for $95,279 for rent, and the collection was stayed by an appeal. Meanwhile unpaid rent has accumulated until it amounts to $20,000, and the Durand Company cannot obtain judgment for this and subsequently accruing rent without waiving the forfeiture of the lease occasioned by previous failures to pay.

It was said yesterday by counsel that the act of the Legislature in question applies at present to no other case and that its passage was procured in the interest of the Thomson-Houston Company to meet a decision of the Common Pleas adverse to it. It is said that the effect of the act will be to enable tenants, by taking appeals from judgments for rent rendered against them where landlords sue for use and occupation, to occupy the premises without payment indefinitely, or at any rate as long as an appeal can be carried from one court to another. Meantime landlords can have neither their rent nor their premises. The expenses of appeals, however, will render this policy impracticable save where the rent is large.

Judge Bartlett, of the New York Supreme Court, has granted an attachment against the property in this State of the River and Rail Electric Light Company as a foreign corporation. William L. Bigley is suing the company to secure money owed him.

At Denver, Colo., Clement B. Smythe a few days ago purchased at sheriff's sale for $3,000 the stock of goods of the Midland Electric Company at 1,737 Champa street.

Boston Notes.

The Sawtell Company have removed their offices to the Shawmut Building, 146 Franklin street.

A good deal of excitement is being caused in Providence, R. I., by a report that has gained credence that the West End Railroad Company of Boston is trying to secure control of the Union Street Railroad. The latter company is capitalized at $2,000,000, and is said to have been paying 18 per cent. quarterly dividends. The par value of the shares is $100, and last week $240 was asked. The price has gone up since then to $260. President Whitney of the West End Company denies the rumors in toto. That the Boston company is trying to secure control of the Interstate Electric Railroad is admitted. Should the latter deal be consummated, the former would be pretty sure to follow, for the Interstate runs through from Attleboro, Mass., to Providence, R. I.

The Edison Illuminating Company of Boston is now supplying current for 75,000 incandescent and over 400 arc lights, and the demand for more is a matter of almost everyday occurrence. Their three large central stations are inadequate, and a fourth has become necessary.

An important and interesting patent case was tried in the United States Equity Court Wednesday, before Judge Carpenter. The litigants were the Electric Gas Lighting Company vs. the Holtzer-Cabot Electric Company, both of Boston. The device in dispute was an electric gas lighter, the patents on which have been owned for years by the Electric Gas Lighting Company, which owns about all fundamental patents on these devices, and has been doing an enormous business with them for years. It was claimed that the defendants have been infringing one of their patents. Samples of many different types of electric gas lighters were shown in court by both parties in interest, and the case was argued at length by Boston and New York counsel employed. After all the evidence had been submitted, the Judge took the subject under consideration and will give his decision shortly. As this case has most important bearings on this branch of the electrical business throughout the country, great interest is felt in the outcome of the suit.

The members of the Catholic Union of this city had a rare treat on Tuesday evening, February 7, when Mr. Peter A. Dowd, a well-known and accomplished electrical engineer, gave an interesting address on "The Electric Motor." The subject was discussed from a historical and commercial standpoint rather than in a technical manner, though a brief resume of the labors of Michael Faraday, Sir Humphry Davy, Dr. Galvani and other pioneers in the electrical field was presented in an appreciative manner by the speaker. His Eminence Archbishop Williams was present and was particularly interested in the subject.

The Nova Scotia Power Company of Halifax, N. S., has transferred all the street railway plant of that city over to the Old Colony Trust Company of Boston as security for the issue of $240,000 in bonds, the cash to be used in building an electric street railway through Halifax. The local electric lighting plant was included in the transfer.

A most interesting case is at present before Mr. Justice Morton in this city. Some three or four years ago the Citizens' Gas Light Company was organized in Wakefield, Mass., for the purpose of lighting that town and the adjoining town of Stoneham. A gas plant was established and subsequently an electric lighting plant was added and a combined business has been carried on. After the Municipal Lighting Act became law, in 1891, the purport of which law was to enable towns or cities to purchase or build their own lighting plants, the citizens very soon began to think they ought to avail themselves of this law and own their own plant. Public meetings were held; the movement met with popular favor, and funds were appropriated for the purpose. It was not thought best to purchase the local plants, but to contract for new ones. The Citizens' Company were prepared to sell theirs, and they are now seeking to induce the court to compel the town to purchase its plant. The court appears to take an opposite view, and the town authorities have determined to test the constitutionality of the Municipal Lighting Act as a whole rather than be compelled to do what they didn't want to.

There is at present under construction at the works of the General Electric Company in Lynn a 20 H. P motor that will weigh only 1,250 pounds. This will supersede the present type of 15 H. P. motor that weighs 2,000 pounds.

The incandescent lamp makers of Boston keep uncommonly busy filling orders which flow in with their usual volume. The decision in the lamp case which Judge Colt will give ere long is being looked forward to with intense interest by all electrical men, the general feeling being that the whole lamp case is in a fair way for being reopened. The additional evidence handed to Judge Colt a week ago has proved interesting reading, and the demand for the special supplement issued by ELECTRICITY was great, the supply being exhausted immediately on arrival.

A new device called an "Illuminable Revolvable Electric Sign and Signal Combined" has been invented by Dr. *A. T. Buswell, Boston*, and is placed upon the market with every appearance of being a success. It is for use on electric street cars at night to indicate to passengers the routes along which the cars run, also the places they run to. This will be accomplished by a colored lamp attached to the trolley arm, indicating the route, with a four sided revolving sign over the driver's head, illuminated by electric lamps inside, the glass sides of the sign having written on them names of streets, avenues or districts. It is a most ingenious device and will meet with speedy recognition.

General News.

What is Going on in the Electrical World.

Montreal, Can.—The late fire entirely destroyed the electric plant in the Ogilvie block.

Yuma, Ariz.—A San Francisco capitalist intends to build an electric street railway in this town.

Urichsville, Ohio.—An electric railroad is to be built between this place and New Philadelphia, the county seat.

Hyattsville, Md.—An electric railway from Washington to Hyattsville is no longer a matter of speculation. A portion of the line has already been surveyed.

Pittsburg, Pa.—McKee & Brothers' glass factory at Jeannette, it is stated, will soon begin the manufacture of incandescent electric light bulbs, shades and glass bells.

Rome, N. Y.—The work on the electric system is going ahead on all sides, and if the weather continues favorable the cars will soon be on the tracks. The power house is nearing completion.

Baltimore, Md.—The Baltimore Traction Company has determined to push the work of supplying with electrical equipment the subsidiary lines recently acquired by the company.

Albany, N. Y.—Assemblyman Plant has introduced a bill in the House creating a State Board of Telephone Commissioners, with power to fix the telephone rates throughout the State.

Indianapolis, Ind.—Judge Elliott has made a formal request to the Board of Works for a grant of the right of way for a new street railway line. The road will be an electric one and will be located chiefly on the South Side.

Laurel, Md.—The Electric Light Company of Laurel have erected part of their poles, and will have them all up and wired in a few days and in operation about the first of March. The power house has been erected and most of the machinery put in.

Seattle, Wash.—The Union Electric Company is fitting up a handsome library for the use of its employes at its office on Second street. It will be supplied with books on the subject of electrical engineering and all the current electrical periodicals.

Atlanta, Ga.—It is proposed to equip the Pryor street dummy line for electricity. The same change will be made on Georgia avenue from Pryor to Grant Park, and on Piedmont avenue north to the city limits there will be a line of electric cars.

Ishpeming, Mich.—The Cleveland Cliff and Lake Angeline Iron companies, two of the largest producers in the Lake Superior district, have signed contracts with the Thomson-Houston Company for complete underground electric traction plants, costing $50,000.

Alexandria, Va.—A new company has recently obtained a charter for an electric railroad from Alexandria to Washington, with branch lines to Arlington, the Theological Seminary, and to Falls Church. L. W. Spear is the chief promoter of the new enterprise.

Elkton, Md.—The Elkton Electric Light Company has been applied to by citizens of Chesapeake and North East for an estimate of the probable cost of furnishing current for electric lights for those towns from the Elkton plant. They are each about six miles from Elkton.

New Brunswick, N. J.—The proposed electric road will make a belt line around the city and will connect with the Raritan River Railroad station on Commercial avenue and thence run across town to French street. The charter is being considered by the Board of Aldermen.

Middletown, Ohio.—Several of our wealthy citizens have determined upon having an electric street railway in the city, and have applied for a charter. The capital stock is $100,000, and the incorporators are George Jacoby, Charles Goldman, Joseph Iseminger, W. O. Barnitz and Wm. P. Noble.

Gallitzin, Pa.—The borough council has granted a franchise for electric lighting, and a company has been organized with a capital stock of $12,000 to establish a plant in this town. Among those identified with the movement are Dr. Ferguson, M. Fitzharris, Thomas Bradley and J. L. Mitchell.

Findlay, Ohio.—In the suit brought by the Findlay Electric Light and Power Company attacking the franchise of the Hancock Electric Light and Power Company on the ground that it had never been submitted to the people, Judge Norris, in the Common Pleas Court, decided in favor of the Hancock Company.

Canandaigua, N. Y.—The Canandaigua Electric Light Company have purchased the Littleville flouring mill, about six miles from town, and will put in an electric plant there by which they propose to light the village and run the street cars. The water power at the old mill is to be utilized in generating electricity.

Waterford, N. Y.—An electric railway line is projected to run from Waterford to Mechanicsville and then follow the route of the present street railroad to Stillwater; thence along the Hudson to Schuylerville and Fort Edward, whence it will connect with the Fort Edward, Sandy Hill and Glens Falls street railway.

Detroit, Mich.—The contract for electric car motors has been awarded to the Detroit Electrical Works by the Citizens' Street Railway Company. Before awarding this contract the motors of several systems were tested, under various conditions, and the showing made by the Detroit motors was so satisfactory that the home company secured the contract.

Salt Lake, Utah.—The West Side Rapid Transit Company have electric cars now running on their line. As soon as the weather will permit the work of extending the line to Crescent Beach at the lake will be begun.—If the negotiations now pending are successfully carried through the Salt Lake Electric Light, Power and Heating Company and the Salt Lake Gas Company are soon to pass into the hands of an English syndicate.

Washington, D. C.—The Columbia Street Railway Company have made application to the Commissioners for permission to adopt electricity on their line, the system to be the underground conduit. Although more expensive than the trolley, it is said to possess advantages that make it preferable to that mode of propulsion. The underground conduit system selected has been successfully operated in Buda-Pesth.

San Angelo, Tex.—The dam in the South Concho River which was washed away about six months ago, entailing heavy losses to the electric light and power company, has been replaced by a stronger one about five miles south of the town, the water from which is conveyed in a canal to the power house of the company, a short distance out of the city, where a fifty foot fall supplies power sufficient to run the electric lights of the town, woolen mills, etc.

McKeesport, Pa.—The electric railway to connect McKeesport and Wilmerding will be built at an earlier date than expected. The land company working in connection with the railroad company has decided to arrange for a model town on its plan, which embraces almost 300 acres between McKeesport and Wilmerding. A big water works will also be erected in North Versailles township to supply the town and an electric plant to supply power for the road and light for the business houses and dwellings.

Philadelphia.—The *Inquirer* says: "A ride from Philadelphia to Washington by way of Baltimore in a trolley car is one of the possibilities of the future, and if legislation is favorable and the investing public continues to have faith in the Philadelphia Traction magnates, that future may not be far distant. The principals of the Traction syndicate, Messrs. Widener and Elkins, already have a firm footing in two of the cities mentioned; they are acquiring a foothold in the third; have projected a portion of the connecting line and are shaping legislation which will enable them to consummate the plan as above outlined."

Lynchburg, Va.—Application has been made to council for permission to build a new electric street railway, the route to be down Cabell street from a point where it intersects the corporation line to Sixth street, thence along said Sixth street across Sixth street bridge to Commerce street, thence along Commerce street to either Seventh or Eighth streets thence with said Seventh or Eighth street to Church street, thence along Church to Washington, thence along Washington to Grace, thence following Grace to a point near the Presbyterian cemetery. The Rivermont Electric Car Company is said to be sponsor for the scheme.

ELECTRICAL COMPANY ELECTIONS.

The Youngstown (Ohio) Gas Company, the Youngstown Electric Light Company and the Mahoning Electric Light Company, all under the same directory. Directors: C. H. Andrews, George Tod, John B. Smith, W. E. Taylor, Thomas E. Davey, Frank Hitchcock, John C. Wick.

Electric Light and Power Company, Centralia, Ill. President, O. V. Parkinson; secretary and treasurer, F. F. Noleman; superintendent, J. R. Young; directors, O. V. Parkinson, E. A. Hartman, A. H. Rainey, James Benson, F. F. Noleman, G. E. Els, M. C. Wetmore, R. J. Merkle and R. J. Young. The capital stock is to be increased from $10,000 to $20,000, and an arc system put in.

Flatbush District Telegraph Company, Flatbush, L. I., N. Y. President, Isaac Harris; vice-president, James Ryan; treasurer, W. G. Pearson; secretary, W. H. Pearson. These officers and Messrs. Henry Hesterberg, William M. Lynam and John Maguire comprise the directors.

East End Electric Light Company, Pittsburg, Pa. The old board of directors was re-elected, as follows: James H. Willock, E. H. Myers, H. C. Bughman, John S. Scully and George H. Blaxter.

Toledo Electric Light Company, Toledo, Ohio. President, J. J. Moore; vice-president, J. S. Rodgers; secretary, E. C. DeLong; treasurer, G. G. Hadley, Sr.; directors, J. J. Moore, E. W. Wilson, E. C. DeLong, J. S. Rodgers and G. G. Hadley, Sr.

A Progressive Concern.

Messrs. J. Jones & Son, of 39 Vesey street, New York, dealers in general electrical supplies, report an unusual demand for the well-known goods manufactured and handled by them, and Mr. Ernest A. Lowe, manager of the company, expresses great satisfaction at the outlook for business during 1893. They aim to include the entire field of electrical supplies and in addition to this carry a stock of specialties which have been well patronized. Among these may be mentioned the Varley Electric Time Call, Berlin Watch Demagnetizer, DeMott Electric Motors, Medical Appliances, etc. The company invites correspondence concerning any class of electrical goods and will furnish circulars, prices, etc., on application.

The Carpenter Enamel Rheostats.

The principle of the Rheostats manufactured by the Carpenter Enamel Rheostat Company of Bridgeport, Conn., is set forth at length in a neat pamphlet recently published by the company. Its operation consists in the conduction and dissipation of heat by holding a resistance wire in intimate mechanical contact with a supporting plate, so that the heat generated in the resistance wire, by the passage of a current, is rapidly conducted to the plate, which becomes the radiating surface. This is accomplished by the use of enamel, which attaches the wire to but insulates it from the radiating surface plate, and which also completely surrounds the wire and protects it from chemical action. In this way the capacity of a resistance wire for current is greatly increased. In practice it is found that a wire that will carry a certain current when exposed to the air will carry ten times that amount of current safely in this rheostat. On this principle, since the cross section of the conductor can be greatly reduced, it follows that its length can also be proportionately shortened for any required resistance, and no consideration of mechanical strength of the wires enters into this construction since it is so perfectly protected and supported on all sides.

For convenience in rapidly supplying the demands of concerns preferring to furnish their own regulating switches, Standard Plates for four sizes of motor starting rheostats are always carried in stock by the company. These plates have bosses or lugs at the corners for convenience in attaching to switch, and are provided with connecting bolts, insulators, etc., at the connecting points of the resistance.

The Carpenter Company manufacture their rheostats in several forms with a view to their adaptation to the various uses for which they are intended. Among the appliances they furnish are regulating switches, theatre dimmers, feeder equalizers, arc lamp resistances, etc. Chas. D. Shain, 136 Liberty street, New York, is the general selling agent of the company.

The Buckeye Lamp.

Both the New York and Chicago branches of the Buckeye Electric Company have sold during the past sixty days enormous quantities of their well known Buckeye lamps. They are now putting on the market a coiled filament lamp which has proved a favorite with the trade and is in large demand.

This enterprising concern are prepared to furnish lamps in any quantity on short notice, made to fit any standard sockets.

National Electric Manufacturing Company.

Attention is called by this company to the following tests of their transformers during which the temperature of the iron was raised to 90 degrees. These transformers are wound for 1,000 volts on the primary and 100 volts on the secondary coils:

TRANSFORMER NO. 9,880.

Primary load,	1.844	amperes.
Secondary load,	18.220	amperes.
Efficiency,	98.76	per cent.

TRANSFORMER NO. 9,882.

Primary load,	1.895	amperes.
Secondary load,	18.220	amperes.
Efficiency,	96.09	per cent.

TRANSFORMER NO. 9,921.

Primary load,	1.853	amperes.
Secondary load,	18.220	amperes.
Efficiency,	97.29	per cent.

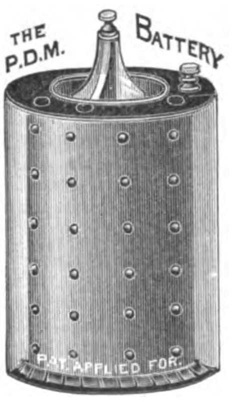
The Commonwealth Electric Company.

The office of the Commonwealth Electric Company in Philadelphia is now at No. 418 Market street, the removal to the new location being rendered necessary by the demands of increasing business. The company are now prepared to fill orders on the shortest possible notice, and guarantee their work in every particular.

Trade Note.

Mr. W. R. Mason, the General Manager of the Railway Equipment Company, Chicago, has just sent out a circula to the Eastern trade, calling attention to the unequaled facilities of the company for furnishing everything necessary for the complete equipment and maintenance of electric roads, and also calling particular attention to the merits of type "G" overhead material manufactured by his company. This material has been specified on a majority of the leading roads during the last season. He also informs the trade that he expects to be in New York the latter part of this month, and will call on the leading contractors and street roads in the East.

The Premier Batteries.



The Premier products have become so generally and favorably known among the users of electricity that it may appear intrusive to speak of them, but as improvements are being constantly made in these as in all other electrical appliances, it is within the province of an attentive journal to give them such notice as they deserve. Among the latest products of the maufacturer of the Premier appliances is a new form of Bluestone Battery, which as a motor battery for operating from 4 to 12 inch fans, or even larger, is considered a highly efficient contrivance, and is commended by the maker as superior to any in the market. The motors used with this battery have distinguishing features that will be appreciated by all who have occasion to employ such apparatus; they need not be specially wound, and resistance coils and short-circuiting devices are not necessary to keep the battery in working order when motors are not required. The commutator, if oil is used sparingly, will always remain clear and bright. No chisels nor scraping tools are necessary, an old cloth is all that is required to keep the zinc of this new cell clean: the coating never hardens on the zinc. These cells have run the No. 3 Premier Motor 200 hours continuously, at a cost of less than 50 cents. The zincs will last 1,500 hours, and are never taken out of solution. The best type of cell for running sewing machine motors, for large induction coils, electro-plating, experimental work, or where a powerful current is necessary, contains a surface of nearly 100 square inches of best quality oxidized carbon and 60 square inches of zinc. The zincs are made specially for this cell, and with a view to increase of electro-motive force and a decrease of internal resistance, hence increased efficiency and economy. The Premier Grenet Battery, the manufacturer claims is ahead of all other cells yet produced for amateurs and students in electricity. The carbons are of the same quality as those used in the Premier Battery. These cells have been very successful. Circulars containing full particulars may be obtained by applying to the sole manufacturer of the Premier Batteries, M. R. Rodrigues, Nos. 17 and 19 Whipple street, Brooklyn, N. Y.

INCORPORATIONS.

The Perry Electric Light Company of Perry, Wyoming County, N.Y. Capital, $25,000. Directors: Henry N. Page, William D. Page, M. H. Olin, George K. Page, Clarence M Smith, all of Perry.

A new electric railway company at Chattanooga, Tenn., represented by C. E. James, Willard Warner, Xen Wheeler and others, have made application for a charter. The rights of way to and through the suburbs east of the city have been granted.

The People's Traction Company, of Philadelphia, have applied for a charter to operate passenger railways by cable, electrical and other means. The capital of the company is $10,000,000, and $1,000,000, 10 per cent. of the capital stock, has been paid in cash to John Lowber Welsh, of Philadelphia, treasurer of the company. The directors are Wm. H. Shelmerdine, R. Nelson Buckley, John Lowber Welsh, Edward J. Matthews, Caleb F. Fox, Philadelphia.

An electric company is being organized in Athol, Mass. The capital stock of the company is $60,000, and among the local men interested are N. D. Lucy, C. A. Chapman and H. R. Barber.

The Harrison International Telephone Company, Chicago. Capital stock, $80,000,000. Directors: Dr. E. M. Harrison, Fort Smith, Ark.; L. E. Ingalls, Chicago; George R. Peck, Topeka, Kan.; Charles M. Ferree, Albert I. Stone, Major William Warner, John T. Blake, Howard M. Holden, Webster Davis, Kansas City; Richard C. Kerens, D. J. Young, St. Louis. The telephone will comprise what will be known as the long distance typewriter, a system of telegraphy which is calculated to abolish the dot and dash. The typewriter will be more or less of the ordinary character. Each word is spelled out and an exact fac simile produced on the machine with which it has been connected by electric wire. The cost, it is said, will be one-third less than telegraphy.

The St. Louis, Collinsville and Eastern Railroad Company, of East St. Louis, Mo. Capital stock, $250,000. Incorporators: Alexander Young, St. Louis; Walter Young, St. Joseph, Mo.; James Hannerty, Chicago; John S. P. Gordon, Collinsville, Ill.; and Perry A. Gordon, Glen Carbon, Ill. The object of the company is to build a railroad from East St. Louis to Collinsville, with a branch to Venice, Ill.

Universal Electric Launch Company of Nyack, N. Y. The purpose of this company is to manufacture, lease and sell boats propelled by electricity and of batteries, machinery and other supplies for the use of sail boats. Capital, $25,000. Directors: Stephen R. Bradley, Stephen R. Bradley, Jr., and Charles L. Seabury of New York City, and Andrew L. Riker and Thomas L. Proctor of Brooklyn.

The Varley Duplex Magnet Company, Englewood, N. J. Capital stock, $20,000. Incorporators: F. C. Jones, of New York; Richard Varley, Jr., Wm. Varley, and Treadwell Cleveland, Englewood. The company will manufacture duplex magnets, electrical appliances, machinery, etc.

A certificate of incorporation of the Bound Brook Electric Light, Heat and Power Company has been filed in the office of the Secretary of State at Trenton, N. J. The capital stock is $5,000. The incorporators are Charles P. Sebring, of Plainfield; Louis J. Auerbacher of Newark, and Frederick H. Cook, of Bound Brook.

The Patty Electric Burglar Alarm Company, Cooper, Iowa. Capital stock, $5,000. President, T. S. Patty; John Frame, treasurer; C. E. Miller, secretary. Mr. Patty has recently had patented a closed circuit burglar alarm, and it is the intention of the company to manufacture these machines.

Electric Supply Company, Port Huron, Mich. Capital stock, $5,000.

The Southern Electric Railway Company, of St. Louis. Capital stock, $1,500,000. Incorporators: Tom L. Johnson J. C. Richardson, E. S. Lovejoy and others.

The Manasquan (N. J.) Electric Light and Power Company. Capital stock, $25,000. Incorporators: George Lane, Wm. E. and E. G. Harrison, Asbury Park; M. Stanton Taylor, Spring Lake.

The Fonda and Fultonville Electric Railway Company, Fonda, N. Y. Directors: James Shanahan, Tribes Hill; Edward Wemple, William P. Myers, Charles Pickard, A. Z. Wemple, William Niles, Fultonville; J. Hess, Fonda; James P. Argersinger, John G. Ferris, James I. Younglove, Johnstown; G. Lever, A. J. Zimmer, P. C. Freuycar, James S. Burr, Gloversville. The company will operate a street railway from Fonda to Fultonville.

Electrical and Mechanical Engineering and Trading Company of New York City. Capital stock, $150,000. Directors: J. H. Vail, George F. Sandt, Westfield, N. J.; U. T. Factenthall, Brooklyn; J. H. Miller, Mount Vernon, and H. Wray Weller, Jamaica. To act as consulting, contracting and constructing engineers for electrical and mechanical construction and to deal in apparatus, materials, etc.

The Lewistown Electric Light and Power Company, Lewistown, Fergus County, Mont. Capital stock, $10,000. Incorporators. M. M. Erickson, Cyrus Styles and W. C. Waldo.

The Florida Telephone and Telegraph Company, Pensacola, Fla. Capital stock, $25,000. C. M. Baldwin, president and general manager; John C. Witt, secretary and treasurer. The company was organized to build and operate telephone lines in Pensacola and other Florida towns.

The Lancaster and Philadelphia Electric Railroad has been chartered with a capital of $1,500,000. The line, commencing in the city limits of Lancaster, will extend through Lancaster township, East Lampeter, Paradise Borough, Salisbury Borough, Landisville Borough, West Salisbury Township, over the Philadelphia and Lancaster Turnpike, to Coatesville Borough, then along the same road to Downingtown, to Radnor and Bryn Mawr, where it will connect with the electric road into Philadelphia.

The Ocean City Electric Railway Company has filed a certificate of incorporation in the County Clerk's office at Cape May, N. J. Directors: Ezra B. Lake, H. B. Adams, J. E. Lake, R. B. Stites, W. S. Lake, William Lake, of Ocean City, and Dr. Gilbert E. Palen, of Philadelphia.

The North Side Electric Street Railway Company, Chicago, Ill. Capital stock, $500,000. Incorporators: August Rieke, F. W. McNally and William Kilpatrick.

The Augusta Electric Light and Manufacturing Company, Augusta, Ill. Capital stock, $16,000. Incorporators: William Golm, B. B. Garm, D. P. Coffman, R. J. Grigson and O. L. Pitney.

COMMERCIAL PARAGRAPHS.

The Packard lamps are more in demand to-day than ever before, and the factory at Warren, O., is taxed to its full capacity.

The Consolidated Electric Manufacturing Company of Boston will soon be an active competitor in the field of arc-lighting apparatus.

The National Electric Manufacturing Company of Eau Claire, is carrying on a very active campaign and with gratifying success.

The Waddell-Entz Electric Company are installing several very fine plants just now. Their plant in the *Mail and Express* Building is worthy of examination by all intending purchasers of isolated plants.

"Gonda Batteries" long since passed the experimental stage, and the best exponents of their merits to-day are those who have used them the longest.

One of the most important features of a correct and efficient steam plant is a good packing material. The Gould Company, of East Cambridge, Mass., are among the oldest in this line. Central station requirements have received careful attention by this company.

The Briggs & Allen Manufacturing Company, of Lawrence, Mass., has contracted for a 350-light dynamo to light its mill. The machine will operate about 300 incandescent lamps and 3 or 4 arc lamps. The Rodney, Hunt Machine Company, of Orange, Mass., has also ordered a machine of the same size. From it 200 incandescent lights will be run and several arcs. Both machines are of the Mather type.

The firm of Swan & Lane, electrical engineers, 192 Summer street, Boston, will in future be continued at the old address by Mr. Fred Swan alone, his partner, Mr. Lane, having retired. Mr. Swan is one of the most talented engineers in the country and enjoys a fine reputation for theatre, ballroom and similar artistic illuminating undertakings. At the present time several good contracts are in hand.

Cumner, Craig & Company is the title of a new firm of electrical engineers having offices in the John Hancock Building, Boston, Mass. They do general construction work in addition to representing several leading firms. Though only recently organized, this new firm is handling motors, dynamos and batteries at a lively rate.

"Insullac," the new insulating medium, made solely by the Massachusetts Chemical Company, Boston, has captured the whole electrical fraternity throughout the country. It is being shipped everywhere.

The Detroit Electrical Works announce the appointment of Mr. E. L. Myers as District Manager for the company with offices in Nos. 917-918 Monadnock Building, Chicago. The company is to be congratulated on securing the services of Mr. Myers, whose business qualifications and popularity in the trade make him a valuable acquisition.

The Electric Light and Manufacturing Company of Richmond, Va., finds constant employment for several competent mechanics, and seems to be doing a satisfactorily profitable business.

The contract for forty-three additional electric motors was awarded last week by the Detroit Citizens' Street Railway Company to the Detroit Electrical Works, whose motors on the Jefferson and Woodward avenue lines have proved so satisfactory.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED FEBRUARY 7, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

491,132. Inclosed Conductors for Electric Railways. Frank C. Perkins, Dunkirk, N. Y. Filed May 27, 1892.

491,210. Trolley-Stand. Samuel Harris, Cleveland, Ohio, assignor to the Steel Motor Company, same place. Filed Nov. 14, 1892.

491,361. Electric-Railway Trolley. Benjamin Kochs and Albert Kochs, St. Louis. Mo. Filed July 25, 1892.

491,483. Switch for Electrical Tram-Cars. Noritz Immisch, London, England, assignor to the Immisch Electric Navigation and Power Company, of New Jersey. Filed Nov. 21, 1891.

DYNAMOS AND MOTORS.

491,106. Bipolar Electrical Machine. Thomas H. Hicks. Detroit, Mich., assignor of one-half to George F. Case, same place. Filed Feb. 8. 1892.

491,294. Dynamo-Electric Machine. Gabriel V. M. A. Parrot and Antoine C. Reignier, Paris, France. Filed August 3, 1892.

ELECTRIC LIGHTS AND APPLIANCES.

491,09[illegible]. Electric-Arc Lamp. Wallace E. Freeman, Long Island City, assignor to Lawrence M. Closs, New York, N. Y. Filed July 8, 1892.

491,124. Arc-Light Carbon. James McLaughlin, Chicago, Ill. Filed May 5, 1891.

491,251. Duplex Electric-Arc Lamp. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Oct. 20, 1890.

491,268. Lamp Socket. Edwin R. Elliott, Litchfield, Ill. Filed March 28, 1892.

491,412. Windlass for Lowering or Raising Street Electric Lamps. Charles R. Eddy, Springfield, Mo. Filed May 28, 1892.

TELEPHONE AND TELEGRAPH APPARATUS.

491,109. Telephone Cable. Silas W. Holman, Boston, Mass. Filed Nov. 5, 1892.

491,133. Printing Telegraph Receiver. Major D. Porter, Brooklyn, N. Y., assignor to the National Ticker Company, of West Virginia. Filed Dec. 10, 1891.

491,163. Vibratory Telegraphy. Stephen D. Field, Yonkers, N. Y. Filed Jan. 7, 1892.

491,275. Telephone Transmitter. Harry L. Tyler, Corning, N. Y. Filed May 13, 1892.

MISCELLANEOUS.

491,171. Retouching Device. Albert S. Harry, Steubenville, Ohio. Filed Nov. 15, 1892.

491,208. Insulator Clip. William H. Edmunds, New York, N. Y. Filed Aug. 9, 1892.

491,250. Testing Apparatus for Multiple Switchboard Systems. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Sept. 9, 1890.

491,252. Metallic Circuit for Multiple Switchboard Systems. John A. Seely, New York, N. Y., assignor to the Western Electric Company, Chicago, Ill. Filed Nov. 15, 1886.

491,311. Electrically Heated Soldering Iron. Samuel B. Jenkins, Boston, Mass., assignor, by mesne assignments, to the American Electric Heating Company, same place. Filed June 8. 1892.

491,312. Electrically Heated Smoothing-Iron. Samuel B. Jenkins, Boston, Mass., assignor, by mesne assignments, to the American Electric Heating Company, same place. Filed June 8, 1892.

491,313. Electric Curling-Iron Heater. Samuel B. Jenkins, Boston, Mass., assignor, by mesne assignments, to the American Electric Heating Company, same place. Filed June 8, 1892.

491,320. Electric Water Heater. Willis Mitchell, Malden, Mass., assignor, by mesne assignments, to the American Electric Heating Company, Boston, Mass. Filed June 8, 1892.

491,321. Electrically-Heated Vessel. Willis Mitchell, Malden, assignor, by mesne assignments, to the American Electric Heating Company, Boston, Mass. Filed June 8, 1892.

491,322. Electrically-Heated Gridiron. Willis Mitchell, Malden, assignor, by mesne assignments, to the American Electric Heating Company, Boston, Mass. Filed July 2. 1892.

491,339. Electric Clock. John H. Dyson, Belleville, Wis. Filed June 6, 1892.

491,346. Electro-Mechanical Movement. Elisha Gray, Highland Park, Ill. Filed Jan. 8, 1892.

491,347. Telautograph. Elisha Gray, Highland Park, Ill. Filed Sept. 21, 1892.

491,362. Insulator. Augustus R. Lane, New York. N. Y. Filed May 13, 1892.

491,369. Electric Lock. Oliver A. Moyer and Henry W. Rhodes, Ogden, Utah. Filed April 9, 1892.

491,387. Electric Circuit for Railway-Signalling. Louis Thaler, New York, N. Y. Filed Aug. 24, 1892.

491,394. Process of Electrically Reducing Aluminium and Forming Alloys thereof. Thomas L. Willson, Brooklyn, N. Y. Filed March 25, 1891.

491,426. Combined Electric Switch and Door-Lock. John H. L. Holcombe, U. S. Navy. Filed Oct. 24, 1892.

491,437. Electric Metal-Heating Device. Willis Mitchell, Malden, assignor to the American Electric Heating Company, Boston. Mass. Filed June 16, 1892.

491,438. Electrically-Heated Muffle. Willis Mitchell, Malden, assignor to the American Electric Heating Company, Boston, Mass. Filed July 5, 1892.

491,457. Electrical Measuring-Instrument. Elmer G. Willyoung, Philadelphia, Pa., assignor to Samuel L. Fox and Edward B. Fox, same place. Filed Aug. 11, 1892.

491,465. Electrical Transmission of Power. Charles S. Bradley, Avon, N. Y. Filed April 4, 1892.

491,484. Electrically-Heated Vessel. Samuel B. Jenkins, Boston, Mass., assignor to the Butterfield-Mitchell Electric Heating Company, same place. Filed June 9, 1892.

491,491. Insulated Magnetic Coil. Thomas E. Morford, Minneapolis, Minn., assignor, by direct and mesne assignments, of one-half to the Enamel Insulator Company, of Illinois. Filed Jan. 28, 1891.

RE-ISSUES.

11,303. Method of Insulating Electric Conductors. Thomas E. Morford, Chicago, Ill., assignor by direct and mesne assignments, to the Enamel Insulator Company, of Illinois. Filed June 3, 1892. Original No. 457,828, dated Aug. 18. 1891.

11,306. Multiple-Switchboard System. Charles E. Scribner, Chicago. Ill., assignor to the Western Electric Company, same place. Filed Nov. 6, 1891. Original No. 442,143, dated Dec. 9, 1890.

DESIGN.

22,207. Resistance-Box. Edward Weston, Newark, N. J. Filed Sept. 10, 1892. Term of patent 14 years.

ELECTRICITY.

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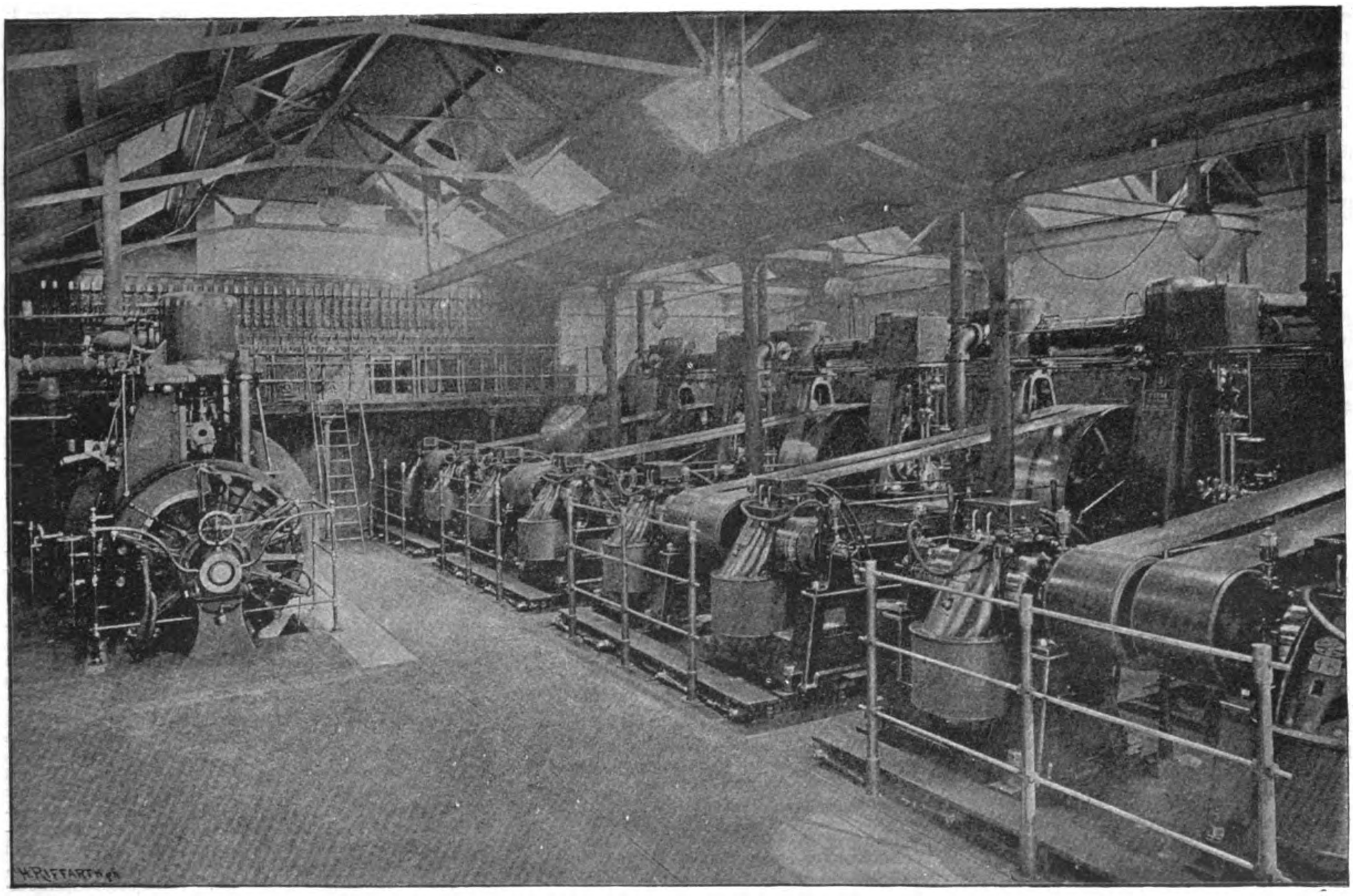


DYNAMO ROOM—ELBERFELD MUNICIPAL STATION. (SEE PAGE 65.)

The Elberfeld Municipal Station.

This station, which was contracted for by the city of Elberfeld in 1887, was commenced in the summer and finished in November of the same year. The distribution is on the three-wire continuous current system.

There are three Cornwell boilers which carry 120 pounds pressure, and six separate compound engines which are run condensing. Four of these engines are from 100 to 170 effective horse power and run at 180 revolutions per minute, and each is connected by belts to two dynamos. The other two engines are rated at 350 H. P. at 160 revolutions and each is direct coupled to two dynamos.

The dynamos, of which there are twelve, were manufactured by Siemens & Halske. Eight of these machines are of the constant current type and generate 390 amperes each at 112 volts pressure and the four direct connected machines have a capacity of 900 amperes each. The total capacity of the plant is 1,400 H. P.

Fire Insurance Rules.

At the meeting of the Executive Committee of the Suburban Underwriters' Association held on February 7, Mr. Fremont Wilson was appointed as consulting electrician for said Association. Rules governing the equipment of electric light, heat and power installations have been recommended, and are the same as those recommended by the United Association of Underwriters' Inspectors, of which Mr. C. M. Goddard, of the New England Exchange, is Secretary.

Insurance companies and brokers throughout the district covered by said Association have been notified that electric light privileges will hereafter be only given to parties whose installations have been certified to by Mr. Wilson. Electric light and power companies and contractors will be furnished with printed rules and regulations and blank forms of application to be signed by all parties doing work in their districts. The territory at present under the jurisdiction of this Association is Queens, Suffolk, Westchester, Putnam and Rockland Counties. Richmond County is practically under the jurisdiction of the Association, and the same rules and regulations will undoubtedly be required there.

Any information which parties may desire will be furnished by Mr. H. E. Bowers, Secretary of the Association, 44 Pine street, New York City.

Mr. William McDevitt, Chief of the Electrical Department of the Philadelphia Fire Underwriters' Association, took passage for Europe on the North German-Lloyd steamship Lahn on February 21st. Many claims have been made by authorities in foreign countries of superior methods in the distribution and use of the electric light, especially as to "wiring" and its application to houses and for safety from fire. This subject Mr. McDevitt will particularly inquire into, and he will also examine the safeguards used for the protection of theatres.

It must be understood that Philadelphia has the largest number of electric lighting stations of any city in the United States. This class of risk has almost been refused insurance throughout the country owing to the number which have been burned down—yet Philadelphia has never even had a serious fire in a single station.

Mr. McDevitt will visit Berlin, London, Paris Vienna and Marseilles, and goes at the request of nearly all the electrical contractors, central stations and electrical engineers in the city of Philadelphia who are interested in this work and who believe that our methods are not very far behind.

The Philadelphia Fire Underwriters' Association has granted Mr. McDevitt a two months' leave of absence, and he carries with him letters from Hon. Edwin S. Stuart, Mayor of the city of Philadelphia, to the municipal authorities abroad, besides other letters which will give him the entree to all places he may wish to visit. A very full and interesting report is looked for, and one which cannot fail to be of great use to the electrical fraternity in general.

Edison's Lamp Patent Stands.

Judge Colt's Decision in the Beacon Company's Case.

Exhibit No. 4 Viewed With Suspicion.

On Saturday, February 18, Judge Colt, in the United States Circuit Court at Boston, handed down his decision in the case of the Edison Electric Light Company vs. the Beacon Vacuum Pump and Electrical Company, granting the injunction asked for by the plaintiffs.

Following is a summary of the decision:

In May, 1885, the plaintiff brought suit in the United States Circuit Court for the Southern District of New York against the United States Electric Lighting Company for infringement of the patent now in controversy, which was granted to Thomas A. Edison, January 27, 1880, for an improvement in electric lamps; and on July 23, 1891, a decree was entered, adjudging the validity of the patent and ordering an injunction and account. Upon appeal to the Circuit Court of Appeals for the Second Circuit, the decree was affirmed in October, 1892. Another suit was then brought in the same court against the Sawyer-Man Electric Company, and a preliminary injunction was granted *pro forma* until a decision could be had by the Circuit Court of Appeals, which on December 19, 1892, affirmed the order. and directed an injunction. Suits were then immediately brought against the Westinghouse Electric Company in Pennsylvania, the Perkins Electric Lamp Company and the Mather Electric Company in Connecticut, and preliminary injunctions obtained.

The present bill was filed January 10, 1893, and the plaintiff now moves for a preliminary injunction against the defendants, based upon the foregoing prior adjudications. This motion is resisted on the ground of newly discovered evidence bearing on the question of novelty in the Edison invention, which was not before the courts in the other cases. As to these other cases, it is said that there has been but one final adjudication upon the merits, which was in the suit against the United States Electric Lighting Company, that the defendants in the other prior suits were so connected with that company that they were in privity with it, and that therefore injunctions were granted as a matter of course.

The suit against the United States Company was thoroughly and obstinately contested, as is shown by the record, which covers about six thousand printed pages. The general rule is that where the validity of a patent has been sustained by prior adjudication, and especially after a long, arduous and expensive litigation, the only question open on motion for a preliminary injunction in a subsequent suit against another defendant is the question of infringement, the consideration of other defences being postponed until final hearing.

The only exception to this general rule seems to be where the new evidence is of such a conclusive character that if it had been introduced in the former case it probably would have led to a different conclusion. The burden is on the defendant to establish this, and every reasonable doubt must be resolved against him.

There is no denial of infringement in the present case under the construction given to the patent in prior adjudications. The contention of the defendants is, that this motion should be denied on the ground that they have recently discovered that Henry Goebel, a German watchmaker, living in New York, invented the Edison incandescent lamp as early as 1854, and that therefore the Edison patent is void for want of novelty, or at least must be limited to the coiled form of filament. This is the same line of attack upon the patent which was unsuccessfully made in the case against the United States Electric Company.

To subdivide the electric light and embody it in a cheap and durable domestic lamp, capable of successfully competing with gas, had for years baffled the science and skill of the most eminent electricians in this country and in Europe. The difficulty lay in the practical construction of a durable incandescent lamp rather than in a knowledge of the elements which should compose such a structure. Carbon burners, platinum wires, exhausted glass receivers were old and well known.

The arc lamp, was known as early as 1844, but its great light made it unfit for use in dwellings. The question was how to divide the electric light for domestic purposes. Many scientists considered the problem as hardly within the range of possibility. From the results of the experiments of Fontaine, the French scientist, published in 1877, it would seem that almost insurmountable obtacles, founded on the operation of natural laws, stood in the way of the successful division of the electric light. Mr. Preece, the electrician for the British General Post Office, pronounced early in 1879 that "the division of the electric light is an absolute *ignis fatuus*."

Those who dissented from this view were Mr. Edison in this country and Mr. Lane-Fox in England, who both reached the conclusion that the sub-division of the electric light could be accomplished provided the radiating surface of the burner of the lamp was reduced in extent so that only a moderate volume of light would be emitted while at the same time the resistance of the burner was increased so as to enable the employment of relatively small conductors for leading the electric current to the lamps; or, shortly stated, the burner should have a high ratio of resistance to radiating surface. Edison first embodied this discovery in his platinum lamp in 1879. but this lamp was unsatisfactory and the problem remained unsolved.

After the failure of the platinum lamp, it occurred to Edison to substitute a short filament of carbon in place of the long platinum burner, into the nearly perfect vacuum chamber. and it was found that such filament was stable at high temperature and free from disintegration and oxidation. It was thus made known that the disintegration of the carbon burner was not caused by the electric current, but was due to "air washing," or the attrition produced by the passage of the air over the highly-heated surface of the carbon.

As late as 1878, Mr. Sawyer, in a patent to Sawyer and Man, stated that no incandescent lamp had yet been devised which was practically operative, because of the defective methods employed for charging the lamp with artificial atmosphere which resulted in the disintegration of the carbon; second, because it was impossible under varying degrees of heat and pressure to maintain perfect joints; third, because unequal expansion of the carbon and its holder had resulted in fractures of the burner. But Edison overcame these obstacles and produced a practical lamp. When we review the literature which preceded this invention, the subtle force with which it had to deal, whose laws had to be intelligently investigated and understood, the well nigh perfect workmanship necessary in construction, and the slow steps by which the end was finally reached, it seems on its face almost incredible that the incandescent lamp of Edison was in fact invented and operated by Henry Goebel in New York forty years ago, and publicly exhibited before hundreds of people.

[Here follows a resume of the affidavits in the case, with which our readers are already familiar. —Ed.]

Upon consideration of the whole of the evidence on this motion I have reached the following conclusion:

It is extremely improbable that Henry Goebel constructed a practical incandescent lamp in 1854. This is manifest from the history of the art for the past fifty years, the electrical laws which since that time have been discovered applicable to the incandescent lamp, the imperfect means which then existed for obtaining a vacuum, the high degree of skill necessary in the construction of all its parts, and the crude instruments with which Goebel worked.

Whether Goebel made the fiddle-bow lamps 1, 2 and 3, it is not necessary to determine. The weight of evidence on this motion is in the direction that he made these lamps, or lamps similar in general appearance, though it is manifest that few, if any, of the many witnesses who saw the Goebel lamp could form an accurate judgment of the size of the filament or burner. But assuming they were made, they do not anticipate the invention of Edison. At most they were experimental toys used to advertise his telescope, or to flash a light upon his clock, or to attract customers to his shop. They were crudely constructed, and their life was brief. They could not be used for domestic purposes. They were in no proper sense the practical commercial lamp of Edison. The literature of the art is full of better lamps, all of which were held not to anticipate the Edison patent. The prior art demonstrates that to protect a carbon filament ten one-thousandths of an inch in diameter from speedy disintegration the lamp chamber must maintain a nearly perfect and stable vacuum, and every part of the structure must be composed of such materials and so put together as not to imperil this vital condition. Leaving out other defects, it is abundantly shown that the Goebel lamp did not possess this requirement, and could not by reason of the elements which entered into its composition and the mode in which it was constructed. Goebel says he made more than 100 lamps, and that a continual improvement took place in their construction, and yet the only three lamps produced at the hearing by his own confession were made as early as 1854, or before gas was introduced into his house. Where are the other lamps which show these improvements except Exhibit 4, which I will deal with presently? The evidence of Goebel and his witnesses point to the conclusion that work ceased on these lamps in the "fifties," and was not revived until Edison twenty years later startled the electric world with his invention. Goebel brought from Germany the ideas contained in the old lamp of Starr, with its carbon pencil enclosed in a Torricellian vacuum, and he probably constructed some lamps after that pattern. In doing this he was up and in line with the art as it existed at that early day, but to say that with a sudden bound he jumped from Starr to Edison passes the limits of credulity. The history of great inventions shows a gradual and labored progress. Each new investigator records some advance until it may be the desired discovery is almost within his grasp, but it is only after many attempts and many failures that some one appears who accomplishes the long sought for result. The discovery of the domestic incandescent lamp is no exception to this rule, as the record in the New York case bears witness. Speaking from the standpoint of the art of incandescent lighting in 1854 and in 1892 are two different things, and it is, therefore, quite easy for witnesses to think that Goebel did much more than there is any legitimate reason to suppose.

As for lamp No. 4, I cannot but view it with suspicion. It presents a new appearance. The reason given for not introducing it before the hearing is unsatisfactory. This lamp, to my mind, envelopes with a cloud of distrust the whole Goebel story. It is simply impossible under the circumstances to believe that a lamp so constructed could have been made by Goebel before 1872. Nothing in the evidence warrants such a supposition, and other things show it to be untrue. This lamp has a carbon filament, platinum leading-in wires, a good vacuum, and is well sealed and highly finished. It is said that this lamp shows no traces of mercury in the bulb because the mercury was distilled, but Goebel says nothing about distilled mercury in his first affidavit, and twice he speaks of the particles of mercury clinging to the inside of the chamber, and that for this reason he constructed a Geissler pump after he moved to 468 Grand street, which was in 1877. Again, if this lamp has been in his possession since before 1872, as he and his son swear, why was it not shown to Mr. Crosby, of the American Company, when he visited his shop in 1881 and was much interested in his lamps? Why was it not shown to Mr. Curtis, the leading counsel for the defendants in the New York cases, when he was asked to produce a lamp and promised to do so? Why did not his son take this lamp to Mr. Bull's office in 1892 when he took the old fiddle-bow lamps 1, 2 and 3? Why did not his son take this lamp to Mr. Eaton's office in 1882 when he tried to negotiate the sale of his father's inventions to the Edison Company? A lamp so constructed and made before 1872 was worth a large sum of money to those interested in defeating the Edison patent like the American Company, and Goebel was not a rich man. Both he and one of his sons were employed in 1881 by the American Company. Why did he not show this lamp to McMahon when he called in the interests of the American Company and talked over electrical matters? When Mr. Dreyer tried to organize a company in 1882, and procured an option from him of all his inventions relating to electric lighting, for which $925 was paid, and when an old lamp of this kind was of vital consequence and would have insured a fortune, why was it not forthcoming? Mr. Dreyer asked Goebel to produce an old lamp, and was especially anxious to find one pending his negotiations with the Edison Company for the sale of Goebel's inventions. Why did he not produce this lamp in his interviews with Bohm of the American Company, or Moses of the Edison Company, when it was for his interest so to do? The value of such anticipation of the Edison lamp was made known to him. He was desirous of realizing upon his inventions. He was proud of his incandescent lamps, and was pleased to talk about them with anybody who would listen. Is it conceivable, under all these circumstances, that he should have had this all-important lamp in his possession from 1872 to 1893 and yet no one have heard of it or seen it except his son? It cannot be said that ignorance of the English language offers an excuse. He knew English very well although Bohm conversed with him in German. His children spoke English. Neither his ignorance nor his simplicity prevented him from taking out three patents, the first in 1865 for a hemmer, and the last in 1882 for an improvement in incandescent lamps. If he made lamp No. 4 previous to 1872, why was it not also patented?

There are other circumstances which throw doubt on this alleged Goebel anticipation. The suit against the United States Electric Lighting Company was brought in the Southern District of New York in 1885. Large interests were at stake, and the main defence to the Edison patent was based upon prior inventions. This Goebel claim was then investigated by the leading counsel for the defence, Mr. Curtis. It was further inquired into in 1892, in the case against the Sawyer-Man Company. It was brought to the attention and considered by the Edison Company in 1882. It was at that time known to the American Company, who hoped by this means to defeat the monopoly under the Edison patent. Dreyer tried to organize a company for its purchase. Young Goebel tried to sell it. It must have been known to hundreds of people. And now when the Edison Company after years of litigation, leaving but a short time for the patent to run, have obtained a final adjudication establishing its validity, this claim is again resurrected to defeat the operation of the judgment so obtained. A Court of Equity should not look with favor on such a defence. Upon the evidence here presented, I agree with the first impressions of Mr. Curtis, and with the opinion of Mr. Dickerson that whatever Goebel did must be considered as an abandoned experiment.

It has often been laid down that a meritorious invention is not to be defeated by something which rests in speculation or experiment, or which is rudimentary or incomplete. The law requires not conjecture, but certainty. It is easy after an important invention has gone into public use for persons to come forward with claims that they invented the same thing years before, and to endeavor to establish this by the recollection of witnesses as to events long past. Such evidence is to be received with great caution, and the presumption of novelty arising from the grant of the patent is not to be overcome except upon the most clear and convincing proof.

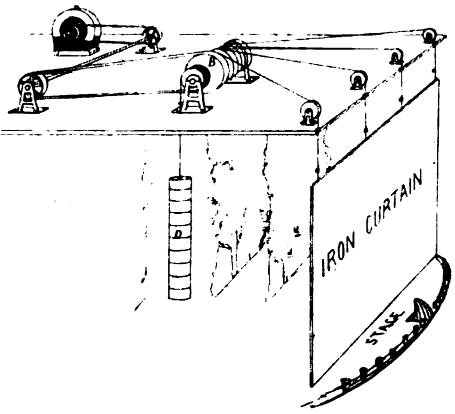
When the defendant company entered upon the manufacture of incandescent lamps in May, 1891, it well knew the consequences which must follow a favorable decision for the Edison Company in the New York case.

Owing to the large interests involved, I have carefully considered this motion, and I am satisfied upon the evidence, and the law applicable thereto, that it should be granted.

The Electric Curtain at the Comedie Français (Paris).

Since the burning of the Opera Comique at Paris, in 1887, it has been the effort of nearly all French theatrical managers to adopt a speedy means of lowering the iron curtain in an instant, and electricity has been found to supply the demands of both the managers and public for shutting off instantly any fire occurring on or about the stage from the audience.

The first theatre in Europe known so far to use the electric iron curtain is the Comédie Français at Paris. The *rideau électrique* was put up and arranged by the Edison Electric Light Company, M. Anton, chief machinist of this theatre, giving valuable aid in erecting the curtain, which commenced working a few weeks ago. The curtain is hung by four steel wire ropes which run over pulleys, the ropes then meeting at and going over a wooden drum B. This is driven from the pulley G by an electric motor F.



The counter-weight D is held by a cord to insure equilibrium at any instant required. The total weight of this curtain is about 400 kilogrammes, and is balanced by the counterweight D. The speed at which the wheels run is about 1,800 revolutions per minute, and the capacity of the motor which works the curtain is equal to two horse power. The curtain can be let down at the maximum rate of 1.5 meters per second, the minimum being 0.75 metre per second, the same speeds being available for lifting it. The electric current is supplied from the light circuit. This will undoubtedly come into use in most play houses, and would have been the means of saving many lives and considerable property in London, New York and Paris theatres had it been adopted before. There is an iron curtain in the Paris Opera House, and electricity will soon be applied for operating the safeguard.

A Correction.

Electric Cranes at the World's Fair.

There was a slight inaccuracy in our "World's Fair News" in the issue of February 1. Of the three electric cranes to be used, the Yale & Towne Mfg. Company, of Stamford, Conn., Messrs. Wm. Sellers & Co., of Philadelphia, and the Morgan Engineering Company, of Alliance, O., each furnished one.

Electric Meters.[*]

DISCUSSION.

Mr. Furgeson—Mr. Chairman, I would like to ask Mr. Weart if the Aron meter is designed to be used in connection with the alternating current?

Mr. Weart—I cannot answer that question. My impression is that the meter is all right for the alternating current, but I may be mistaken.

The Chairman—Mr. Gates, don't you know something about the Aron meter? Doesn't the Siemens & Halske Company use that meter?

Mr. Gates—I do not know anything about the Aron meter. The Siemens & Halske Company use that meter quite extensively on the other side, but not exclusively. At some other meeting of the Club I will bring one of our meters here and exhibit. I think the Aron meter is used for alternating current, but not to any great extent. There are very few alternating plants in Germany. They are mostly in Austria, Hungary and that part of the world.

Mr. Weart—Mr. Chairman, on second thought it is apparent that the alternating current will not affect the permanent magnet. The alternating current does not detract from the magnet as the direct current does.

The Chairman—I know that Aron meters have been used on some alternating systems satisfactorily.

Mr. McFadden—Mr. Chairman, in answer to Mr. Furgeson's question, I will say I am quite sure that it is used on the alternating current also, because the conditions mentioned by the French engineers in the competition for the prize were that the meter should be a wattmeter to run equally well on alternating or direct currents, and the prize was divided between Prof. Aron and Prof. Thomson.

Mr. Weart—They must have had a coil in the permanent magnet.

Mr. McFadden—I presume so.

Mr. Weart—But then it would not be a true Aron meter.

The Chairman—I would like to ask Mr. Weart a question: How about the constant of the Aron meter in relation to the value of gravity at different places? The pendulum of the clock, you know, runs faster or slower in accordance with the distance from the center of the earth, due to what we usually call gravitation. Now, supposing the meter is calibrated in Chicago, and would be taken to Helena, Montana.

Mr. Weart—Gravity would affect the two pendulums alike, and they would both increase at the same rate and the increment due to magnetic force would be practically in the same ratio as before.

But that brings up a point I meant to have spoken of but overlooked, and that is the extremely small margin the Aron meter works on. These pendulums run at the same rate when any current is passing through the coils, and you have got to spend less time to make them run at the same rate. I have heard of a device for making the pendulums synchronous when the variation is small. I have not seen that, but the total increase in rate of the magnetic pendulum with the full load on the meter is only one part in a thousand. That means, to get the reading of the meter you have got to differentiate the one-thousandth part; and that meter will do that down to another one part in a thousand, but it is apparent that a very slight change in the rate of either pendulum will give you somewhat serious error. Whether that becomes serious in actual practice I cannot say, for I have not had actual practice with the meter.

Mr. Grier—Mr. Chairman, in regard to the effect of heat upon those two pendulums: they are of different shapes and different material, and will their rate remain the same relatively in different temperatures?

Mr. Weart—The fact that they run at the same rate indicates that their centres of gravity are at the same point, and the rods being of the same material they ought to operate at the same rate.

Mr. McFadden—I would like to ask if the clockwork is the same for all sizes except the coils and pendulums?

Mr. Weart—I have not seen very many of

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[*] Meeting of the Chicago Electric Club, June 16.

these meters, but I see no reason why a change in dials and pendulums should not be all that is required. I think that is one of the advantages of the meter.

Mr. McFadden—I notice in some that instead of a permanent magnet there is a single pendulum.

Mr. Weart—I remember when the Aron meter first came out, the description answered to the style you speak of. In that case the meter had hands, and the reading was gotten by the difference between the time of the meter and the true time. I think the fact of the variation being so small is sufficient to account for that form being dropped, because if you had to take the difference between your meter and the true time at the place where you happened to be, the little variations that would take place in your clockwork would wipe out the possibility of reading the meter correctly. It would evidently be of great advantage to have two sets of clockwork in the same case, made in the same way, which would be utilized together and would be liable to vary at the same rate, in order to avoid that difficulty.

Mr. Armstrong—Mr. Chairman, I have had experience with several different kinds of meters. I had some experience with the Thomson wattmeter in testing an electric elevator. I wanted to take some current readings on an electric elevator, and as you probably all know, the readings have to be taken very hurriedly. The current runs up to two or three hundred amperes and the voltage drops down from normal at the time the elevator cord is pulled, and very often readings have to be taken inside of fourteen, or fifteen, or twenty seconds; and I happened to want to find out about what it cost to operate an electric elevator, and I had about four days in which to do it. I got a Thomson wattmeter and put it on, and I found some quite surprising results which went to show that notwithstanding the fact that the load was thrown on very suddenly and thrown off again, and then on and off, that the meter read fairly accurately.

I found that the point which Mr. McFadden mentioned about the disc taking about so long to stop seems to be true; that what it loses perhaps in inertia in starting it gains in stopping, so that it seems to about balance, and, as near as I could tell, comparing it with readings with the watch and with the ampere meter and voltmeter, three or four reading at the same time, they were quite near together. I believe, take it all in all, that the wattmeter was more nearly correct than anything else, and am using it for both direct and alternating currents.

I like the meter from the commercial view, because the customer can see what he is getting. There is something about the mystery of a bottle and the very great certainty of the bill when it comes in which is appalling to the customer. With the Thomson wattmeter, or with any wattmeter where the indication is read off from a dial, the person can from time to time see how his bill is climbing up, and he is not quite so much astonished at the end of the month. I like that feature. While I have had no practical experience with the meter there shown, I do not believe I would care to have it. I think it is too delicate for anything like practical use. As Mr. Weart said, it might be a very good toy for laboratory use, but it would not be of any value whatever in the market as a meter. The intensely practical American people want something that is simple, that is not liable to get out of order, and something that can be understood by ordinary people, who, after all, make up the majority of those who are handling the practical apparatus. It is all right to place refinements in a station where they are to be handled by men of refinement, but I find in a great many cases that we make grave errors in putting too fine an apparatus into the hands of an ordinary dynamo tender. He does not appreciate it, and he uses it with considerably less skill than he would if he had something very much more ordinary, and we would get far better results with a cheaper, plainer apparatus.

Mr. Furgeson—Mr. Chairman, I would like to add something which I forgot to say and which is suggested by Mr. Armstrong's remarks, as to the customers reading their meters. They can see what the meter is registering, but whether that meter is registering right they do not all know unless they know how to test it. All Thomson wattmeters are made on the principle that one revolution of the disc corresponds to a watt hour. That is the basis of the whole thing. One revolution equals one watt hour. The time is constant. In other words, one watt takes one hour for one revolution, and any larger number of watts, 540 say, would take $\frac{1}{540}$ of an hour, or of 3,600 seconds, to make a revolution. He can time his disc and see how many seconds it takes to make a revolution. Or to do the same thing, use this formula: $W = \frac{r \times k \times 3{,}600}{s}$, in which W is watts, r is revolution, k is constant, 3,600 is time, and s the number of seconds observed.

Mr. Weart—Mr. Chairman, I am very much interested in the Thomson meter, and I fully appreciate the beauty of the constant. The old Edison meter had a very complicated constant, which did not make even figures, and it was quite difficult to hammer the constant into the head of the meter man. In the Edison meter the constant is quite as simple as in the Thomson meter, but it is this: one milligramme equals one ampere hour. So that if the customer wants to know how his meter stands, all he has got to do is to take his plates out and weigh them and get the milligrammes and commence reading right away. I think he would be as likely to go through the operation in one case as in the other. I think the importance of the customer knowing the state of his readings exists principally in a sentimental sense. It may be a satisfaction to know that he can read his meter and get the bulge on the company, but I don't believe that he will do it. The objection is always made against the Edison meter that it is blind, that the customer cannot read it and will not have faith in it. Well, it takes but very little time for them to acquire faith in it. They soon learn that their bills bear a proportion to the amount of service rendered.

There are one or two things about the electrolytic meter that I am inclined to give here, having had some practical experience with the meter, and being now in a position where I might be supposed to be free to speak. There are two or three things against it, and while I have somewhat of a sentimental feeling in favor of the electrolytic meter, I expect to see it go out of commercial use in the course of a few years. The worst thing about it is that if it does not go perfectly straight—and nothing ever does go perfectly straight—the electrolytic meter is going to work against the company. It is the total depravity of inanimate things that makes it come out so. And that is not all: it has a tendency to read slow, and reads slowest when the load is lightest. Consequently in the summer, when the company needs every cent they can get—when the customers are not using much current—they are receiving 10 or 20 per cent. less than they ought to receive, and they cannot use that as a constant. If they could they would, but they don't know how to figure it, and consequently they lose that. It is not even appreciated what real difficulty there is in applying the electrolytic method to a commercial meter. It is known that electrolysis is proportionate to the current that is passing, and the Patent Office is full of meters which are automatic in their action either by casting or a plate attached to a scale beam, or something of that kind. But we cannot apply the current direct to the electrolytic meter, as we have seen here. We have got to send the current through the shunt and take the whole potential on that shunt. The shunt has a fixed resistance and the bottle has a weight resistance, and the weight resistance has necessarily the same variable resistance. The metal chosen for the electrolytic style has the least variation of counter-electromotive force with the variation in the current of any commercial metal that it is possible to use. That makes it desirable for use in the electrolytic style. But steel varies with temperature, and we have been told how it is compensated for by a spool. That is easily accomplished, as the variation in the resistance liquid can be ascertained, but the contact resistance of the plate is somewhat variable, and it varies on the wrong side. In other words, the resistance of the steel in figuring the constant of the meter is taken at its normal value when the steel is fresh and the surface clean: when oxydized the resistance of the oxide cannot be allowed for. The oxide always increases the resistance, so that it reads slower and slower towards the end of the month. I do not want to be understood as saying that this is a frightfully serious matter, or we would not see the meter used; but as a matter of fact it does read slower at the end of the month, and the resistance is affected by the amount of current passing. A large current passing through the bottle tends to remove some of the oxide so that the meter reads a little faster on full load than it does on light load; consequently with the light load the reading is not what it should be. I have another objection against the wattmeter. It is not a real objection but a comparative objection. We hear a great deal said about the beauty of being able to read your current in watt hours. The fact is that current is distributed in these days, almost without exception, at constant pressure. Constant pressure theoretically amounts to constant pressure actually, but as we have seen here to-night, the pressure will vary occasionally, but the wattmeter does not average it properly. We are not buying watts on an incandescent circuit, but light. Nobody has pretended to give us a meter that will read in candle hours, but one that will read in watt hours. The result is that the pressure drops 5 per cent. The meter takes care of that; it measures the watts accurately, and we get that 5 per cent. taken off from our meter readings. But when our light has gone down 50 per cent. we are paying 45 per cent. more than we ought to. That is not very much comfort to us if our light goes down 50 per cent. that we get 5 per cent. rebate on the bill.

I can see in the case of electric railway service, where the pressure is extremely unsteady, that the wattmeter may be desirable and practical. In the case of electric light service I hardly think it is, and it is an injustice to the buyer.

The Chairman—Take one of the meters that simply measure currents, wouldn't the same objection hold good there?

Mr. Weart—That makes no pretence to be virtuous.

The Chairman—But the same objection would hold there, wouldn't it, if you simply measured a current and the voltage goes down the current decreases very little and the voltage comparatively little at the same time, and has the same effect on the light, and while you pay for virtually say five per cent. less current, you pay, as you say, for 50 per cent. less light?

Mr. Weart—Of course I do not claim that the Cooley meter really does measure light. It does not pretend to; but, by implication at least, it is held forth that the watt meter does give the customer a square deal, whereas it is more or less a pretence if the customer is buying light and paying for watts.

Mr. McFadden—I think the matter of paying for light, is a matter between the consumer and the station man who calls it a lamp hour or candle power hour. We furnish a meter that will measure it accurately in watts and give that to the station superintendent as such. He can sell it out to the customer as watt hours or lamp hours, just as he chooses. It is a matter of detail with him.

Mr. Weart—I would like to ask Mr. McFadden if the wattmeter is really accurate over wide variations in voltage.

Mr. McFadden—I have run, for instance, a hundred volts on two-wire 110 voltmeters—I have run them at 92, I don't know how much lower they would go, and as high as 125, and they were still accurate. I have done it in the shops but never in practice.

Mr. Grier—Mr. Chairman, that is a question that came up not long ago where one of the Thomson wattmeters was used. The voltage varied from 100 to 117, according to the load, at different portions of the building in which the station was located, and the meter read apparently, according to the measurements taken with a Mason lampmeter and a Mason voltmeter in circuit; it apparently measured accurately anywhere from 100 volts to 117. One peculiar thing was that while the customer was kicking very hard about his bill it was found that the meter read 5 per cent. too slow.

Mr. Gilchrist—I would like to say in answer to Mr. Wirt's remark in regard to the electrolytic meter running slow on a light load that the idea of the Chicago Edison people is to have a meter constructed in such a way that, where it is a very large meter that is liable at times to run with light load it will register on two small bottles, and then when a heavier load is thrown on it is shunted on to two heavier bottles. In that way we expect to get rid of that loss by the meter running slow on a very light load. We find that necessary in our South Side residence station. We have a great many residences there which are wired for a large number of lights, from 500 to 1,000, and where at all times in the year, especially in the summer months, the average load is very small indeed, as low as ten to twenty-five or fifty lamps.

Mr. Wirt—I would like to ask Mr. Gilchrist what is the gain with the light load from the change of bottles? Of course I don't understand the arrangement.

Mr. Gilchrist—Well, the gain is to get rid of any inaccuracy which may occur by running a very light load on a very large meter.

Mr. Wirt—On the same shunt?

Mr. Gilchrist—Using the same shunt, yes.

Mr. Wirt—You have the same difference of potential then in the larger sized bottles?

Mr. Gilchrist—Not the same bottle shunt, no. We use different bott e shunts. It is to be applied especially in these new meters. We have not used them yet, but there is one being made up for us now. But ordinarily the ratio of the large circuit to the shunt circuit will be as much as exists in the No. 1 meter; that is the smallest meter, which will read down to one milligramme in the bottle. In the cases of very heavy loads it will be thrown on to this highest resistance shunt so that eight amperes on this main circuit will only read one milligramme in the bottle. We also get rid of any difficulty with oxide, which Mr. Wirt knows better than I can explain.

Mr. McFadden—I do not remember whether in reading his paper Mr. Gilchrist spoke about the thermostat. I would like to ask if the lamp was burning all the time if your current goes through the bottles.

Mr. Gilchrist—No, I did not mention the thermostat at all. It is hardly worth mentioning, to tell the truth. We have 3,000 meters out, and the first year we started we sent on an advance order for a dozen thermostats. I think we have four of them out, and the other eight are still at the station. But the current of the lamp does not register on the meter. That is the producer's loss. But it is set in such a way that the lamp only burns over a small portion of the time. Of course if it was in a very cold place, or if the weather was always as cold as at present, the probabilities are that the lamp would burn about half the time.

One Use for the Telephone.*

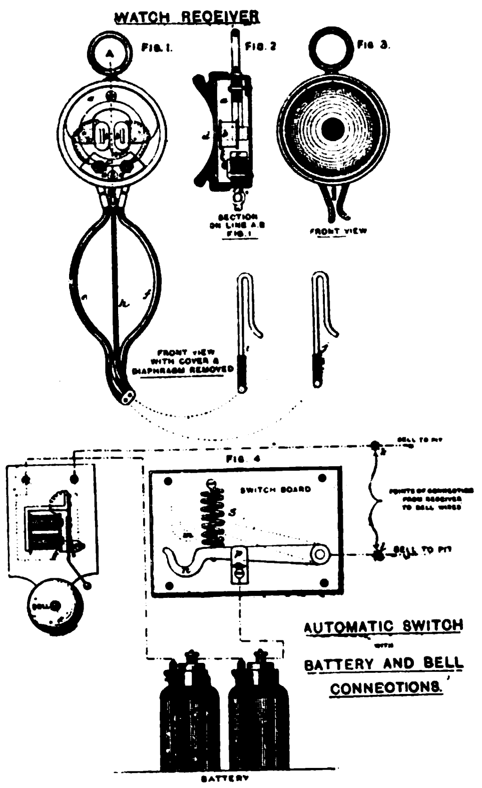
BY F. S. MARSH.

The writer had experienced some difficulty on several occasions in signalling in the usual way by electricity to the engine-driver on the surface when anything had temporarily gone wrong with the underground endless-rope haulage, owing to the fact that on the signal to stop being given, one of the many workpeople along the level not knowing anything was wrong, and sometimes for mischief, rang the signal to start. This happened more than once, with unpleasant consequences. The engine-driver, not knowing who was ringing the bell, of course acted on the signals received, and in the case of the rope being out of the balance wheel, train off the road, or like mishaps, much damage was soon the result. No code of signals the writer could devise would deal with this difficulty, and as anyone along the level could give the signal to start, the engine-driver never knew who gave it, or if anyone was tampering with and making at such time a dangerous use of it.

The only satisfactory solution of the difficulty could be found in a system of signals whereby anyone along the level could signal "stop" in case of accident, but only one man could give the word to start. This, it will be readily seen, is met by the use of the telephone. An occasion arising for stopping the engine, the ordinary code signal "one" is given, followed immediately by a prearranged signal (which all working on the road should know), say ten strokes of the bell; on receiving this signal the engine-driver, who has stopped the engine, takes the telephone off its hook and listens for instructions from the only man who, carrying the transmitter, can give them; he is told what is wrong, and he now knows exactly what he is about, and what is of equal importance, the men below know that it is safe for them to do anything about either wheels, trams, ropes, or other gearing, no matter how they may be entangled. When all is right the engine-driver is acquainted with the fact and told he is about to have the signal to start; he then replaces the receiver on its hook and waits for the signal, after receiving which he goes on with his work, taking instructions by the authorized code. There is here no possibility of mistaking signals, and all work with a sense of security unknown when using code signals alone. There are reasons why an automatic switch is necessary. Were the telephones below ground connected to the signal wires while the battery is on circuit the magnet would be injured, and were it other than automatic the engine-driver might forget to turn the switch; directly the circuit is closed by removing the telephone from its hook no code signal can be given, so the annoyance of continuous ringing is effectually stopped. Replacing the instrument on its hook at once brings the ordinary signals into use again.

Another useful purpose served by the automatic switch is that on removing the telephone (when work for the day ceases), and letting it hang by its suspension cord (provided to preserve the insulated wires from injury), the electric circuit being closed, the battery power is saved. This can, of course, be equally well effected by taking out one of the battery zincs, and in other ways.

For some purposes it is convenient at times for several persons to carry with them a transmitter. Deputies, who in case of serious personal injury to workpeople, can telephone for the stretcher, thereby gaining in many cases, depending on distance, half an hour or more time in removing the injured and obtaining medical advice. Where rope splicing is being done, or ropes are being changed, it is often a gain in time when direct communication can be maintained with the surface or any intermediate point; for it must be remembered that two telephones may be hooked on to the ordinary naked wires at any point along the line of wires, the only additional arrangement necessary being predetermined parts of the road where the person using the instrument must listen, and the battery being off there can be no call bell used. Other uses, depending on local circumstances in any particular mine, may make the telephone a valuable adjunct.


WATCH RECEIVER
FIG. 1.
FIG. 2
FIG. 3.
A
d
SECTION ON LINE A.B FIG. 1
FRONT VIEW
e
h
f
FRONT VIEW WITH COVER & DIAPHRAGM REMOVED
FIG. 4
SWITCH BOARD
S
m
n
p
BELL TO PIT
POINTS OF CONNECTION FROM RECEIVER TO BELL WIRES
BELL TO PIT
BELL
AUTOMATIC SWITCH WITH BATTERY AND BELL CONNEOTIONS.
BATTERY

The instrument selected by the writer, chiefly on account of its portability, is the "Watch receiver" (answering equally well as a transmitter), which is a modification of the Bell telephone. Fig. 1 shows a front view of the instrument, with cover and diaphragm removed, in which *a* is a horseshoe magnet, *b b* are the bobbins wound with silk-covered wire, *c* insulating material, *d* (Fig. 2) the diaphragm of thin ferrotype iron; *e* and *f* insulated wires from the two poles of the magnets secured by the binding screws, G G, and joining in a twin cable at the end of the suspending cord, *h*. The twin cable, 24 inches long, is provided with two brass hooks, *i j*, on the instrument for underground use. For connecting on to the ordinary signalling wires it is immaterial which hook goes on which wire. An arrangement of an automatic switch for use in the engine-house is shown in Fig. 4. The cable terminals are joined permanently to the ordinary signal wires at *k l* on the pit side of the switch, which is shown by dotted lines in closed circuit, *m*, and in open circuit at *n*—that is, when the weight of the telephone, adjusted to overcome the tension of the spring, S, brings the hook in electrical contact at *p*. The receiver for use below ground is best carried in a leather bag, large enough to hold the cable attached (24 inches), all of which will go in the waistcoat pocket, and as it weighs under half a pound it is no inconvenience.

The telephone, arranged as described, has now been in use at the Birch Coppice Colliery for several months on three separate roads, roughly, 1, 1¼, and 2 miles long respectively, and has answered very well. With long lines it might be necessary to use a microphone, but the "Watch" or "Ader" modifications of the "Bell" telephone, answer all ordinary requirements. Whilst not claiming this as the best system in all cases for signalling, it may be suggested as one use for the telephone.

---

* Paper read before the Chesterfield and Midland Counties (England) Institution of Engineers.

An Open Letter

To Mr. W. J. Jenks, Electrical Expert of the General Electric Company

And Inferentially to the Editors of the "Electrical Engineer."*

Most Learned and Erudite Seniors:

A "volt-ampere" does include the unit of time, because an ampere is defined as a "coulomb per second," the coulomb being the unit of quantity. A "volt-ampere" is then the rate of dissipation of energy when one ampere flows under a pressure of one volt, or ten amperes under a pressure of one-tenth of a volt, or one-tenth ampere under a pressure of ten volts; in other words, it is the rate—one "coulomb per second" under one volt, or ten "coulombs per second" under one-tenth of a volt.

To use a hydraulic analogy: Imagine the rate of flow of water denoted by one gallon per second to be called a "galpere"; then an ampere is equivalent to a galpere, and a volt-ampere is the same as a galpere under a pressure of, say, one inch of water, or an "inch galpere."

A kilowatt hour, or say a "watt hour," is then a "volt-ampere hour"; i. e., a "volt-coulomb-per-second hour," i. e., 3,600 "volt-coulombs," or 3,600 "joules"; in the hydraulic analogy it is an "inch-galpere hour"; i. e., 3,600 "inch-gallon-per-second" seconds, i. e., 3,600 "inch gallons." An "inch-gallon" means one gallon under one inch pressure or ten gallons under one-tenth of an inch, and has no relation to time; it may be the work done in a minute or a year.

"Foot pound" in the same way is not a rate, nor is "horse-power hour"; the latter does *not* "indicate work done at a definite rate per second and also for a definite time"; it represents work done at *any* arbitrary rate for such a time that the product of the rate by the time is equal to 33,000 × 60 foot lbs.

The statement that "amperes represent simply and only the number of volts expended in each ohm of resistance" is only partly true; it is purely a numerical relation depending on our system of units and by no means necessarily true; it is not even true with our units in case of a circuit with counter-electromotive force, e. g., an ordinary motor circuit. The amount of coal burned under a boiler is proportional to the "watt hours"; the size of the boiler is proportional to watts.

Mr. Jenks's error seems to arise from his confusion of the meaning of "ampere hour" or "watt hour"; he considers an "ampere hour" to be exactly one ampere flowing for one hour, and apparently has no conception of the fact that it may be made up by *any* rate and the corresponding time.

We recommend to Mr. Jenks and the editors of the *Electrical Engineer* a little book by Swinburne on electrical units.

A BEGINNER.

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* See communication from Mr. W. J. Jenks in the *Electrical Engineer* of February 15, page 171.

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"Electricity," under its present ownership, has never solicited the advertising patronage of the General Electric Company.

Municipal Electric Light Stations.

One of the results of the recent large number of combinations among city lighting plants has been to revive the question of municipal ownership of the so-called "natural monopolies," and the adoption of this policy is warmly advocated by many who are otherwise opposed to the nationalistic idea of a Government industrial enterprise.

Natural monopolies may be broadly defined as those industries which are based upon franchises and thus practically excluded from competition. Corporations operating under these conditions enjoy special privileges the abuse of which in some cases has led to a demand for municipal plants that may in time seriously affect the electric lighting industry.

However effective such a remedy may prove in avoiding the extortionate prices of a corporation, the objections to municipal business enterprises are too apparent to be ignored, and, leaving aside for the present the economic principles involved, it may be reasonably questioned if municipal plants reduce the ultimate cost of lighting to the public.

A few statistics regarding the cost of municipal lights have been compiled and are largely quoted by the advocates of this policy in proof of the claim that municipal plants furnish lights at a figure far below that charged by private companies. To any one familiar with central station work, however, these figures will appear manifestly absurd, as it is obvious that in some cases the most important items of expense are not charged against the plants.

Some of these figures have recently been tabulated by a writer in the *Review of Reviews* who finds the average cost per lamp per year in twenty-three municipal stations is $53.04; to this the writer adds $33.60 per lamp to cover the interest on the investment and depreciation of the plant, making a total of $86.64 per lamp. In the same article the average price per lamp furnished by private companies is given as $106.01, and these figures, if verified, would prove a strong argument in favor of municipal proprietorship. The fallacy in this comparison lies not only in the small number of plants considered but in the total lack of accuracy in the data supplied, which becomes apparent when we consider a few of the cases noted.

Bay City, Mich., is quoted as furnishing lights during the year '89-'90 at $58.00 per year each, while the actual figure is $104.00 as it was ascertained by Mr. Francisco, who made a report on this subject to the National Electric Light Association in August, 1890, that the items of taxes, water rates, interest and depreciation were not included in the estimate, and this service was based upon the moonlight schedule. The taxes and water rates are properly included in the cost of municipal supply, as this income would be received by the city if the plant were operated by private parties.

The city of Bangor, Maine, is quoted as running municipal lights at $45 per year each, yet the facts are that the actual cost is a little over $100 each, and that too in a station that uses water power all but a few weeks during the year.

In Ypsilanti, Mich., the price per lamp is given at $23.60, which has been found to be underestimated by $48.40, as it costs this city $72 per lamp to run eighteen nights a month up to midnight only.

Topeka, Kan., and Lewiston, Maine, are reported with equal inaccuracy concerning the cost of their lights, and further, Mr. Francisco has found that even taking the figures furnished by the city officials on the cost of operating municipal plants, the average of fifty cities was $119.24 per lamp per year while the average charge of three hundred and sixty-five private concerns for lamps was $118; so, without considering the peculiar methods of municipal bookkeeping, of which the above figures are samples, municipal ownership does not appear to have proved the success that is claimed for it. Besides this, however, there are other objections which make it desirable to look in some other direction for the solution of the street lighting question.

* * *

"The Birds, the Beasts and the Bat."

The *Electrical Engineer*, which for several weeks has seemed to be in great doubt as to which side it will pay better to take, would do well to read and reflect over the old fable of "The Birds, the Beasts and the Bat." We print it here for the convenience of our wavering contemporary:

> "The Birds waged war with the Beasts, and each party were in turn the conquerors. A Bat, fearing the uncertain issues of the fight, always betook himself to that side which was the strongest. When peace was proclaimed his deceitful conduct was apparent to both the combatants; therefore being condemned by each for his treachery, he was driven forth from the light of day, and henceforth concealed himself in dark hiding places, flying always alone and at night."

Moral: Choose your side, and stick to it.

* * *

In the Right Direction.

The appointment of Mr. Fremont Wilson as consulting engineer to the Suburban Underwriters' Association, noted in another column, is a step in the right direction concerning the insurance regulations for buildings containing electrical equipments. As the fire risk on the buildings is conceded to be a safe one where the installation is *first class*, the establishment of suitable rules and the appointment of a competent man to see them enforced will be of benefit to both the underwriters and the owners in securing a high grade of work. A reduction in the rates now often demanded would naturally follow if this system were rigidly adhered to.

* * *

IT IS pertinent to ask, what have the *Electrical World* and the *Electrical Engineer* done to avert the disaster which has overtaken the independent interests in the trade?

* * *

NOTWITHSTANDING the splendid programme arranged for the St. Louis Convention, the meeting will be very like a funeral procession.

The Situation up to Date.

It has been our aim to present from week to week a fair and reasonable view of the situation as it was at the time. We have made few prophecies, but have stated a great many facts. Many of our statements of fact have been denied, or treated lightly, by those who either thought they knew better or were blinded by false hopes. But the man or newspaper that is RIGHT can afford to wait. Vindication follows doubt as surely as the night the day.

The statement of facts is sometimes an unpleasant duty. For our contemporaries it has proved an impossible task.

But even at the sacrifice of popularity, Electricity will continue to state the facts, as we believe them to be, after a careful and painstaking survey of the field and with *unequalled sources of information.*

The defeat of the Beacon Company is a blow to the independent manufacturing and selling interests which should not be underestimated. It has given a new lease of life to monopoly, and a new vigor to the campaign of extinction. The selling of a few lamps now and then to competing plants is simply a matter of policy, and no one should be fooled by it. The *intention* of the Trust to drive all others out of business cannot be doubted. Their *power* to do so is increased a hundredfold by the result of the Beacon suit.

The actual existence of supply men, builders of dynamos, wire manufacturers, contractors—in fact the whole range of outside interests—is in imminent danger. The contractors will be perhaps the first to suffer. The supply men in New York and Chicago, and some other large cities, have held that the Trust must maintain business relations with at least one house in each of these towns. This theory is utterly fallacious. The Electric Trust is not built upon such silly ideas. They want ALL the business, and will have absolutely no use for an intermediary supply house to divide profits. Central station men, if the Trust succeeds, will not be free agents. They will buy of their masters, not a part, but ALL of their supplies, and at the price which their masters make. The experience of the past six months has proved that the Central Station men will not yield their independence willingly; the experience of the next six months is very likely to prove that hundreds of them *must yield.*

The makers of dynamos will find few customers with nerve enough to buy their machines in the face of threatened patent suits and the probability that lamp orders will not be filled in six months.

But it is useless to go over the list of those who will find their occupation gone before the year is over, if the Trust is able to carry out its plans. The list of the interests which will not be crippled would be much shorter.

This is not an encouraging prospect for the independent concerns. But it is TRUTH.

Is there any hope, any means of averting the gradual paralysis of business?

The first and most welcome would be that the Trust should fall of its own weight. This is not impossible, but it is improbable for many months to come. The Trust will not go to pieces while it can raise money almost without limit to put into its business; meantime its obligations are piling up, and nothing less than a monopoly of all the business, with at least a doubled percentage of profits, will carry it through. The wreck of the Whiskey Trust, the Book Trust, and the Reading Combine, however, in the last few weeks, gives an entirely reasonable ground for hope that the Electric Trust will meet a like fate. The prospects of the Reading combination sixty days ago were considered by shrewd financiers as infinitely brighter than those of the Electric Trust.

There have been during the past week many unpleasant rumors in regard to the inability of some of the gentlemen high in the councils of the Trust to meet their financial obligations. And there is good reason for believing that the Electric Trust will sooner or later meet the fate of other iniquitous organizations built on the twin ideas of monopoly and extortion.

New lamps, which do not infringe the Edison patent, will come without question. But it may take many months. The new Westinghouse lamp affords a measure of relief, but cannot for some time be supplied rapidly enough. The closing of all other outside lamp factories will diminish the total output by 20,000 lamps a day.

This problem of a new lamp is engaging a great deal of the best thought of our scientific men, and must be solved.

One effective method would be a universal demand for an investigation of the Trust by a Congressional Committee. An investigation which would go back for a few years into the affairs of the Thomson-Houston Company would reveal much more than is generally known to the trade. Trust methods did not begin in 1892.

Every man in the trade can accomplish something in this direction. If you do not know your Congressman personally, you have friends who do. See to it that in some manner your Congressman learns the details of the situation. Let him understand that not only are the businesses of his constituents in danger, but that the people at large are confronted with an excessive and unwarranted charge for light, and that the whole organization of the Electric Trust is in defiance of the law.

Electricity has already suggested a combination for mutual defense in unjust patent suits. It is a suggestion which should be acted on.

Most effective of all methods of self-preservation is INDIVIDUAL HUSTLING, bearing in mind that the rivalries and jealousies of smaller concerns should all be buried in the face of the attack of a common enemy.

The first requisite for intelligent and well-directed effort is a realizing sense of the actual condition of affairs. Do not chase the delusive phantom of hope; do not listen to the palaver of the enemy who makes soft and honeyed statements in the public print while plotting your destruction in secret council. *Cultivate your memories.* Bear in mind the career of the Boston squeezers previous to the past year. Remember the reasons for and the methods of the absorption of the Brush, the Schuyler, the Fort Wayne, the Excelsior, the Van Depoele, the Jenney, the Bentley-Knight, and the Short Companies; the fate which has overtaken most of them, and the present opinions of the original stockholders.

When you have arrived at a full conception of the TRUTH—that the Trust means to drive you out of business, or to commit the equal offense of buying a controlling interest in your concern in order to lay you on the shelf—to rid itself of your competition—then you will be in fighting trim, and with the aid of Electricity will fight a winning battle.

* * *

It is the duty and pleasure of every fair-minded journal to print communications from its constituency whenever these communications are of common interest. It is also the duty and pleasure of every fair-minded editor to see to it that none of his contributors makes himself appear silly.

* * *

If the city of Detroit agrees to purchase the present lighting station in that city, owned by the Trust, the experiment of a municipal plant will be foredoomed to failure. Mr. McDonald is a sly and resourceful man; and the only way for Detroit to beat the Trust is to *leave them alone!*

* * *

The clergy of Central New York (round about Syracuse) who are investing church funds in electric securities would do well to take heed before it is too late. The voice of sound judgment should outweigh that of the plausible district agent.

* * *

The business man who does not know when his business is in jeopardy is an easy victim.

* * *

Scores of the smaller manufacturers and supply men will endeavor to wake up after their business is dead and buried.

* * *

It has been decided that the officers, committees, and Association members of different grades shall wear badges of various bright colors at the Convention, for convenience sake. Supply men and smaller manufacturers could with perfect propriety wear crape.

* * *

The backbone of all previous convention gatherings has been the supply and manufacturing interests. What can they accomplish by gathering at St. Louis next week? This question may be answered during the Convention, and we earnestly urge every independent concern, as well as every central station man who wishes to preserve an open market in which to purchase his supplies, to be on deck.

* * *

"Right forever on the scaffold,
Wrong forever on the throne;
Yet that scaffold guides the future,
And behind the great unknown
Standeth One within the shadow,
Keeping watch above His own."

He Seeks a Wider Field.

Plausible Excuse for Mr. Coffin's Expected Resignation.

This corporation (General Electric) is one of the industrials which interest Wall Street and speculators and investors elsewhere. A splendid money-making future was predicted for it, and yet only twelve months after its organization Mr. Coffin is tempted to go elsewhere. Of course he does it because he sees more money somewhere else.

The plan, as I understand it, is to create a great corporation with many millions of capital, which shall take advantage of the mighty development of electric railways which seems to be spreading throughout the country with a rapidity unequaled even by the development of steam railways or the telegraph in the early years of their establishment.

As I have heard the plan it looks something like that favorite corporation of Henry Villard's, known as the North American Company, which had so dismal an experience, and which was created as a sort of middle-man to aid railway companies in construction and in all sorts of development. This proposed new organization seeks to do the same thing for electric railways all over the United States.

Mr. Coffin must have faith in it, and so must that group of capitalists who are discussing this matter with him, and yet there are shrewd men here who are inclined to think that the various companies now engaged in this prodigious development of electric railways are most of them entirely able to take care of themselves without the aid of any middle-man. It is suspected that behind the apparent scheme is one which has for its object the ultimate consolidation of the electric railway systems of the country, just as the various telegraph companies were ultimately merged into one gigantic monopoly with $100,000.000 capital.

The organization, I understand, is not yet completed, but it must have been well developed to justify the report coming from good sources. as it does, that Mr. Coffin is to seek an even greater field than the one which he now controls.
—*Philadelphia Press*, February 11.

Mr. Barton's Backbone.

Mayor Pingree of Detroit has received the following letter in regard to the Wyandotte electric fight from the Western Electric Company of Chicago:

Dear Sir: Your telegram of this date, advising us not to "weaken on our contract with the Wyandotte," duly received.

Indirect effort has been made to have us default on our contract with the city of Wyandotte, the reason for which is not clear to us, unless it is thought that it may possibly influence the action of your city on the lighting question.

When we execute a contract we aim to carry it out to the letter, and we assuredly will not make any such exception in the case of Wyandotte.

Western Electric Company.

President Ayer has Changed his Mind.

He Will Not be Able to Keep Down Discussion of the Lamp Question.

[*From the St. Louis Post-Dispatch.*]

There is no doubt that the burning issue before the Association will be the incandescent lamp question. President Ayer at first thought that he might be able to keep it down, but it is understood that he has changed his mind. He has requested one of the best known electricians in the country to prepare a paper on the subject, covering the ground exhaustively as between the rival companies, and embracing also a consideration of the equities of the case and the moral rights of the public in the matter. This paper will alone make the session of the Association here historic.

The Electric Selector and Signal Company.

With the assent of ninety-nine per cent. of the stock and bond holders of the Electric Secret Service Company, all of the property, patents, business and good will of that company were sold by C. P. Mackie, receiver, on February 11, 1893, to the Electric Selector and Signal Company.

This new corporation has likewise acquired other important inventions relating to the general subject of electrical selections, and proposes to develop this especial business as applied to telegraphs, block signals, electric light and power and telephones in this country and abroad on a larger scale than the company which it succeeds. The change has been effected without interruption of the business of the Electric Secret Service Company, and upon terms which provide for a settlement of all that company's obligations in full in cash. The Electric Selector and Signal Company will, we understand, have the same technical management as the Electric Secret Service Company, although its Board of Directors will contain several new and influential names.

The Electric Selector and Signal Company will have an exhibit at the St. Louis Convention that should be peculiarly interesting to all electric light men. This exhibit will consist of the company's system of selective arc light and motor cut-outs. Some new devices have lately been added to the system which materially simplify the operation of the cut-outs; these will be shown for the first time to the electrical profession at the Convention.

The company will be represented at St. Louis by Messrs. C. P. Mackie, Robb Mackie, S. S. Bogart and Herbert Laws Webb.

Tests on the Budapest Electric Railway.

A German exchange gives the following figures concerning the reports of some tests made on the Budapest Railway:

	No. of Experiment.			
	1	2	3	4
Weight of car (tons)	4.13	4.13	4.13	4.13
Load (tons)	2.40	2.40	0.37	0.37
Total weight of car (tons)	6.53	6.53	4.50	4.50
No. of driven axles	2	1	2	2
Length of trip in yards	34.0	34.0	32.8	32.8
Incline	level	level	1 in 18.95	1 in 10.42
Time of trip in seconds	51	50	8	14
Speed, miles an hour	13.7	13.95	8.37	4.77
Revolutions per minute of motor.	549	560	337	192
Volts	282.5	285	266	260
Amperes	26.0	24.5	54 0	68.0
Watts	7,345	6,982	14,364	17,680
Elec. energy used, E. H. P	9.85	9.35	19.25	23.70
Tractive force, lbs. per ton.				
On the horizontal	33.6	33.6	33.6	33.6
On the inclines	......	......	118.2	215
Total tractive force lbs	33.6 x 6.53 =219.0	219.0	(33.6+118.2) x4.5=683.0	(33.6+215) x4.5=1120.0
Mechanical horse power	8.14	8.29	15.27	14.30
Efficiency: $\frac{\text{Mech. H. P.}}{\text{El. H. P.}} \times 100$	82.57 p. c.	88.62 p. c.	79.41 p. c.	60.37 p. c.
Losses by friction of gearing, etc., and conversion of energy	17.43 p. c.	11.38 p. c.	20.59 p. c.	39.63 p. c.

The report further states that one of the cases in which electric traction is applicable while horse power is out of the question is that in which steep inclines have to be surmounted; and another case is that in which high speeds are required. Owing to the comparatively great weight of the electric car and its machinery the adhesion of the wheels to the rails is greater and should enable considerable inclines to be easily surmounted. In order to experiment on this subject a trial line was constructed, with inclines of 1 in 10 and 1 in 19, on which trial runs were made, which proved that even inclines of 1 in 10.42 can be easily surmounted, so that in very steep lines the difficulty of the brake would be greater than that of climbing the grade.

All experiments were carried out at night, in order that the fluctuations of pressure due to the working of the line might be avoided. The car was always started outside the trial line proper. Every set of observations is the mean of a series. The car with which the experiments were conducted was an ordinary car of the Budapest Electric Tramway Company, with simple chain gearing of 11.31 from the motor to the axle. As the motor was not sufficiently strong to carry the fully loaded car up the steep inclines, the experiments on these parts of the road were done with a smaller load. The efficiency dropped while ascending the hill owing to the speed of the motor being so low.

These experiments go to show that the electric car is capable of working on lines where the steepness of the inclines would render horse traction out of the question.

Carbon Filaments.

An exchange gives the following process which is employed in the manufacture of incandescent lamp filaments by the Societé Anonyme des Lamps à Incandescence, Budapest:

A cotton or silk filament is used which is impregnated with the following mixture: Silicate of potass, 25 to 30 per cent.; Senegal gum, 10 to 15 per cent.; caustic soda, 12 to 13 per cent. The filament is compressed in the form of a sharp prism, the edges being found to radiate more than the facets. It is then carbonized and flashed; but instead of employing a carbide liquid or gas, the Budapest Company use a solid carbide, such as naphthaline or paraffin wax, which liquefies only in the vicinity of the filament, and assures a very regular layer of carbon. The filaments are prepared of any desired resistance before their introduction into the bulb.

ELECTRICAL COMPANY ELECTIONS.

The Sacramento Electric Power and Light Company, Sacramento, Cal. President, Albert Gallatin; treasurer and general manager, Horatio F. Livermore: secretary, Joshua Barker; directors, Albert Gallatin, A. J. Ralston, Horatio P. Livermore, Charles E. Livermore, Joshua Barker.

Central New York Telephone and Telegraph Company, Utica, N. Y. President, R. S. Williams; vice-president, L. H. Lawrence; secretary and treasurer, F. G. Wood; general manager, C. A. Nicholson; directors, Martin A. Knapp, Syracuse; David B. Parker, New York; A. Cadwell Belden, Syracuse; Charles A. Nicholson, Robert S. Williams, Lewis H. Lawrence and Francis G. Wood, Utica.

The Washington, Alexandria and Mt. Vernon Electric Railway Company, Alexandria, Va. President, G. E. Abbott; vice-president, F. A. Reed; secretary, H. K. Hipple; treasurer, D. C. Leech; superintendent, W.H. Cooper; directors, G. E. Abbott, F. A. Reed, H. K. Hipple, D. C. Leech, Park Agnew, J. S. Schwartz, and J. R. Caton.

Merchants' Co-Operative Electric Light Company, Kansas City, Mo. President, Charles H. Simms; treasurer, C. S. Squires; secretary, John C. Conkey.

The following have been elected directors of the Bell Telephone Company: Henry Altman, Philo D. Beard, Benjamin E. Chase, Daniel H. Cowles, Edward J. Hall, John E. Hudson, Harlow C. Palmer, David B. Parker, Thomas T. Ramsdell, Sherman S. Rogers, Samuel S. Spaulding, Henry M. Watson, William H. Watson, George Weldon, John L. Williams.

Holmes Electric Protection Company, Toronto, Can. President, Thos. G. Blackstock; vice-president, J. R. Wood; secretary-treasurer, A. S. Wigmore; directors, W. B. McMurrich, L. K. Cameron, F. A. Ritchie, B. Jennings and A. S. Wigmore.

Waynesboro Electric Light and Power Company, Waynesboro, Pa. Treasurer, W. T. Omwake; directors, John J. Miller, F. Forthman, Daniel Hoover, E. W. Washabaugh, J. F. Zullinger, E. Elden, W. H. Brown.

Legal Notes.

In the suit of the Thomson-Houston Electric Company vs. the Little Rock (Ark.) City Electric Street Railway, on the application for a receiver for the latter company, the railway company has filed its answer in the Chancellor's Court at Little Rock denying its insolvency and asking for judgment for $50,000 alleged to be due it by the Thomson-Houston Company. The St. Louis Trust Company, holders of $300,000 first mortgage bonds of the railway company, have withdrawn their intervention, and the National Bank of Commerce of St. Louis was made a party defendant. The legality of $200,000 income bonds of the railway, now held by the First National Bank, is security for moneys due. The bank's claim will be bitterly fought by the Thomson-Houston people, and evidence will be introduced to show that the road is fully worth a million dollars and is not responsible for $170,000 indebtedness alleged to be held by the Thomson-Houston Company in notes signed by the railway company payable to and indorsed by H. G. Allis and Geo. R. Brown.

On the 14th inst., after Judge McClure had finished his argument against the appointment of a receiver, Judge Rose, of counsel for plaintiff, asked the Chancellor to grant him until Thursday to prepare his reply. While granting the request, the court at the same time issued an order restraining the Thomson-Houston Company from negotiating any of the notes held by that company signed by the City Electric Street Railroad Company and indorsed by H. G. Allis president, and George R. Brown secretary.

The Robinson Radial Car Truck Company have entered suit in the United States Circuit Court at Boston against the West End Street Railway Company for infringement of their patent covering trucks now in general use by electric street railway companies. While the West End Company has been using fifty or more of the Robinson trucks for several years, having purchased them from the manufacturers, it is claimed by the plaintiffs that the West End Company has, without license or authority, built and put in operation within a few months about 100 trucks differing from the "Robinson Radial" in only a few minor details. The plaintiffs state that in November last the West End Company applied to the Robinson Company for a license to cover the alleged infringement, but their proposition was refused.

A legal question involving the rights of a telegraph line to trespass on private land, at Huntingdon, Pa., a few days ago, was decided by Judge Furst against the private property holders. The Postal Telegraph Company ran their line through the farm of Porter Skinner, in Dublin township. Viewers appointed by the court fixed the damages at $87 and costs. The telegraph company excepted to the report, alleging irregularities, and appealed from the assessment of damages. The whole proceedings were set aside by Judge Furst, requiring Skinner to pay costs. It was shown that the material damage was so slight as not to warrant action at law, as the use of the highway and the private land was not interfered with. A large number of similar cases in the county against the telegraph company have been abandoned.

Important Decision in England.

Ex-Congressman John S. Wise and O. T. Crosby, who were called to London some weeks ago as experts in the suit of the National Telephone Company of Great Britain vs. the Leeds Tramway Company, have arrived in this city, the Tramway Company, in whose interest these gentlemen testified, having won the suit.

The question at issue was whether the Tramway Company, whose wires worked injury to the wires of the Telephone Company, should not be restrained.

The English counsel had collected a mass of evidence showing that the tramway wires did not seriously injure those of the Telephone Company. Mr. Wise advised that all this testimony was irrelevant, and that the proper position to take was to admit the serious injury, but to claim equal rights to the earth with the Telephone Company. His advice was taken, and the court, Mr. Justice Kekewick, sustained Mr. Wise's contention.

Two Large Contracts

Which the Trust Did not Get.

The Traction Company of Philadelphia have closed a contract for the electrical equipment of the various lines in that city with the Westinghouse Company. The first shipment will include 300 car equipments and six 500 H. P. generators.

The contract for the Lindell road in St. Louis has also gone to the Westinghouse Company. Three 700 H. P. generators and 100 car equipments will be the first instalment.

A Municipal Plant.

The city of Marshall, Michigan, has purchased the splendid water power at that point and is installing an electric lighting plant which is to be of the most improved construction and will be used for public lighting purposes. Power will be rented to manufacturers for use during the day. This will prove an economical arrangement both for the city and those seeking cheap and reliable power.

Electrolytic Bleaching.

The purification of starch of an inferior quality by an electric process has been found so effective that the starch so treated is superior to that formerly known as the first quality and is sold for a higher price than the latter. The manufacturers of starch who adopted this process are quoted as saying that in the first year of its operation the plant paid about three times its value by the saving in expense of operation over the old method.

World's Fair Notes.

The first consignment of storage-batteries for the Electric Launch and Navigation Company arrived on last Tuesday and consisted of two car loads, containing 1,800 cells of Julien batteries. The fifty boats of the company are practically completed and will be shipped to the Fair grounds within a few days. As soon as the sheds back of the Agriculture Building are completed the work of placing the batteries in the boats will be commenced. All the interior wiring was done as the boats were being built and the motors will be placed in them before they are shipped.

Part of the iron frame work for the Westinghouse 10,000 light machines, consisting of six car loads, has arrived on the grounds and is ready to be unloaded in the Machinery Hall. These machines are to be used not only for exhibiting purposes but are also to take part in the lighting of a large number of the buildings. The carpenters and structural iron workers have already begun the erection of the switchboard frame which is to compose part of the Westinghouse exhibit. The switchboard is to be one of the finest and largest that have ever been erected in this country.

The Standard Electric Company of Chicago have also shipped ten of their large arc light machines to Machinery Hall, where sheds are being erected for their protection till such time as they can safely be placed in position.

The firm of Agnew & Company, contractors, are just completing the erection of a number of thatforms, raised a few inches above the floor, for ple use of exhibitors in the Electricity Building.

The first machines to be placed on the floor of the Electricity Building for exhibition purposes were five arc light dynamos of the Thomson-Houston make and were shipped direct from the company's factory at Lynn.

The Western Electric Company were the next to follow with a number of their machines, both of the arc and incandescent type. These will be placed in position as soon as the company's booth, which is now being built, is finished.

The Eddy Electric Manufacturing Company have placed two of their 10 H. P. motors in the Electricity Building to operate two freight elevators which are to be used in carrying up the exhibits to the balcony.

General News.

What is Going on in the Electrical World.

Flandreau, Mont.—There is a demand here for an electric light plant.

Knoxville, Tenn.—The West End Street Car line is soon to dispense with its mules and adopt electricity.

Buffalo, N. Y.—The Buffalo and Tonawanda Electric Road has been purchased by a New York syndicate.

Wilson, N. C.—An electric light plant, costing $15,000, with a capacity of 500 lights, has just been installed here.

Columbia, S. C.—The electric railway is nearly completed, and the trolley cars will soon be speeding through the streets.

Jacksonville, Fla.—The Jacksonville Street Railroad Company has determined to equip its road with electricity without delay.

Baltimore.—The Edmonson Avenue street railway is to be converted into an electric line and will be extended to Powhatan.

Portsmouth, N. H.—A bill has been introduced in the Legislature granting a charter for an electric road from Portsmouth to York Beach.

Denton, Tex.—At a recent election, ordered by the city council, the vote in favor of introducing electric lights as against was overwhelming.

Oakland, Cal.—The Gas, Light and Heat Company has applied to the city trustees for a franchise to furnish electricity for light and power.

Waco, Tex.—The Waco Electric Light and Power Company has been legally authorized to dam the Brazos River at Waco for water power purposes.

Hartford.—H. T. Paiste of Philadelphia has entered suit against Messrs. Hart & Hegeman of this city for alleged infringement in the manufacture of switches.

New York.—Frank A. Delbentz has filed an application with the Attorney-General asking for the annulment of the charter of the Magnetic Telegraph Company of this city.

Saratoga, Cal.—A franchise has been granted Warren Olney, of San Francisco, for an electric road to connect Saratoga and San Jose. Work on the road will begin July 1.

Montgomery, Ala.—It is rumored that the Cloverdale Company is to be consolidated with the Terminal and that the road is to be equipped with electricity at an early date.

Red Bank, N. J.—George M. Lane and William E. Harrison have arranged for the purchase of the plant and real estate of the Red Bank Electrical Illuminating Company.

Altoona, Pa.—The east end people are taking measures to secure an extension of the electric railway to Pottsgrove Reservoir and thence to Juniata by way of the Red Bridge.

Frederick, Md.—An electric railway from Frederick to Middletown and thence to Boonsboro and Hagerstown is strongly advocated by the people living along the proposed line.

Toledo, Ohio—An effort is being made to have the Walbridge suburban electric road run from Maumee across to Perrysburg and return on the east side to Toledo, thus making a belt road.

Baton Rouge, La.—The electric street railway belt line is nearing completion, and it is predicted by the president of the company that the cars will be running before the 10th of March.

Poughkeepsie, N. Y.—The South Avenue Railroad Company has been granted a franchise for an electric railway in the town, and also one to build a similar road from here to New Hamburg.

Indianapolis, Ind.—R. I. McDonald, of Ft. Wayne, is to receive an answer on March 1 to his proposition to pay $500,000 for the franchise to the streets of the city now held by the Citizens' Company.

Portland, Ore.—There is talk of the city's disposing of the East Side electric light plant; it costs the city some $4,000 a year more than it would to have the lighting done by an electric company.

Worcester, Mass.—The Worcester Traction Company will soon petition the Board of Aldermen for a franchise for a new electric loop line to be operated in connection with the Chandler Street line.

Fort Collins, Col.—There is talk of utilizing the water power of the Cache la Poudre, at the Big and Little Narrows, to generate electricity for the use of Fort Collins, Loveland, Greeley and Berthoud.

Ellenville, N. Y.—The village trustees have applied to the Legislature to be empowered to raise money by bonding in sufficient amount to secure or erect a lighting plant in order to own and control its lights.

Wheeling, W. Va.—There is a movement on foot here looking to the establishment of an electric plant to be owned and operated by the city, and a petition is to be sent to the Legislature for its permission.

Dallas, Tex.—An electrical department has been added to the Texas Survey and Rating Bureau, and Henry Garrett, of Dallas, an engineer of reputation and experience, has been placed in charge as chief.

Pittsburg, Pa.—The Commercial Telegraphers' Association convention, held here last week, was an occasion of considerable interest, and will probably result beneficially for the numerous body immediately concerned.

Mansfield, Ohio.—The Citizens' Electric Street Railway Company has secured the right of way over several streets in the western part of the city, and will within a few weeks begin work on an extension of their track.

Hightstown, N. J.—The council has passed an ordinance granting to Lane & Harrison, of Asbury Park, the right to form an electric light company in Hightstown, and giving them the necessary franchise for a plant.

Englewood, N. J.—A company has been formed by Mr. A. G. Fischer to start an electric light plant here. They contemplate supplying light for Harrington Park, Norwood, Closter, Cleveland on the Hill and Tenafly.

Valley Stream, L. I., N. Y.—A petition will be presented to the Hempstead Town Board at its next meeting asking that Valley Stream be made a street lighting district and the illumination be by means of electric lights.

Providence, R. I.—The Union Street Railroad Company will soon be reorganized, as a majority of the stock has been purchased by a syndicate who intend to equip the system with electricity. The old board of directors will resign.

Eugene, Ore.—An electric road across the steel bridge at Springfield is the object of a petition now in circulation here. If the franchise is granted, it is thought the proposed electric line from Eugene to Springfield will be built at once.

Camden, N. J.—The proposed electric railway between Camden and Woodbury is almost certain to be built, as the projectors are receiving much encouragement from property owners and are making progress in securing the right of way.

Woonsocket, R. I.—The result of the recent purchase of the Woonsocket Street Railroad will be a large increase of the capital stock, the extension of lines to Blackstone, Millville and Uxbridge and the equipment of the lines with electricity.

Elgin, Ill.—The Dundee Rapid Transit Company has secured the right of way for the railway line between Dundee and Carpenter. The line to Elgin will enter on Logan avenue and connect with either the Douglas or Dundee avenue line.

Gainesville, Tex.—Messrs. Griffin, Leonard and Briscoe have been appointed by the city council as a committee to ascertain to what extent an electric light plant would be patronized by private parties, and to derive ways and means to build the plant.

Scottdale, Pa.—President Miles of the company that proposes to build an electric railroad from this town to Bradford and Connellsville, has interested some Cleveland capitalists in the project, and it is now probable that the scheme will be pushed.

Jersey City, N. J.—A company to be known as the Central Electric Railroad Company is being organized for the purpose of building and operating an electric railroad in Jersey City to connect lower Jersey City with Greenville and Jersey City Heights.

Fort Lee, N. J.—The Ridgefield Township Committee has granted the extension of the right of way through the township to the Fort Lee Electric Railway Company. The company has been negotiating for the purchase of a large tract of land in the township.

Amherst, Mass.—Citizens of Amherst, Hadley, Belchertown and other towns in the county are signing a petition asking the Legislature to grant the petition of the Northampton Street Railway Company for authority to extend its lines from Northampton to Hadley and Amherst.

Wausau, Wis.—A franchise has been granted J. D. Ross, Walt Alexander, B. E. Jones and H. Dunfield to build an electrical railway through the principal streets of this city, work to begin on or before June 1. The territory embraced in the construction is about four miles.

Americus, Ga.—The Thomson-Houston Company, having become the owners of the street railroad, have offered to undertake to refit and operate the road if the citizens will undertake to secure certain privileges heretofore granted and give the road a certain guaranteed amount of patronage.

Montclair, N. J.—An electric railroad from Main street, Orange, to Montclair, with a branch running from West Orange to Eagle Rock, is to be built as soon as the weather will permit the work to be done. The terminus at Montclair will be at the Delaware, Lackawanna and Western Railroad station.

Leavenworth, Kan.—Arrangements have been completed for an electric railway between Fort Leavenworth and the Soldiers' Home.—The old "dummy" line is to be equipped with electricity, and for this purpose two carloads of electric railway material have been ordered from the Westinghouse Company at Pittsburg.

Brooklyn, N. Y.—The capital stock of the Traction Company has been increased from $3,000,000 to $9,000,000.—New electric lines will have the effect of reducing the rates to Coney Island, and it is thought probable that 15-cent round trips between Brooklyn and that popular pleasure resort will be made next summer.

Minneapolis, Minn.—Measures are being taken to consolidate the Water Power and Mill Company, the Water Works Company, the Electric Light Company and the Street Railway Company. The capital stock will be about $500,000. The Thomson-Houston Company will own the stock and control the consolidated concern.

Albany, N. Y.—A bill has been presented in the Legislature authorizing Sherman Petrie, of Kings County, to use the Erie Canal to experiment with the trolley electric system as a motive power for canal boats. The experiments are to be made at Mr. Petrie's expense, under the supervision of the State Superintendent of Public Works.

Spokane, Wash.—It is understood that the War Department has granted the Cœur d'Alene Electric Railway Company permission to cross the Fort Sherman land. This was the only obstacle to the building of the road, and operations will commence as soon as the snow goes. The motive power is to be obtained from the Spokane River and Post Falls.

Kansas City, Mo.—The city engineer has recently been at work on the specifications for the city's electric lighting plant. On the completion of his work of outlining the circuits and locating the lamps everything will be ready to receive bids.—The Merchants' Co-operative Electric Light Company have in view the building of a first-class electric light plant in Armourdale.

Marietta, Ohio.—The electric light plant owned by the city is advertised for sale. It cost $18,000 and has been in use three years. A syndicate has offered $15,000 for the plant for the purpose of establishing it at Devol's Dam on the Muskingam River, where there is abundance of water power for an electric plant of large capacity.—T. F. Davis, D. S. Milne, John Mills and W. J. Crane have asked permission of council to erect poles and string wires for electric lighting.

Newark, N. J.—The fortieth anniversary of Judge Gottfried Krueger's arrival in this country was celebrated on the 13th inst. by substituting electricity for horses on the South Orange street car line of which Judge Krueger is one of the largest stockholders. The first car that was sent over the line under the new system was named the "Judge Krueger," and it is said to be the handsomest and most costly street car in existence.

Norfolk, Va.—The people of this city are making a loud demand for electricity in the street-car service. The *Landmark* says: "It costs less to use electricity; it retires the poor animals from a killing service; it increases travel; it enhances safety and increases speed. All this necessarily adds to the profits of the business, and to the attractions of the locality in which the improved service is given. Give us electricity in our street cars, and do it quickly."

Detroit, Mich.—Frank A. Kirby, Neil McMillan and Fred A. Ballin, of the Detroit Dry Dock Engine Works, have formed a company called the Detroit and Belle Isle Electric Navigation Company. They intend to run a system of electric launches from the bridge approach on the American side, through the south canal to the Casino, and thence through the canals on the south side of the island to the upper end, around to the American shore, and back to the starting point.—Mayor Pingree, having been favorably impressed by the new Westinghouse lamp, will introduce the lamps into his factory, where he has an electric light plant sufficient for 1,000 lamps.

Philadelphia.—Chief Walker of the Electrical Bureau is in favor of the city owning and operating its electric light plant. The average cost of the electric lights at present is 44 cents for each lamp.—The *Record* says that "although the telephone patent issued to Alexander Bell in 1876 will expire on March 23, the Bell Telephone Company of Philadelphia does not expect to find any competitors in the field for ten and most probably seventeen years to come. The fact that Attorney-General Miller has filed a complaint in the United States Circuit Court at Boston against the American Bell Telephone Company and Emile Berliner has hardly disturbed the placid tranquillity of the local capitalists interested."

Boston Notes.

If one was to attempt to chronicle a tithe of the rumors current on Boston steeets day by day, having reference to the present and future prospects and the final destiny of the General Electric Company, this column would be unusually interesting reading. The briefest and most convincing summary of the situation is found in the daily stock market reports and the price for which General Electric can be bought to day as compared with the prices of three weeks ago. To the uninitiated even, the fact is patent that this stock, in the aggregate, is to-day less by several millions of dollars in value than a few months ago.

The sudden demand for the new Westinghouse lamp throughout New England is taxing the resources of the Boston office to the utmost, and nothing like even pace can be kept up with the incoming orders.

A corporation known as the Electric Brake Company, having its headquarters in Salem, Mass., has recently appointed its officers and will at once proceed to place on the market a device invented by Mr. W. Y. Ober, of Lynn, which it is claimed will perform the same service as the Westinghouse Air Brake on trains, Ober's device, however, being operated by electricity.

Electricity is to play a prominent part in future in the manufacture of bleaching powders. The Chemical Association of Rumford Falls, Me., which manufactures such powder on a large scale, has ordered a large generator for the purpose from the General Electric Company. It would be of 200 H. P., 140 volts and 1,400 amperes. This voltage it is estimated will be just sufficient to overcome the resistance where current flows while the amperage is such as to give heat sufficient to decompose common salt, from which chlorine is obtained.

Many large contracts are being booked by Boston electrical firms, both for installations in the city and in the surrounding towns. The Mather Electric Company is particularly fortunate in securing many of these contracts, so that it is enjoying a veritable boom. The company has never before done such a volume of business.

Quite a number of Boston gentlemen engaged in the electrical business are laying out their plans for a trip to the forthcoming Convention of the National Electric Light Association at St. Louis. The journey is a long one, but the Hubites don't consider distance when they are going to see friends or going for business. There will be quite a Boston contingent, so that it goes without saying that the approaching Convention will not be lacking in those characteristics of intellectual refinement and "culchar" which are sure to be around when men of "light and leading" from the modern Athens are on deck.

Beginning with the present issue of our journal there will be found in our advertising columns something interesting about new devices that will be of value in the electrical field which have had their birth in Boston.

The New England Street Railway Company has just been incorporated under the laws of New Jersey, to acquire, improve, operate and sell street railway properties. The capital stock will be $5,000,000. This company practically owns already nearly all the electric street railways in New England outside a few of the largest cities.

Mr. L. S. Dumoulin, the widely known and accomplished electrical superintendent of the West End Railroad Company, Boston, has resigned his place to accept other lucrative appointments of a more private character, but will continue to act as consulting electrical engineer of the West End Railroad Company.

Mr. F. S. Pearson, chief-engineer of the West End Railroad Company, Boston, has resigned his responsible position, but will be retained as consulting engineer for the company. Mr. Pearson is the prime mover in the gigantic project for the purchase of the Nova Scotia coal fields.

The Riehle Bros. Testing Machine Company announce that, beginning April 1, Mr. J. R. Matlack, Jr., will act as its representative at the World's Columbian Exposition, Chicago, and can be found, previous to the opening of the Exposition, at the office of R. W. Hunt & Company, Rookery, Chicago.

Walker & Kepler.

Messrs. Walker & Kepler, who formerly represented the Edison Company in Philadelphia, have taken the agency for the Siemens & Halske Company, their territory embracing the eastern part of Pennsylvania and the State of Delaware. This firm has a great many friends in the trade, and we predict a large success for them in their enlarged field.

W. S. Chesley & Company.

The above firm, located at 24 Morris street, Jersey City, make the following announcement: "We make a specialty of repairing Street Railway Apparatus, also large Dynamos, Lamps, Motors and Converters. Armatures of any make rewound, new Commutators, &c. We have sixty horse power for testing purposes and facilities for turning out work promptly and at lower prices than the manufacturer.

"We buy and sell all kinds of apparatus. We are manufacturers' agents and can furnish new machines. Our second-hand machines are thoroughly overhauled, supplied with new wearing parts and are guaranteed to be as good as new. Complete plants erected. Prices low. *Write for anything wanted.*"

New England Enterprise.

Foremost among the electrical supply houses of New England stands the Pettingell-Andrews Company, whose extensive establishment occupies the Estes Block, 192-202 Summer street, Boston. Here in extensive warerooms is carried a large, varied, indeed complete, line of all conceivable electric light, power and railway supplies. Incorporated less than four years ago, the company has steadily grown and expanded until at the present time it does by far the largest business of its kind in New England.

Under the direct personal management of the four principal stockholders, Messrs. C. H. Price, president; C. B. Price, secretary; D. A. Andrews, treasurer, and D. A. Andrews, Jr., vice-president, an extensive business with a far-reaching connection has been built up, its capacious stores occupying the whole of two floors in the block aforementioned. Here nearly $50.000 worth of stock is carried right along, including the well-known high-grade specialties made by the following and other companies, whose sole New England agents they are: The Okonite Company, Siemens & Halske Electric Company, Interior Conduit and Insulation Company, Boston Electric Wire Company, Bryant Electric Company, and many other well-known firms.

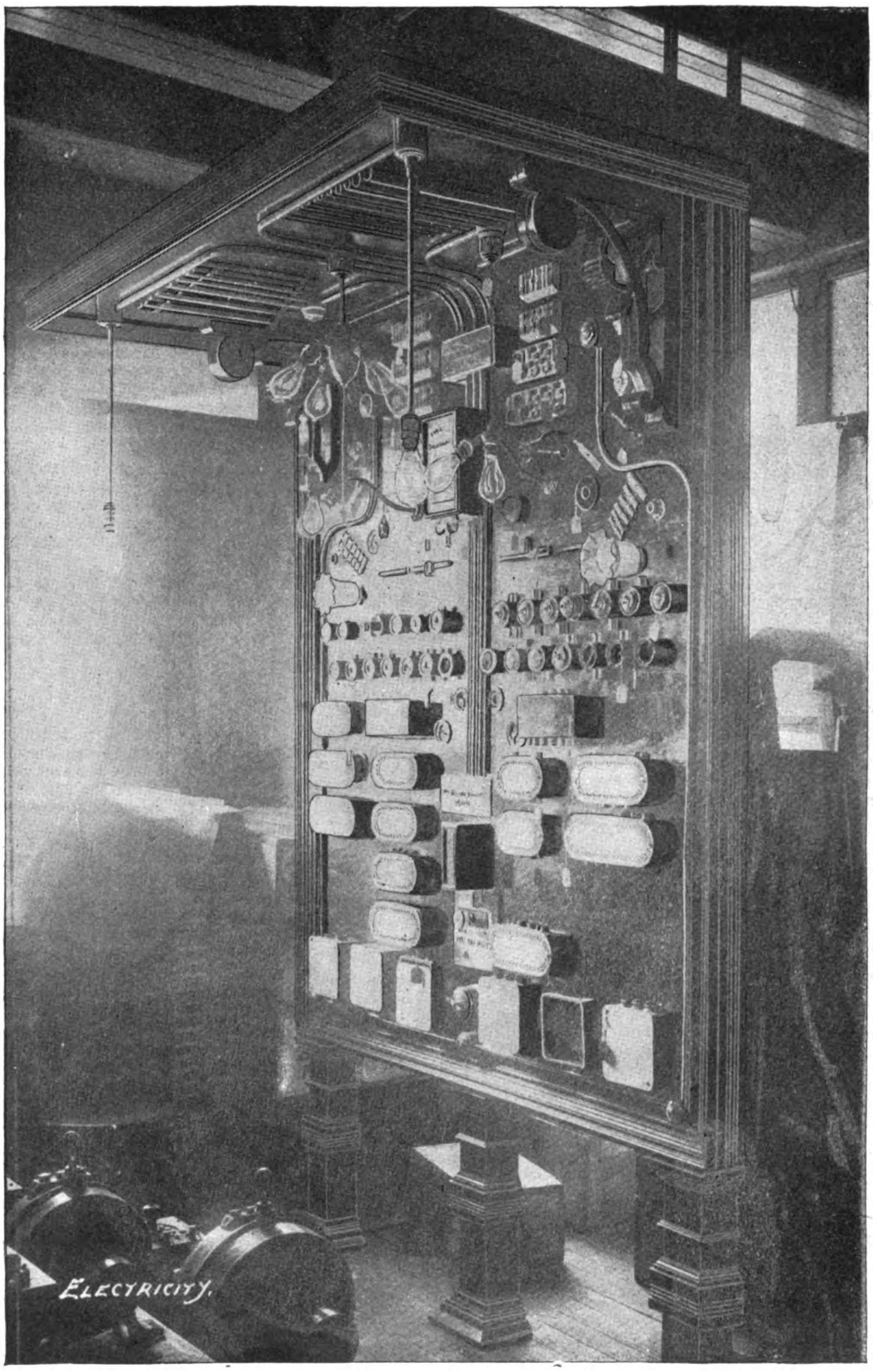

EXHIBIT BOARD, PETTINGELL-ANDREWS SUPPLY HOUSE, BOSTON.

The Pettingell-Andrews Company also handle large quantities of useful specialties of their own. Included on their list of patrons are the names of every light and power company throughout New England, while heavy shipments of goods are regularly made to distant parts of the country.

The accompanying cut shows an exhibit board in this mammoth establishment, on which are displayed every conceivable specialty manufactured by the Interior Conduit and Insulation Company of New York. There are various sizes of junction boxes, sections of the well-known interior conduit, with a notable variety of switches and cut-outs, all got up in different tints and colors to match the rest of the appointments in any room, hall, office or store. The entire board is wired up, having lamps connected in circuit so that quite a variety of illuminating effects can be produced, showing the merits of their manifold devices. The display is one of the most imposing and attractive that have been made by any manufacturing firm or supply house, and is quite a unique object in every respect.

But the Pettingell-Andrews Company does not simply handle supplies successfully. It has shown much enterprise in other directions, and its latest undertaking is to secure a franchise and contract to construct a new electric railway complete from Bellows Falls, the great paper-making centre, and Saxon's River, Vt. The track will be between five and six miles long, and equipped for both passenger and freight service, the entire electrical equipment to be of the Siemens-Halske type and make—overhead trolley system. This road will be not only the first electric railway in the State of Vermont, but will be the first Siemens-Halske road in New England, and the undertaking will be watched with great interest by the entire electrical fraternity. Construction will begin directly the frost is out of the ground. The company has several similar undertakings in view.

The Card Motor and Dynamo Company.

Some years ago an electrical manufacturing plant was started in the Queen City, and organized under the laws of Kentucky as the Card Electric Motor and Dynamo Company. Its progress was so apparent that a number of

Cincinnati's best known citizens purchased the same, and in January, 1892, incorporated it under the laws of Ohio, making the company a full fledged Ohio concern and entitled to encouragement as such.

The officers of the company are: J. W. Wilshire, president; George Bullock, vice-president and secretary; Otto W. Jantz, superintendent and electrician. Their mammoth factory is located at the southeast corner of Second and Plum, while the general offices are at 59 West Fourth street. The company consists of men of indomitable will power, who are peculiarly adapted to make a success of their undertaking. At the time of this their mammoth undertaking electricity was in its infancy in Cincinnati. They have, by absolute determination and straightforward business methods, so greatly increased the business of the company that they find their present quarters inadequate to carry on the business and have purchased grounds and commenced the erection of a three-story brick building, 175 feet on Hunt street by 86 feet on Broadway.

This company has on file in their office testimonials from every machine they have installed, either for the purpose of motor power or electric light, substantiating their claim to superiority.—*Cincinnati Post.*

The Lundell Motor.

The fact that the small as well as the larger sized Lundell Power Motors manufactured by the Interior Conduit and Insulation Company of New York have been and can be adapted to many useful purposes, is again exemplified in the new Beach Emery Grinder which this company has just standardized. The accompanying cut illustrates this neat little machine, which will at once commend itself to machinists and others interested in the grinding of small tools, such as twist drills, lathe tools, graving tools, knives, scissors, etc., etc. All shops that have adopted the electric illumination can most conveniently use this device. The Emery Grinder illustrated is 12 inches high, weighs 18 pounds, operates at a speed of 2,500 revolutions maximum and has in its base a regulating device for two lower speeds. It is of 1-6 H. P. capacity, 115 volts, and swings a 2 inch emery wheel. Larger and smaller wheels driven by motors of higher or lower powers are also furnished by the Interior Conduit and Insulation Company.

INCORPORATIONS.

The People's Electric Heat and Light Company, Springfield, Ill. Incorporators: F. W. Tracy, J. Henry Schuck, Frank Reisch, Chas. F. Herman, Frank Hoblit, of Lincoln; William L Gross and Edgar L. Gross.

The South Peoria Street Railway Company, at Peoria, Ill. Capital stock, $100,000. Incorporators: Charles A. North, Isaac M. Hornbacker and John W. Culbertson. To construct and operate horse, dummy and electric railways in Peoria County.

Articles of incorporation have been filed by a syndicate composed of twenty-six citizens of Newburg, N. Y., forming the Newburg, New Windsor and Balmville Street Railroad Company, with a capital stock of $100,000. The contemplated railway will be an electric system.

The Michigan Electric Company has been incorporated with a capital stock of $60,000, all paid in. The incorporators are John E. Moore, E. F. Sweet, A. C. Sekell, of Grand Rapids; C. Jesse Church, of Greenville, and Dr. O. C. McDonnell and Charles A. Church, of Lowell. The company will, as soon as the weather will permit, proceed to improve the water power of Flat River and to erect electric works to supply Grand Rapids with power and light by a system of long distance transmission.

The Butte (Mont.) General Electric Company has filed amended articles of incorporation. Under the new articles the capital stock is placed at $850,000, and the limit to the indebtedness is fixed at $1,000,000.

Kennett Electric Light, Heat and Power Company, of Kennett Square, Pa. Capital stock, $20,000. Directors: W. W. Gawthrop, J. M. Palmer, H. H. Gawthrop, D. W. Hutchinson, J. E. Worrell, Henry C. White, John C. Yeatman and Theodore Penrock.

Articles of incorporation have been drawn up for an electric railway in Wauwatosa, Wis. The incorporators are August Richter, Joseph P. Schubert and A. C. Dick, and the capital stock is put at $25,000.

The Alton Electric Street Railway Company, Alton, Ill. Capital stock, $250,000. President, A. M. Farnum; vice-president, J. H. Porter; secretary and treasurer, G. H. Walbridge; directors, J. G. White, J. H. Porter, E. C. Harrison, G. H. Walbridge and A. M. Farnum, all of New York City.

A charter has been granted to Senator John J. Patterson, and R. B. Focht, H. E. Gutelius, E. N. Tool, Silas Patterson and H. M. Nolf, directors, for an electric railway to extend from Lewisburg, Pa., to Middleburg, via Mifflinburg and New Berlin, with extensions to Laurelton and Cowan. It is understood that a portion of the road will be constructed during the coming summer.

The Crescent Electric Light, Heat and Power Company, Chicago. Capital stock, $100,000. Incorporators: Joseph R. Bickerdike, Tracey D. Hull and Burton Johnson.

The W. E. Irish Thermal Arc Light Company, Chicago. Capital stock, $250,000. Incorporators: W. E. Irish, F. B. S. Morgan and J. S. Morgan.

Beers Electric Fan and Motor Company, Newark, N. J. Capital stock, $100,000. Incorporators: Erastus Hayes and A. R. Bradley, of New York; William M. Tallman, of North Plainfield, and Franklin H. and William P. Beers, of Newark.

United Traction and Electric Company. Capital stock, $8,000,000. Incorporators: Henry W. Calhoun, of New York; Adrain H. Larkine, of Nutley, and Thorwall Stallknecht, of Orange. The concern will have offices in New York, Jersey City, Connecticut, Massachusetts, Rhode Island and in the District of Columbia. Its objects are the making and forming of contracts or sub-contracts for the purpose of building and equipping railroads, whether operated by horse or electric power.

The Arapahoe Railway Company, Denver, Col. Capital stock, $25,000. The company intends to build an electric railway through the eastern and southern environs of Denver. Among the principal backers of the project are the Arapahoe Investment Company, the Fairmount Cemetery Company and B. H. Du Bois.

The New York Traction Company. Capital stock, $5,500. Directors: John A. McCall, F. K. Hain, T. D. Jordan, W. H. McIntyre, George V. Turner, New York; Charles A. Johnson, Raymond C. Johnson, Charles H. Russell, Charles Curie, Brooklyn; James A. Morrissee, F. C. Van Dyke, Paterson, N. J. The purpose of the company is the construction of railroads and furnishing power for railroads in New York City.

Articles of incorporation of the Jersey City, Hoboken and Rutherford Railway Company have been filed. Among the New York and New Jersey capitalists interested in the project are H. B. Hyde, president of the Equitable Life Assurance Company of New York; John A. McCall, president of the New York Life; Thomas D. Jordan, controller of the Equitable; Charles A. Johnson, president of the United States Fireworks Company; ex-Senator Russell of Brooklyn, Gen. Louis Fitzgerald, James A. Morrissee and James R. Lee of Paterson, and Charles Curie of Brooklyn. The capital stock is $525,000, and it is all subscribed for.

A number of well known men of Lancaster, Bethlehem, Littleton and other New Hampshire towns, and also of Portland, Me., have organized the Coos and Grafton Electric Light, Heat and Power Company. The intention of this company is to locate on the Connecticut River, near the town of Dalton, on a valuable water power already secured, a large and fully equipped electric light and power plant, with a capacity of at least 4,000 16-candle power lights, or between 300 and 400 horse power. Their purpose is to run wires to Lancaster, Littleton, Bethlehem, St. Johnsbury, and to any neighboring town where sufficient power and lights can be sold to make it an object.

The New England Street Railway Company; certificate of incorporation filed at Trenton, N. J. Capital stock, $5,000,000, which may be increased to $50,000,000. Directors: John R. Bullard, president of the Dedham National Bank; James C. Elmo, president of the Shoe and Leather National Bank of Boston; Col. John H. Cunningham, president of the Winnisimmet National Bank of Chelsea, Mass., W. B. Ferguson, president of the Gloucester Street Railway Company; William H. Leonard, vice-president of the North National Bank of Boston; Dr. A. F. Mason, Major A. C. Pond, president of the New Haven and West Haven Street Railway Company; A. K. Mitchell, vice-president of the New England Trust Company of Boston; Thomas T. Robinson, treasurer of the West Leicester and Spencer Street Railway Company of Boston, and James B. Dill of Dill, Chandler & Seymour, of New York, counsel of the company. The company proposes to acquire as many street railroads as possible in New England and operate them by electricity. Its charter gives it the power to acquire and operate by electricity street railways in any part of the United States and in the City of Mexico. The Corporation Trust Company of New Jersey is its trustee in New Jersey, and the New England Trust Company in Boston.

The Power City Illuminating Company of Niagara Falls has been incorporated at Albany with $5,000 capital, to generate electricity for light, heat and power. The directors are H. L. Brewster, H. C. Brewster, A. Erickson Perkins, Haywood Hawkes, Peter A. Porter and Lewis A. Boore.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED FEBRUARY 14, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

491,666. Electric Locomotive. Sidney H. Short, Cleveland, Ohio, assignor to the Short Electric Railway Company, same place. Filed Jan. 16, 1891.

491,667. Directly-Connected Motor for Cars. Sidney H. Short, Cleveland, Ohio, assignor to the Short Electric Railway Company, same place. Filed March 30, 1891.

491,691. Series System for Railways. George L. Thomas, Brooklyn, N. Y. Filed June 16, 1892.

491,857. Electric Locomotive. Frank B. Rae, Detroit, Mich., assignor to the Detroit Electrical Works, same place. Filed April 11, 1891.

DYNAMOS AND MOTORS.

491,567. Conductor for Armatures. Emil Kolben, Schenectady, assignor to the Edison General Electric Company, New York, N. Y. Filed Feb. 8, 1892.

491,568. Armature and Means for Supporting the same. Emil Kolben, Schenectady, assignor to the Edison General Electric Company, New York, N. Y. Filed Feb. 8, 1892.

491,695. Alternating-Current Dynamo-Electric Machine. James J. Wood, Brooklyn, N. Y. Filed Oct. 30, 1890.

491,708. Electric Motor and Dynamo Mica Insulator. Charles W. Jefferson, Schenectady, N. Y., assignor to Eugene Munsell & Company, New York, N. Y., and Elizabeth, N. J. Filed June 1, 1892.

491,829. Electric-Motor Regulator. Joseph A. Williams, Canal Dover, Ohio. Filed Feb. 11, 1892.

491,970. Electric Motor. Alexander W. Meston, St. Louis, Mo. Filed June 15, 1891.

ELECTRIC LIGHTS AND APPLIANCES.

491,548. Electric-Arc Lamp. Frederick D'A. Goold, Schenectady, assignor to the Edison General Electric Company, New York, N. Y. Filed April 15, 1892.

491,561. Incandescent Lamp-Socket. Joseph Hutchinson, New York, N. Y., assignor to the Edison General Electric Company, same place. Filed June 11, 1891.

491,596. Electric-Lamp Fixture or Bracket. James T. Robb, Mount Vernon, assignor to the Edison General Electric Company, New York, N. Y. Filed Aug. 31, 1891.

491,603. Duplex Electric-Arc Lamp. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Oct. 27, 1890.

491,604. Electric-Arc Lamp. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Oct. 30, 1890.

491,605. Cut-Out for Arc Lamps. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Dec. 1, 1890.

491,682. Bushing for Incandescent-Lamp Sockets. Cromwell A. B. Halvorson, Saugus, assignor of one-half to Robert B. Lincoln, Boston, Mass. Filed April 4, 1892.

491,915. Electric-Arc Lamp. William H. Akester, London, England. Filed Sept. 9, 1892.

491,916. Electric-Arc Lamp. William H. Akester, London, England. Filed Sept. 9, 1892.

TELEPHONE AND TELEGRAPH APPARATUS.

491,553. Trunk-Line Signalling Apparatus and Circuit for Telephone-Exchanges. Edward J. Ball, Morris, N. J., assignor to the American Telephone and Telegraph Company, of New York. Filed Oct. 13, 1892.

491,595. Telegraph-Transmitter. Robert S. Roberts, Philadelphia, Pa. Filed April 29, 1892.

491,688. Switching System for Telephone-Exchanges. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed May 19, 1892.

491,777. Memorandum-Tablet for Telephones. William M. Kleeman, Columbus, Ohio. Filed April 11, 1892.

491,893. Telephone-Call. John H. Kinsman, Bridgeport, Conn. Filed Jan. 20, 1892.

BATTERIES.

491,684. Manufacture of Secondary Battery Electrodes. Robert McA. Lloyd, New York, N. Y. Filed Sept. 30, 1892.

491,726. Accumulators. William A. MacLeod, Boston, Mass. Filed Dec. 17, 1890.

491,878. Secondary Battery. Nathan H. Edgerton, Philadelphia, Pa. Filed July 11, 1892.

491,811. Alternating Current Generator. Octave Patin, Paris, France. Filed July 8, 1892.

MISCELLANEOUS.

491,531. Electrical Signaling Apparatus. Jacob B. Currier, Lowell, Mass., assignor to the Currier Telephone Bell Company, of Massachusetts. Filed Dec. 15, 1891.

491,560. Coulombe-Counter. George Hummel, Nuremberg, Germany. Filed Feb. 16, 1891.

491,700. Method of Electrolytically Producing Soda and Chlorine. Elisha B. Cutter, New York, N. Y. Filed Dec. 30, 1893.

491,701. Method of Electrolytically producing Potassium Chlorate. Elisha B. Cutter, New York, N. Y. Filed April 11, 1892.

491,707. Electrical Insulating Conduit. Charles W. Jefferson, Schenectady, N. Y., assignor to Eugene Munsell & Company, New York, N. Y. and Elizabeth, N. J. Filed May 21, 1892.

491,713. Electric Head-Lamp. William Main, Brooklyn, N. Y. Filed Oct. 29, 1892.

491,729. Insulator. Louis McCarty, Boston, Mass. Filed Aug. 8, 1892.

491,758. Electric Signaling Apparatus. Ludwig von Orth, Berlin, Germany. Filed April 14, 1892.

491,824. Electric Alarm Money-Drawer. William J. Walker, St. Louis, assignor of one-half to Alexander L. Bedford, Savannah, Mo. Filed Oct. 29, 1892.

491,837. Railway Train Order and Signaling Device. Leonard T. Crabtree, New London, Wis. Filed April 2, 1892.

491,874. Electric Signal. Frank H. Clarke, Springfield, Ohio, assignor of one-half to Alfred L. Clarke, same place. Filed Oct. 24, 1892.

491,890. Insulator. Andrew L. Johnston, Richmond, Va. Filed May 4, 1892.

491,945. Self-Winding Electric Clock. Emil Klahn, West Hoboken, N. J., assignor to Daniel C. Hood, New York, N. Y. Filed Feb. 17, 1892.

ELECTRICITY.

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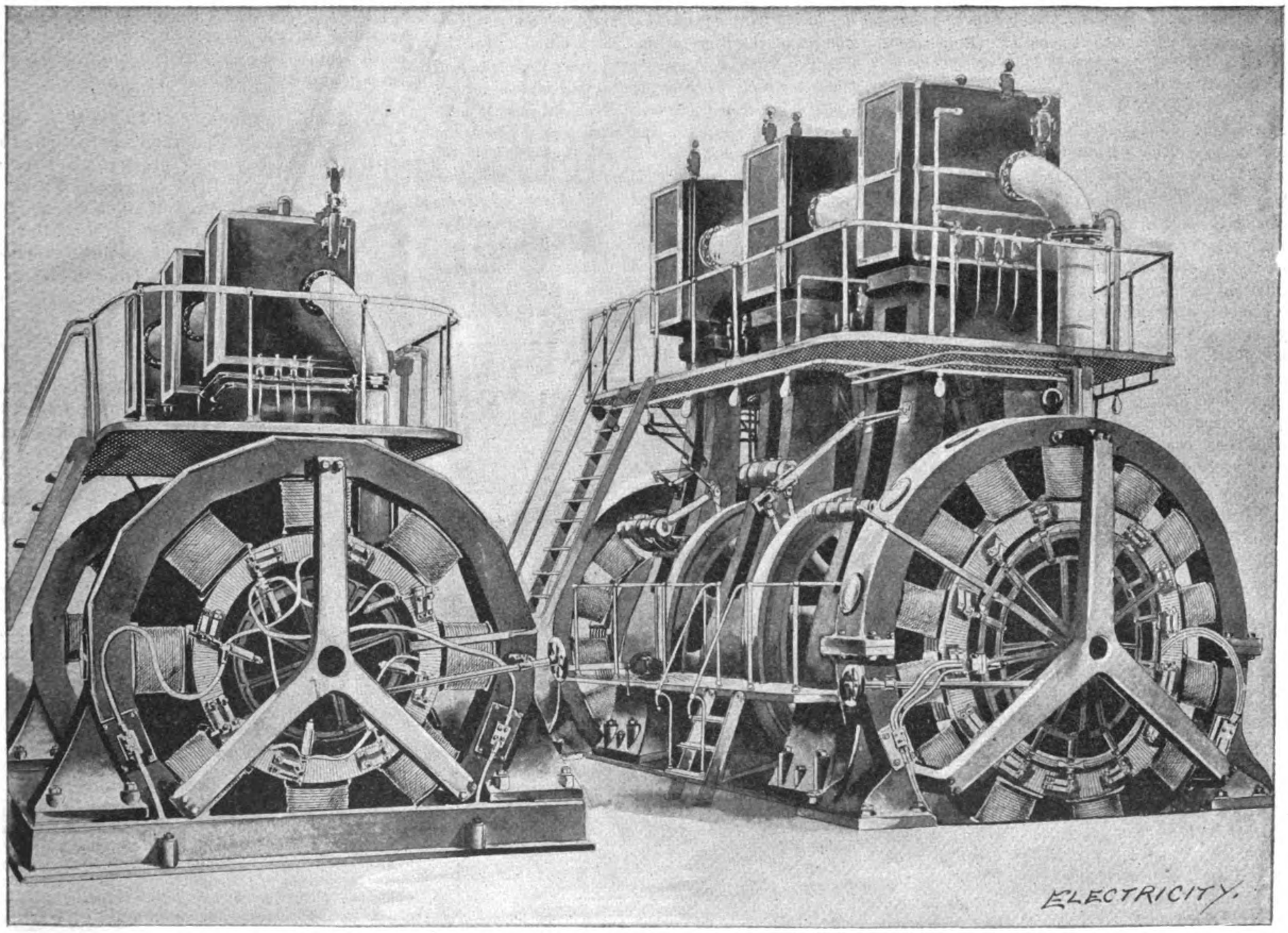


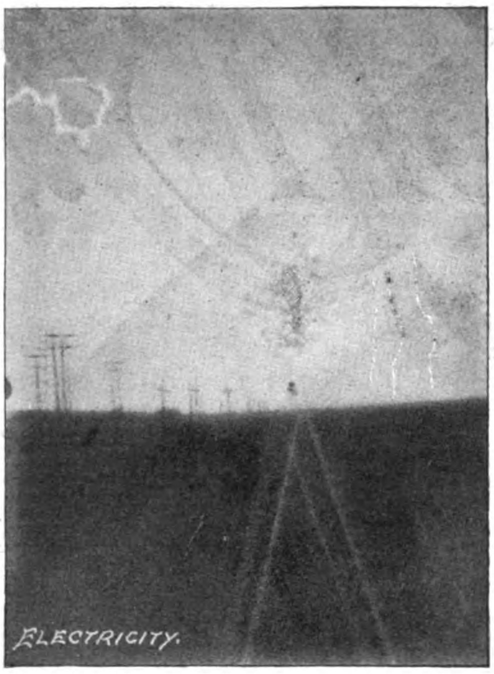
DYNAMO AND ENGINE ROOM, GWINNETT STREET STATION, EDISON ILLUMINATING COMPANY, BROOKLYN, N. Y. (SEE PAGE 87.)

Lightning Photography.

From an Express Train.

BY W. N. JENNINGS.

When a school boy, I remember watching with much interest the professor turning the handle of an electrical machine, and still recall the thrill of delight I experienced when I saw for the first time a bright spark flash across the three-inch space between the prime conductors with the "crack" of a toy pistol.



LIGHTNING PHOTOGRAPHY. (FIG. 2.)
(Taken from moving train. Showing multiple images of telegraph poles.)

A needle was then placed upon one of the brass knobs of the machine, the handle rapidly turned, but no spark would pass, the electricity passing from the point of the needle in the form of a luminous brush as fast as it was generated. The experiment was varied by allowing one of the boys to revolve the glass cylinder after the professor had removed the needle, followed by numerous sparks in quick succession. Holding the needle in his fingers, the professor brought its point near one of the conductors, when the spark stream ceased and a silent brush of light blue tint swept over the brass knob, appearing to come from the professor's body.

So much for electrical dissipation. A number of condensers were next connected with the machine, and while the handle was being turned we were told that these acted as reservoirs where the electric fluid was stored until it had gained energy enough to bridge the eight-inch gap between the prime conductors, which it presently did with a brilliant flash and the report of a rifle.

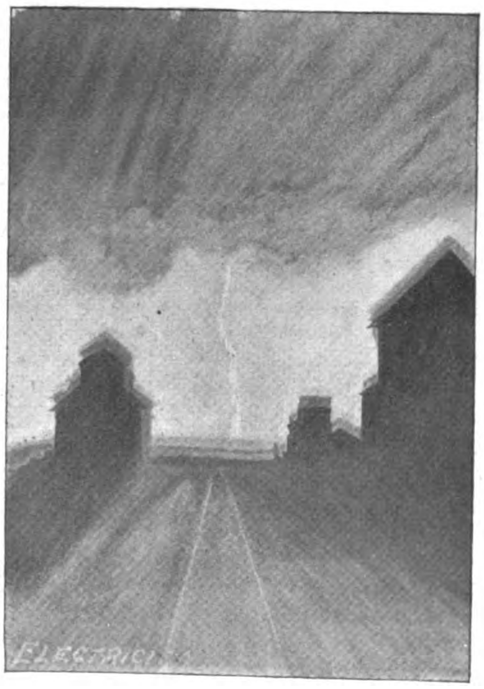
Then it was when I got my first conception of the service of the lightning rod—not to carry away the electric fluid, but to throw out from its point a stream of electricity of the opposite kind with which the sky is charged and thus neutralize the effect of the storm. Thunderstorms are usually preceded by a heavy downpour of rain, and in built-up cities every church spire and a thousand pointed gables send up peace offerings to Jove, and thus avert great destruction.

But out in the Western prairies of the great American Continent a thunderstorm is seen at its best—or worst. These stretches of land serve as enormous condensers, with the poles of Nature's electrical machine many miles apart. I had often wished to have the privilege of watching a Western storm, and last summer my yearning was satisfied to its fullest extent.

We had reached the middle of the prairie of North Dakota. The day had been very sultry, and as an old railroader said thunder was in the air, I loaded my camera and waited anxiously for Jove's pyrotechnics. At midnight I was startled from my sleep by a strange rumbling sound, quite unlike that of the train, and a peculiar glare filled the car, not shed by the oil-lamps overhead. I rolled up the window shade, and for the first time in my life saw lightning. Seizing my camera I made my way to the rear platform of the train, from which point I had a clear view of the storm. The sight was terribly grand: a quivering banner of light as broad as a house, threw its flaming folds far out into the night; flying hailstones became scintillating stars, the railroad track a blazing sunbeam, and the prairie a surging sea of molten silver, while the thunder boomed continually like the sound of great breakers rolling in upon the seashore.

As a streak of lightning shot out from the horizon the train flashed past a telegraph pole, which stood out against the sky in quadruple. The same thing happened in the case of a water tank, which showed six outlines in front of a single line of light. The glass eye of my camera corroborated the vision of my own; and my travelling companion, Mr. F. E. Ives, of color-photography fame, indorsed my views, he too having noted the phenomenon from the car window.

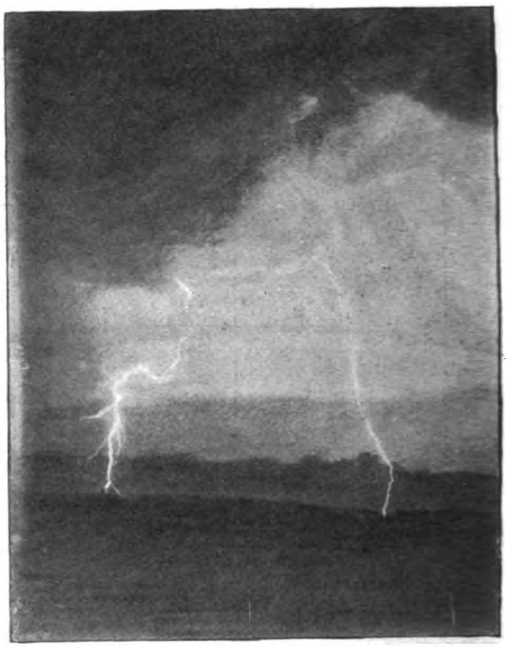
Many years ago, while passing my hand before my face during a thunderstorm, I noticed multiple images of the fingers, and have since noted the flight of bats between a lightning discharge and the eye which gave a number of instantaneous images of the bat, showing clear-cut images with different wing movements, with a space between each. This led me to conclude that when lightning has once opened up a path in space, that line being a conducting one, electric energy oscillates to and fro along it, until a balance between the two points is maintained or the electric area is drained or neutralized. If during the progress of such a discharge the camera is passed quickly across it, the resulting photograph will be likely to show a number of images having the same general outline.



LIGHTNING PHOTOGRAPHY. (FIG. 3.)
(Taken from moving train. Showing multiple images of buildings.)

In the case of the large photograph illustrating this article the discharge was a single one, which is proven by the fact that the train was running at a high rate of speed, and yet the railroad ties quite close to the camera are clear cut, which image I have failed to secure during the daytime under the same conditions with the most rapid instantaneous shutter at command.

Another peculiar feature of this storm was shown by great bands of light shooting up out of the prairie, quite close to the camera, and after reaching the clouds recoiling and striking the earth again. One such flash I succeeded in capturing, and it is here reproduced.



LIGHTNING PHOTOGRAPHY. (FIG. 4.)
(Taken from moving train.)

The Administration of the Royal Saxon State Railways has decided on the construction of an electric central station to supply all the Dresden railway stations with light and power. From the various schemes submitted, that of Messrs. Siemens & Halske, slightly altered by Mr. Ulbricht, of Dresden, was adopted. This scheme proposed the use of the "drehstrom." On completion of the station, the output is to be 1,300 H. P. The installation will consist of five boilers, four engines, and the same number of "drehstrom" machines of 330 H. P., each running at a speed of 100 revolutions per minute. The station pressure of 120 volts is raised by transformers to 3,000 volts, and reduced again for use at the lamps and motors. The network stretches to places four miles distant, and feeds 600 arc lamps and over 3,000 glow lamps. The work has been divided between Messrs. Siemens & Halske and the Helios Company of Cologne, the former firm being responsible for the station, the motors, and the station transformers, while the latter company provide the mains and the lighting arrangements. This station will be the largest in existence working on the "drehstrom" principle.—*London Electrician.*

Modern Invocations Not Wanted.

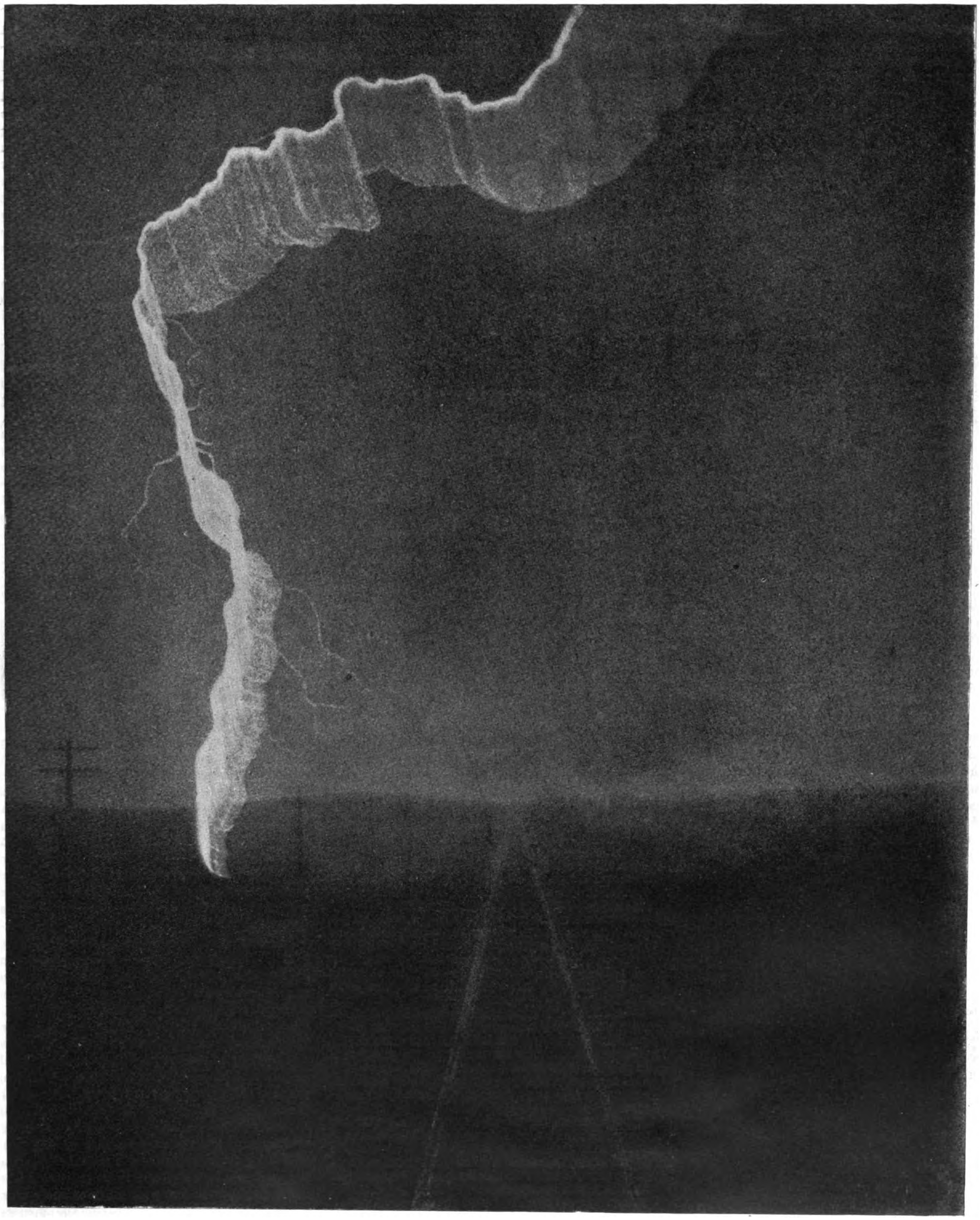
The Singing of the Trolley Wire Misinterpreted.

(From the St. Johnsbury Caledonian.)

A summer visitor who admires Brattleboro has become anxious concerning the proposed electric street railway there, and writes to the *Phoenix*, pleading that the streets of Brattleboro may be kept "inviolate from the rush, noise and danger of the city electric railway." The city folks are evidently somewhat jealous of the modern invocations which threaten to destroy the charm of the country towns of which they have grown fond.

Personal.

Mr. Walter Lodia, whose communications on electrical matters abroad have appeared from time to time in ELECTRICITY, has returned to this country and will represent several English publications at the World's Fair.



A DISCHARGE OF "RIBBON" LIGHTNING.

PHOTOGRAPHED FROM THE REAR PLATFORM OF A RAPIDLY MOVING TRAIN, CROSSING THE PRAIRIE OF NORTH DAKOTA.

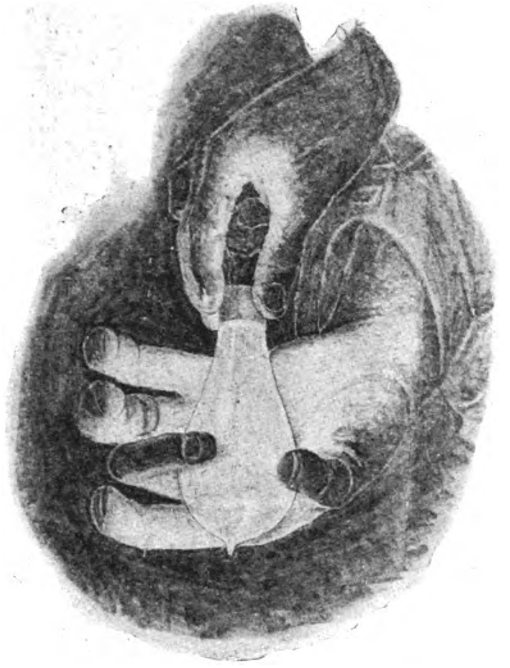
BY W. N. JENNINGS.

(FIG. 1.)

Glowing of Disconnected Incandescent Lamps.

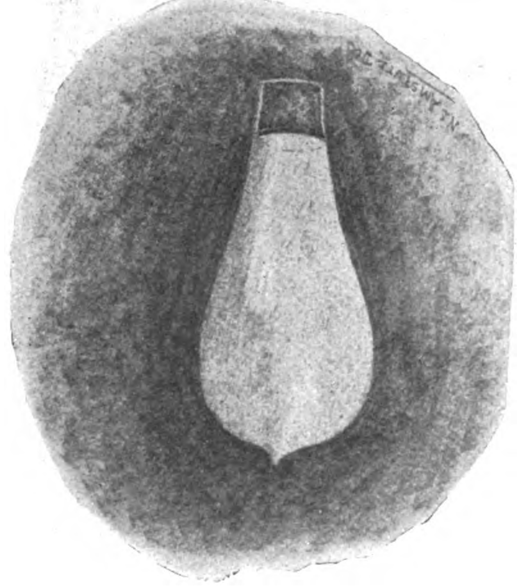
BY N. S. AMSTUTZ.

A most peculiar and interesting phenomenon may be produced from the ordinary incandescent lamp, in which a considerable illumination of the whole interior of the lamp can be produced for a very short time without having the lamp connected to any source of current by wires, etc. This interesting experiment may be performed in any one's parlor without any appurtenances other than an incandescent lamp, a darkened room and mechanical power in the shape of two unobstructed hands. The lamp is grasped about, as shown in Fig. 1, at its lower end with the thumb and first finger of the other hand partly and gently encircling the bulb of the lamp at its upper end—not holding the lamp so firm as to not enable the right hand to rapidly move the lamp up and down through between the thumb and first finger of the left hand, in the meantime holding the left hand stationary. After a few rapid movements the lamp will glow about as shown in the accompanying figures.



GLOWING OF DISCONNECTED INCANDESCENT LAMPS. (FIG. 1.)

At times the glow will be maintained for some moments after the left hand is removed entirely, showing a delicate cream colored phosphorescence with a slight bluish tinge, the apparent points of discharge being marked by increased luminosity of ever-changing forms, appearing very much as a miniature "aurora." Again, at times when this glow disappears, by returning the left hand to the position shown in Fig. 1 the glow reappears, but for only a moment. Simply bringing the lamp within the field of the left hand will sometimes cause the after glow to appear slightly. If the thumb and first finger be brought partially around the lamp the after glow is concentrated and intensified. I do not profess at this time to explain the phenomenon, but state these facts for the notice of others who have possibly investigated the same features. If ever a phenomenon was full of caprice, certainly this is one, for at times in following out the same conditions that have been acted upon previously no results whatever were produced. The experiment again has been a failure when tried at different locations, three or four miles apart, with the same lamp in use and taking precautions to carefully insulate the experimenter from possible grounds, etc., but without effect. Certain persons seem unable to call forth vacuo aurora after repeated attempts. The results are also modified by different kinds and sizes of lamps, the smaller bulbs appearing to give the best results. A specific instance of the capriciousness of the whole matter may be cited as follows: On September 29, 1892, I was enabled to produce the glow illustrated in the engravings shown, repeatedly, at my house, whether standing on carpets, wooden or cement floors. Upon the next day the same lamp was used at my office in a large vault having a cement floor without success. Standing on paper or rubber had no effect whatever in luring the phosphorescent glow from its mysterious stronghold.



GLOWING OF DISCONNECTED INCANDESCENT LAMPS. (FIG. 2.)

I hope the recitation of the experiments which have been performed may call out the experience of others in the same line.

In all of the experiments which were successful the glow appeared to be directly proportional to the speed with which the lamp was moved and the distance of such movement. Of course a limit of speed is soon reached, above which it is impossible to proceed by manual power. The glow did not affect the filament at all, and there were no peculiar sensations felt in the hands. A slight crackling sound was at times noticeable.

A Model Plant.

(From the Detroit News.)

Mayor Pingree is indignant over the proposition that this city should be made to purchase the plant of the Detroit Electric Light and Power Company. He said: "The idea of asking the city to buy such a rattrap plant is preposterous. By rights, their power house ought to be condemned." A few moments after the Mayor had said this, he received corroboration from Wm. C. Cullen, a mechanical engineer, who told his experience as follows:

"I think my health is as good as that of almost any man, but one week's work in the Detroit Electric Light and Power Company's plant was too much for me. In the first place I was offered $75 a month, a lower figure than has been offered me in twenty-seven years. I went to work, and intended to continue working, but I simply couldn't stand it.

"Their alleged steam condensers are located in the basement, but they are such poor machines that the steam pours out of them and fills the institution with a killing heat and vapor. I have left there with the perspiration pouring out of my shoes when the weather was freezing I left there last Sunday and my feet are still discolored. Their engines are no good, though the dynamos are not so bad.

"One night during the week I worked there. I think it was a week ago Tuesday, they shut down fifty minutes to repair one of the engines, and not a light was burning in the city during that time. Yet the next day the police reported only 25 lights of the 1,200 being out. I am now just recovering from my experience."

Mayor Pingree recently visited the plant and says he would not work there an hour for the price of the whole plant. He'd be afraid of being blown up.

The details of the Wyandotte fight with the General Electric Lighting Company have been carefully compiled by Mayor Pingree and sent to Lansing, where they will be used in aiding the passage of the Moore bill in the Legislature.

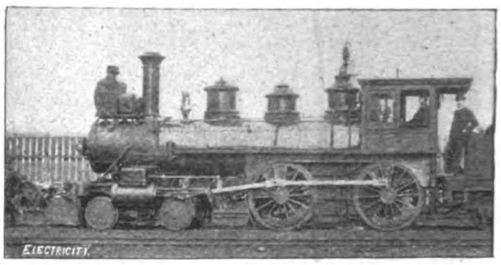
An Electric Headlight.

Designed for Locomotives.

The apparent slowness and disinclination of railroad authorities to adopt inventions of a class presumably beneficial is so often a matter of comment that it has grown to be an axiom. Be this as it may, it is a known fact that the heads of operating departments are constantly besieged with all classes of inventors, good, bad, and indifferent, to such an extent that an entirely separate and distinct bureau could be kept busy considering the multitudinous claims presented by the inventors. It is not to be wondered at in view of this fact that master mechanics and other officials are not consumed by a burning desire to welcome the army of claimants, but notwithstanding this fact, it can safely be said that the various departments are quick to take advantage of any improvements that will cheapen the cost of maintenance, facilitate the operation of trains over their lines, or render the liability of accident less.

Under the caption of the latter head, it is the purpose of this article to set forth in detail the system of electric head-light apparatus manufactured by the National Electric Headlight Company of Indianapolis, Ind.

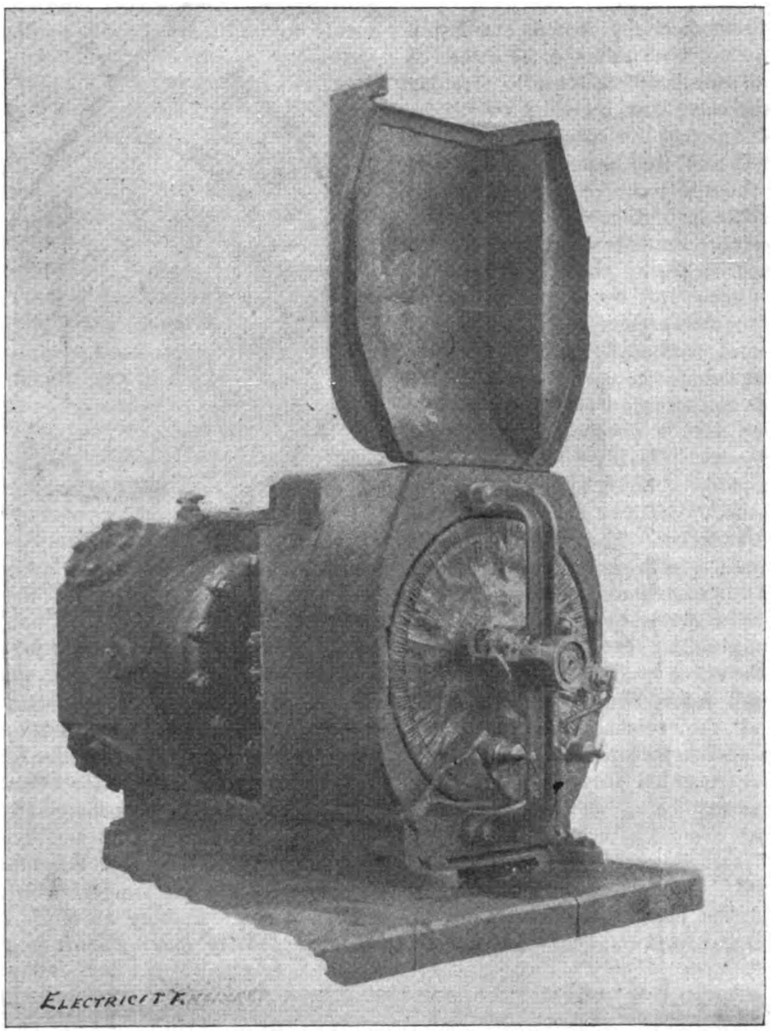
Two distinct views of the function of the headlight are entertained concerning its usefulness. The foreign one (and to some extent patterned after in this country) is that it should merely consist of a bullseye, this being all-sufficient, for the reason that it fulfils its purpose in warning stationmen and others of the train's approach. It is claimed that this is all that is required, that the purpose is served with a lens three inches in diameter fully as well as a twenty-two inch reflector, inasmuch as the latter does not well illuminate the track for any distance sufficiently to make an emergency stop. The other view taken is that it can be used as an illuminator of ample power to determine a scope of vision of sufficient length to make a stop for an obstacle or any other cause within the rate of speed now run by the fastest trains.



AN ELECTRIC HEADLIGHT. (FIG. 1.)

It would seem, from a humane standpoint, that such an agency for preservation would be a great desideratum, not only by reason of the distance seen ahead by the engineer and the protection afforded thereby, but on account of the most effectual warning given to those approaching dangerous grade crossings at night, a continual and fruitful source of accident, for such a light affords a most positive notice of the train's approach. General Superintendent Neilson, of the Cincinnati, Hamilton & Dayton R. R., also contends "that the use of so powerful an illuminant entirely obviates trouble arising from mistaking train orders and rights by reason of the warning being given in so positive a manner as to preclude the possibility of their being misunderstood," and for that reason the apparatus manufactured by the above mentioned firm is being generally placed on locomotives of that system, freight as well as passenger.

In analyzing the list of accidents on railroads, compiled monthly, the fact is very apparent that the use of just such an agency as is herein described would have averted a large per cent. of them, and on systems where it is used repeated instances have arisen where wrecks admittedly have been averted, but as corporations naturally are averse to have information of this character paraded before the public, the strong endorsement, fairly obtained, cannot be utilized to further the claims of the apparatus.



AN ELECTRIC HEADLIGHT. (FIG. 2.)

With the advent of the arc light to commercial use, attention was at once directed toward applying it to the locomotive, and for a number of years much hard work and great sums of money have been expended in solving the problem, and devising a plant that could be placed on a strictly commercial basis. Probably no department of electrical science involving the given amount of machinery has presented so many difficulties of so varied a character. It is not desirable here to go into too great detail touching the developments that have taken place ; suffice it to say that the mere mention of the great variation of steam pressure, the exposed situation of the apparatus, the determination of speeds for both dynamo and engine that would be conducive to longevity in both, devising a lamp that would be absolutely trustworthy in the hands of the average engineer and be surely operative under the most adverse conditions, to feed at the predetermined time and duration under the violent vibration to which the front end is subjected while running sixty miles per hour, drawing a heavy load—these are some of the essentials, and they have been successfully met.

The pioneers in this branch of study were George C. Pyle, of Indianapolis, and Howard L. Pyle, of Wilmington, Del. Experiments conducted by them at various times were contributory to the stock of knowledge on the subject, and opened up a thorough understanding of the needs of the situation. To the former belongs the credit of embodying practically the improvements and latest practice as shown.

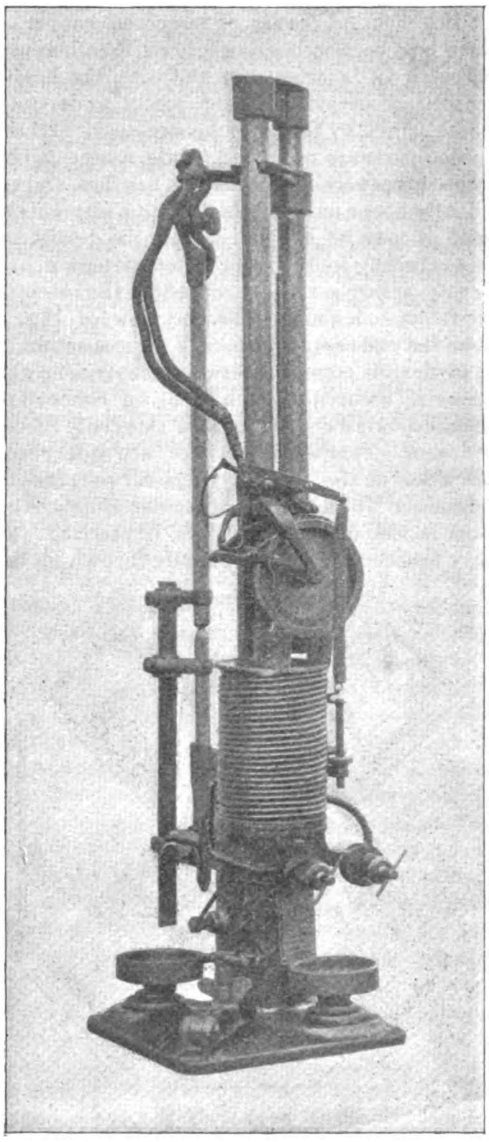
The apparatus as shown in Fig. 1, on Engine 26 of the Wilmington and Northern Railroad, is placed between the head case and the stack. The lamp is placed in the location formerly used by the oil font, the reflector in the same relative position. Steam is taken from the boiler end in the cab, where access to the valve and lubricator are within easy reach. Without leaving his seat, the engineer can obtain any size of light he wishes by admitting the necessary amount of steam.

Fig. 2 gives in perspective on an enlarged scale the coupled dynamo and engine, with the protection case of the dynamo thrown up and the coupling guard removed.

The total space occupied is 28 inches long by 15 inches wide and 17 inches high ; the total weight is 650 lbs., and the normal speed 425 revolutions per minute.

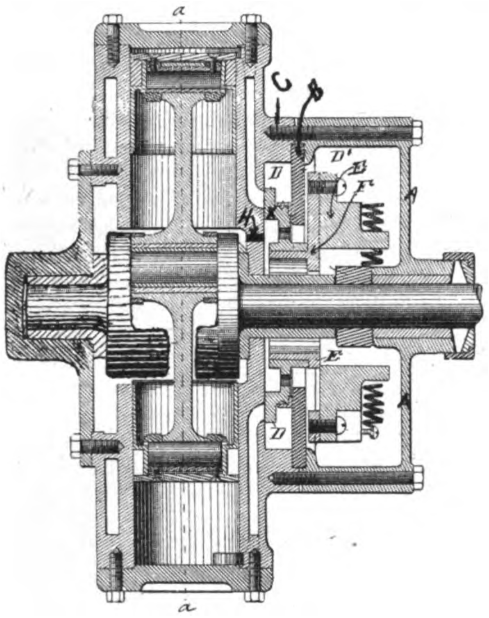
Fig. 3 shows the lamp removed from its position by the reflector, revealing the elements incorporated for operation. It is so designed that the feed guide and carbon rod can be lowered to enable its being removed from the case. The mechanism is positive in its action, and by the predetermined adjustment, keeping the feed securely locked till the time for the same coming into play arrives, when it is released, a friction pull comes into action, and the descent of the rod and carbon are smoothly intercepted. Should the feed be a fraction too much, the arc is at once automatically re-established to the normal point. The lift or feed is obtained by the use of a single solenoid in the main current. The hand nuts at the base allow the lamp being focussed within the reflector ; the set screw and lifting screw at the base serve to allow the apparatus being raised and lowered in a vertical plane for the same purpose. New carbons are readily inserted by lifting the rod and carbon holder up within the scope of travel, when the latch is then dropped in engagement with the ratchet wheel. The new carbon is then entered in the guide, the latch released, the holder descends to and is secured to the carbon, when the lamp is ready for operation ; each carbon averages from eight to eight and one half hours in consumption. The earlier experiments in lamps were confined to using two carbons in producing the arc, and with a great range of readings of current, varying from fifty to one hundred and twenty volts and from ten to twenty amperes; but after a long series of experiments it was finally determined that for practical usage this form was undesirable for the reason that differential ratios of consumption could not accurately be maintained, and as a consequence the focus was so constantly disturbed as to throw the beam of light either up or down, thus impairing its efficiency. After a long series of experiments, a rating of current was determined by which the use of a copper rod could be substituted for the lower carbon, the deterioration being nil. The current used gives practically the same result in penetration and volume of light, while the temperature is considerably below that of the ordinary arc in common practice, and safely inside the melting point of copper. When the latter becomes blunt by long usage, it can be taken out and retipped.

One of the imperative requirements of the situation as made manifest was the need of a suitable guide to hold in alignment the descending carbon. The arrangement shown meets this by providing two such guides insulated from a bar of iron, one of which embraces the lower electrode of copper, the other allows the carbon to pass freely through it; when the current is off, the tapered points are thus held in fixed and operative relationship. It is absolutely impossible to submit the lamp to action however violent



AN ELECTRIC HEADLIGHT. (FIG. 3.)

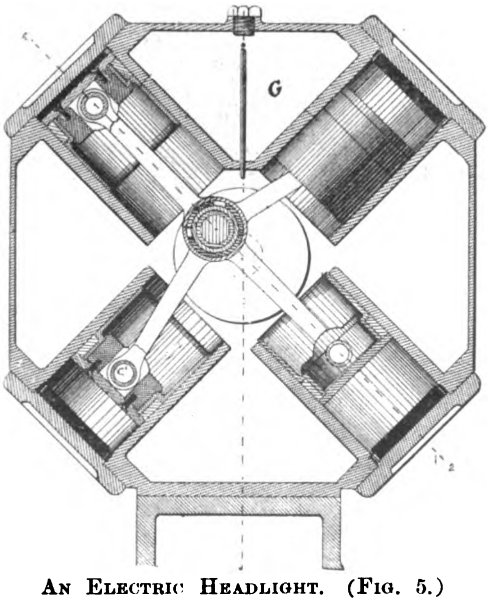
enough to destroy the arc in operation, and exemplifies what may be accomplished in a given direction by persistent effort and research.



An Electric Headlight. (Fig. 4.)

The dynamo, which is coupled direct to the engine by means of an improved flexible coupling, is of the bipolar type, designed and constructed on the most approved scientific principles, giving out the required current with the low rotative speed mentioned. The bearings are of the latest production graphite filled, requiring little or no oil; the commutator is of tempered copper on which bear carbon brushes, giving excellent service with little attention, and with the holder comprising an arrangement easily understood and managed by the average engineer. All the exposed parts are protected, while a zinc cap on hinges gives accessibility to the brushes, and effectually keeps out cinders and the elements to which it may be subjected. All the details are most carefully looked after in construction, and the satisfactory service rendered by the machine attests its efficiency. The end view of Fig. 3 shows the end case thrown back for inspection.

The flexible coupling between the dynamo and engine is secured to each by being clamped to the end squared on each, and is especially clever in design. Tempered springs are interposed both sides of the driving wings for purposes of cushioning. In the event of sudden stoppage by water in the engine cylinders in starting, the heavy armature is thus gradually thrown on the engine and parts, reducing the chances of breakage to a minimum.



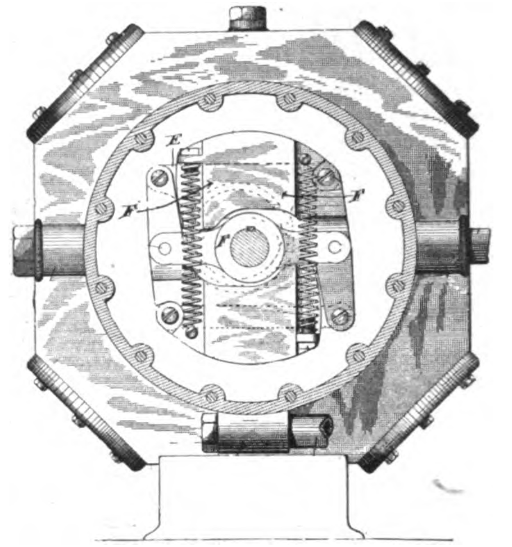
An Electric Headlight. (Fig. 5.)

The engine is of the multiple cylinder type having four cylinders, each set at an angle of ninety degrees with each other, as shown in Figs. 4, 5 and 6. Fig. 4 is a section through the lines 2–2 of Fig. 5. Fig. 5 gives a side elevation showing all four pitmans in position, and Fig. 6 an end elevation with the exhaust chamber removed, displaying the governor and valve. The pistons are of the trunk pattern, each by the pitman having a direct bearing on the crank pin bushing. The exhaust chamber A by means of studs, clamps an annular plate B on the circular off-set C from the valve seat, by which two divisions are formed, one for live steam D, the other for the exhaust D'; in the latter is placed the governor E of the disc pattern, erected directly on the shaft. The swinging yoke F under the control of the weights, extends through the opening of the plate, engaging the valve X, conveying to it the throw, and by the action of the weight controlling the speed. The valve is circular in form and balanced, admitting steam and receiving the exhaust at the same time. By this method of construction, close regulation and extreme simplicity is obtained, allowing accessibility for repairs. Having no dead centres, the engine is capable of being started from any point of the stroke, a condition strictly essential by reason of its location. The cylinders are all erected and contained in the crank casing, which contains an overflow of exhaust pressure, thereby reducing the loss of steam by radiation in the cylinders to a minimum. This chamber allows space in which the crank and pitmans play constantly in oil and water, thus affording ample lubrication to all the wearing surfaces. This arrangement in construction protects all the moving parts and frictional surfaces from dirt, cinders, etc., the same being entirely enclosed. Outside governors are also eliminated.

Three large bearings are provided of crown bronze. The shaft is of forged steel, and all the appointments of the engine are first class in point of material and workmanship. An oil font P is cast between the two upper cylinders, carrying a good supply of oil, so arranged as to feed directly on the wrist pin. Through means of the overflow ducts H, the surplus oil and water is carried over to the valve, affording an excess of lubrication other than that coming from the sight feed in the cab. The engine was patented by Geo. C. Pyle in 1891.

Fig. 7 is a view of the track lit up by the light looking *from* the engineer's seat. In ordinary weather twenty to thirty-four telegraph poles can be counted. Twenty-eight to thirty poles are placed to the mile. Thus it is evident objects can be seen within that distance, dependent upon the prominence and color.

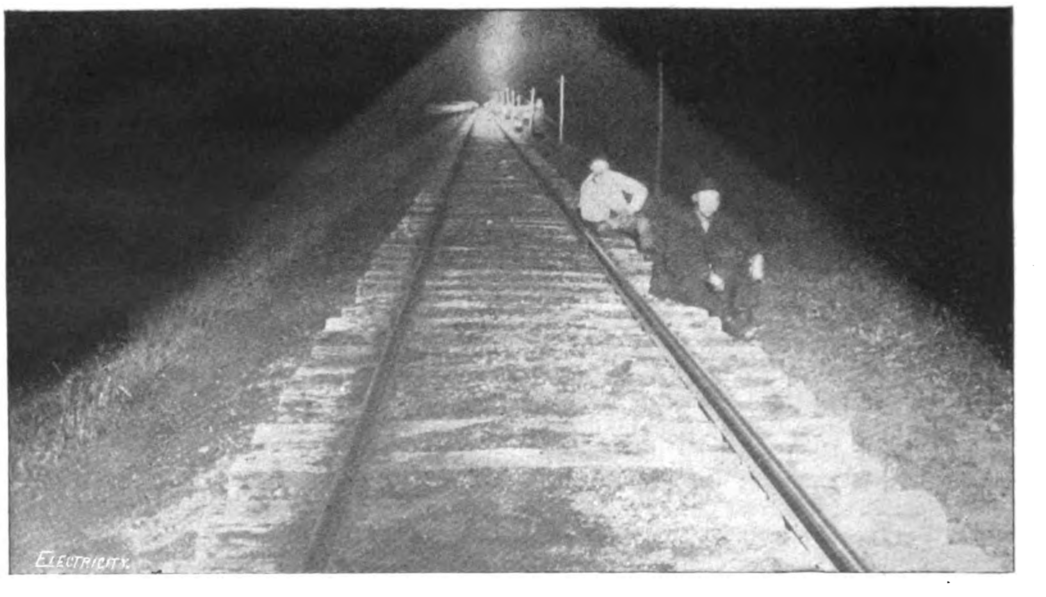
Semaphores, switch-lights, targets, etc., can be seen plainly, giving both the day and night colors, the lenses in the lanterns refracting the light, thus enhancing their power of illumination. In clear weather the results are of course the best, but the cases are very few when storm or fog renders the limit of view to a dangerously short space. An engineer familiar with his road would undoubtedly be able to discern his landmarks even in the darkest night for safe running, and it could hardly happen that the beam would not penetrate sufficiently far to stop the train for an obstacle, a misplaced switch or broken rail.



An Electric Headlight. (Fig. 6.)

Sitting in the cab back of one of these lights is decidedly a novel sensation. Small objects are brought out most prominently at long distance, the color of foliage in summer is exquisitely lit up, and the eyes of animals that chance to be in the path of light are converted into resplendent globes of fire. Passing through a snow storm with the swiftly moving shaft is a sight of rare beauty; the flakes become miniature prisms reflecting the rainbow's gamut of colors, while the search beam lights up for the passing moment all objects within its path, producing weird effects. No more beautiful sight would one wish to see than tracing the coming of an engine equipped with the apparatus through a snow storm or through fog; the illumination can be seen at a distance so great as to tax the credulity of the uninitiated should he not see for himself. There is but one word from engineers and firemen using the light, and that is praise. In the language of one of them, "They have daylight both ways now."

In addition to other virtues, the cost of the headlight apparatus is comparatively little, quite inconsiderable compared with the advantages to



An Electric Headlight. (Fig. 7.)

be gained from its use, when a single collision averted would prevent a loss sufficient to entirely equip the road with these lights, which would render such accidents very improbable.

Only one objection has been raised to the use of electricity, and that by pilots, but notwithstanding this, the powerful search-light is one of the surest safeguards of men-of-war and other vessels, and is now considered part of a first class equipment. It is in a measure true of the mechanical as well as the physical world that "nature deals in compensations," and so it is with the use of the headlight; running against it may possibly make the distinguishing of signals more difficult, but this is mitigated by having the system standard and lights of a given intensity oppose each other. Even the large oil lamp kept in good condition is amenable to the same argument. Experiments on the Cincinnati, Hamilton and Dayton Railroad on forty miles of double track, with these lights in actual use, reveal no actual difficulty from this source, and this section includes the suburban district of Cincinnati, where signals of all classes are extremely plentiful.

The whole equipment thus set forth is admirably adapted in its appointments for the purpose for which it was designed, and the satisfactory service obtained in use is its best recommendation.

Lights are now regularly in operation on the Vandalia lines, the Cincinnati, Hamilton and Dayton, Indianapolis, Decatur and Western, Michigan Central, Cincinnati Southern, Columbus, Hocking Valley and Toledo, Louisville, New Albany and Chicago, Rock Island, Wilmington and Northern, Chesapeake and Ohio, Chicago and Eastern Illinois, and on several others. A number of these systems have a large installation in nightly service.

Electric Light for Brussels.

The contract for lighting the city of Brussels throughout by electricity has at last been signed by the Silvertown Indiarubber Company. The following are some of the specifications and clauses in the contract:

All the cables are to be insulated with indiarubber. The first station is to have six units of 500 H. P., but each machine is to be able to furnish, if so required, 625 H. P. The battery of accumulators which will be employed is to have a capacity for supplying 1,250 lamps of 16 candles each.

The station is to be built where the old church (to be pulled down in February), Sainte-Catherine, now stands, close to the boulevard Anspach.

The boilers are multitubular, with 226 square metres surface each, and are to be of the Sulzer compound condensing type, as constructed by Carels of Gand.

The distribution system to be adopted is the three-wire system. The station is to be completed and ready for working by October next. The current will be sold by the Indiarubber Company for two years, after which the city will take the plant over from them.

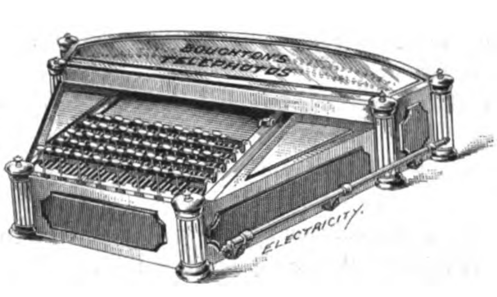
The electric meter patented by Oscar Fröhlich, and assigned to Messrs. Siemens & Halske, consists of a soft iron bar capable of oscillating on a central axis, two coils through which the current to be measured, or a certain fraction of it, is made to flow, one wound transversely and the other parallel to the iron bar; means consisting of a polarized relay, intermediate mechanism and circuit connections for alternately reversing the direction of the current through the coil wound parallel to the iron bar. The effect of the oscillation is somewhat that of a hairspring of a watch, or the escapement of a pendulum, and the oscillations are indicated by a set of gears and escapement in the usual way.—*London Electrical Engineer.*

The Telephotos.

A New Electric Signalling Device.

The members of the Buffalo Electrical Society and their friends were recently entertained by Mr. C. V. Boughton, the inventor of the "telephotos," at his laboratory. That more than ordinary interest was centered in this invitation was evinced by the large number who assembled to witness the practical working of the apparatus, which was operated and fully explained by Mr. Boughton.

The "telephotos" is designed for the purpose of communicating between ships at sea, armies in the field, and for other similar purposes now usually accomplished by means of rockets, flags and other visual devices. Among the advantages claimed for Mr. Boughton's invention is the facility with which such communications can be effected, the compactness of the apparatus, which permits of easy transportation, and the unlimited scope of the communications. The Morse telegraphic code of dots and dashes is employed for signals, and they are produced by means of incandescent lamps operated by dynamo currents and controlled by a keyboard on which the characters are designated or marked by Roman letters, thus enabling anyone, whether familiar with the Morse code or not, to transmit dispatches, which must, of course, be received and translated by an attendant expert in reading those characters.



The lamps employed to produce the dots and dashes are arranged in a vertical or horizontal line and are of the ordinary 32 C. P. make. The lamps are placed in individual pockets with suitably arranged reflectors for projecting the rays of light. There are 106 of these lamps, two of which are glowed to produce a dot, twenty to produce a dash and twenty intervening lamps left unillumined to effect the space between the dots and dashes. Sixty lamps are glowed for a long dash representing the cipher or naught, and two red lamps denote a period. The case is made of aluminium to secure lightness, and is contained within an area of two and one half feet square with a depth of six inches. The keyboard, comprising thirty-seven letters, numerals, etc., occupies one foot and six inches; the remaining portion is taken up by the electrical connections, of which there are necessarily a great number. The manner in which the multifold connections necessary to energize the required number of lamps to produce any required letter when the key is depressed are made is best understood by imagining a flat commutator, having a segment for each lamp, against which is pressed a metallic bar covering all of the segments, on the face of which are gaps over the segments connected with the lamps not to be energized in producing the letter represented by the key depressed. The keys are marked by letters and figures on rollers running across the keyboard which are simultaneously revolved by a thumbscrew and ratchet at the side of the machine. As each side of the rollers has a sequence of letters, etc., starting from a different letter of the alphabet, secret signalling is effected by a transposition of the alphabet and the code. When the rollers are in their normal position the letters correspond with the Morse characters produced, but when the rollers are turned, depressing the key designated by the letter A may cause the Morse B to be shown by the lights, or any other predetermined Morse character. Attached to the keyboard is a very ingenious and simple device, the invention of Mr. Boughton, which locks all the keys except the one depressed and prevents more than one key being depressed at a time. Mr. Boughton has also applied this device to typewriting machines, where it will fill a long felt want.

The key and the lamp boards are connected by a cable containing the requisite number of conductors, and may be of any length desired. The weight of the keyboard is about 75 pounds and that of the lamp frame 120 pounds. It is stated that the weight of a wagon containing all the apparatus necessary for field operation, including boiler, engine and generator, will not exceed 1,500 lbs.

Mr. Boughton has demonstrated that his signals can be read at a distance of three miles by daylight and ten miles at night. He feels confident that these distances can be increased. The apparatus can be worked at a speed of fifteen words per minute, and has the advantage of greater scope and precision than any other method of signalling in vogue.

Mr. Boughton has just completed a keyboard which contains an automatic device for recording the messages as they are transmitted. This is accomplished by an ingeniously arranged type-wheel mechanically controlled by the key bars which, when depressed, bring the corresponding letter on the type-wheel in position to be embossed on a moving paper tape, by the pressure of the armature of an electro-magnet energized when its circuit is completed by the key being fully depressed. The record produced is authentic, because it can only be made by operating the lamps.

Mr. Boughton sails in a few days for England, where he will exhibit his system to the British Navy. He will also have it in operation in Washington during the International Naval Review to be held there in April.

The American Institute of Electrical Engineers are preparing for the Chicago Congress. They want a unit of "magneto-motive force," and one of "magnetic intensity," which appears to be induction. "Magnetic reluctance" is, fortunately, preferred to "magnetic resistance"; it is a pity they adhere to "magneto-motive force" for a quantity which is not a force but a potential. They also speak of the "meter candle" and "foot candle," when they mean candle per square foot or square meter. "Current strength" appears for "current." Attention is called to these points, which would in ordinary circumstances be trivial, because in connection with an International Congress scientific accuracy is of the first importance. With most of the recommendations electrical engineers in this country will cordially agree. "Voltage" is really a barbarous word, which is quite unique in its termination, and is therefore unsystematic. "Diphase" and "triphase" are common, but inaccurate. Why not double-current and triple-current? The exact meaning of the word "phase" is seldom understood. In America electricians talk of alternators being "out of phase," and so on. The word comes from astronomy. If a planet had two or three satellites we should not say they were diphased or triphased; we should say there were double or triple satellites, or two or three of them. It is thus simpler to talk of double and triple currents. We shall probably return to the subject of electrical nomenclature before the summer comes upon us, as we fear by the autumn most of our readers will be very tired of it.—*Industries.*

ELECTRICITY

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GEORGE R. METCALFE, - - - EDITOR.
K. H. WILLOUGHBY, - - ASSOCIATE EDITOR.

W. M. ALLISON, - - BUSINESS MANAGER.

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OUR Table of Contents will be found on the last page of this issue.

To their eternal discredit be it said that, with the single exception of ELECTRICITY, the *Electrical Journals of this country have not done their duty.* If they had, the smokestacks of many a factory, now closed, would have visibly spoken of activity and business. Hundreds of men, now idle, would have been earning a living for their families. The dark cloud of impending ruin would not now be hanging over the electrical trade.

The guilt of these cowardly journals is black as hell. *The Trust could not have maintained its insolent and outrageous policy in the face of the united attack of all the electrical journals.* They have so'd themselves too cheap. A few hundred dollars more or less is no equivalent for reputation and self-respect.

Whatever be the merits or the shortcomings of ELECTRICITY, the fact remains, and cannot be blotted out, that the other electrical journals HAVE NOT DONE THEIR DUTY. The chief culprit, the Coward of cowards, is the *Electrical World.* But the conduct of all of them, since the avowed intention of the Trust to drive everybody else out of business became a matter of common notoriety, has been an exhibition of bad faith and selfishness unparalleled in trade journalism.

"Electricity," under its present ownership, has never solicited the advertising patronage of the General Electric Company.

The St. Louis Convention. The programme arranged for the Sixteenth Convention of the National Electric Light Association, at St. Louis, is an admirable one. It proves the good fortune of the Association in the selection of its chief executive officers, Mr. James I. Ayer and Mr. George F. Porter. From a scientific or technical standpoint, the meeting is sure to be a grand success, unsurpassed in the history of the Association.

But from the inception of the Electrical Industry, it has been impossible to set apart or ignore the *business* side of the Industry. By far the larger number who have attended previous Conventions have been *business men*; and it has been universally recognized that the scientific men in the trade cannot well dispense with the business men, or *vice versa.* Hand in hand, and working generally in harmony, the two elements have built up an enormous industry, one in which a vast majority of the city and town residents in this country are interested, directly or indirectly.

The chief factor in the rapid growth and development in the business has been active competition—the persistent struggle to produce something better.

If the ultimate has now been reached in electrical development, then monopoly may be endurable; if it has not been reached, the situation demands continued strife, continued competition. Technical men have as vital an interest in this subject as the purely business men.

Monopoly means stagnation, a cessation of the development of more efficient methods. Open competition means a yet more rapid improvement.

We desire to impress upon all who gather at St. Louis the momentous importance of the independent business interests in the trade, the necessity for their preservation.

Will this Convention mark a turning point, a distinct change for the better in the present critical condition of the electric lighting business, or will it be remembered as marking the end of the independent element, the end of decent business methods in the trade?

Will it stand in history as a gravestone, bearing the inscription, "Here was buried forever open competition in the electrical lighting trade of America?" A demonstration of the proper kind at St. Louis would go far towards furnishing an immediate answer.

The independent manufacturing and selling interests are not alone in danger of extinction. Central Station men have already felt the weight of the iron hand of the Trust.

It is unnecessary to dwell on the present aspects of the situation. They are too well known.

But it is imperative that consideration be given to the topic of possible relief. How can the trade free itself from the proposed monopoly?

Almost the first distinct policy announced by Mr. Coffin as President of the Trust was the consolidation of local electric lighting interests. These consolidations have been brought about in many cities. And it is pertinent to ask, Who has been benefited? What are the prospects for the consolidated companies? In no instance, save perhaps in Buffalo, has such a deal proved satisfactory. In nearly every town which has been bottled up, municipal plants are threatened, or new companies have been organized. Competition in this line cannot be killed. The price of city lighting cannot be raised without creating a new danger—a municipal plant.

We hold that the Central Station men have just as much at stake in this matter as the supply men. The prime requisite for a successful Central Station is an open market. With monopoly once firmly established, it is not difficult to foresee where the profits would go. Central Station men should not be compelled to pay any interest whatever on thirty-five millions of water.

There will never be a more appropriate time for discussion of these matters than at St. Louis. The battle will be fought and won before another year has rolled around. The next Convention may hold an autopsy over the corpse of the independent interest, or it may hold a celebration over the death of monopoly.

In our last issue we outlined several methods for securing relief. They are all worthy of consideration.

* * *

The Association and the Supply Men. At the time of the Niagara Convention a majority of the National Electric Light Association were of the opinion that the supply men and manufacturers should be excluded from voting privileges in the conduct of the Association. At that time it was perhaps best to take this action, though men of sound judgment then expressed the opinion that, with this plan in practice, the Association would sooner or later come under the control of the one company which controlled the greatest number of Central Stations.

It is not our purpose to question the wisdom of the Association in adopting this rule. Whether wise or unwise, it was done.

But it is now in order to consider the changed condition of affairs. The one company is in virtual control at the present time of an overwhelming majority of the Central Stations.

The Central Station men, who are the voters in the Association, should ask themselves the question, Cannot the supply men and manufacturers do us good in the present crisis? Have not our interests come to be identical? *Do we not need each other?*

We fail to see how there can be two opinions on these points.

Central Station men are threatened, nay, are actually experiencing, extortionate charges for supplies of various kinds at the hands of the Trust. Do they wish to see the grip of the Trust strengthened, or are they willing to assist in forcing it to relax?

Gentlemen, these are questions of vital import. Can you stand further increase in the cost of your supplies? Can you in turn get higher prices for your light, or is your business so profitable that you can still make money? Does not the craze for municipal plants, from Maine to Texas and from Washington to Florida, answer emphatically, *You cannot charge more for light?*

Is not the very safeguard of your success in business **an open market in which to buy your supplies and additional machinery?**

Cannot the Association take action which will aid in preserving this open market? And,

Cannot the independent manufacturers and supply men, if you give them a voice and vote in your deliberations, give you inestimable aid in preserving for you this **open market.**

* * *

ELECTRICITY'S Headquarters for the Convention is the Ladies' Parlor, first floor, where all our friends will be welcome.

* * *

Dividend Paying Stations. It has been unfortunate perhaps for the central station industry that in its early days the cost of incandescent lighting was considerably misrepresented, and the inference was natural that this method of illumination was at its commencement able to compete with gas lighting upon an equal basis.

That such was not the case is evidenced by the number of stations which have since been established that from a commercial standpoint have met with comparative failure. The price for incandescent lamps of sixteen candle power has generally been fixed at one cent per hour each, and it has been a matter of considerable moment to central station men to operate their plants profitably on this basis.

Every succeeding year has seen more economical methods evolved, and further refinements added in the line of central station lighting, so that to-day everything which tends to diminish the operating expenses of a station is the object of careful study by electrical engineers.

Higher steam pressures than formerly were used, compound and triple expansion engines, units of large size, automatic apparatus and every expedient which practice has shown to conduce to economy of operation are now being adopted by progressive stations.

The Brooklyn Edison Illuminating Company, whose latest plant is described and illustrated in this issue, is a notable example of the engineering skill which central station lighting should receive, and the results achieved in this case prove the possibility of competing with gas lighting at equal rates. Experience has shown this to be impossible unless every feature of economy is included, but the case just cited proves that this business may be put upon a sound financial basis if the best engineering practice is followed.

* * *

THE ELECTRIC TRUST COULD NOT SURVIVE AN IMPARTIAL AND FAITHFUL INVESTIGATION BY A CONGRESSIONAL COMMITTEE, WHAT CAN YOU DO TO BRING THIS INVESTIGATION ABOUT?

* * *

IN the defeat for re-election last Tuesday of Mr. Thomas Mud Hammett, the Trust loses its most influential agent in the Philadelphia City Council.

Common Sense Sacrificed for Dramatic Effect. The annals of history furnish almost innumerable instances where men have achieved imperishable fame through giving utterance, at a critical moment, or at a time of great popular excitement, to terse or striking expressions, which have since been incorporated into the traditions of nations, and are constantly appearing in varying form throughout the entire range of literature. Not a few even great men are better remembered by the exclamations which thus came from their lips on the spur of the moment than by all the real accomplishments of an active life. These famous sayings supply in fact the light by which we see, as if present in the flesh, many dead men.

Our first proposition is that these famous sayings, however effective they may have been at the time of their expression, are found, upon cold and unsympathetic analysis, to be either false, misleading, vague, or inaccurate, or all four.

Addison, it will be remembered, came into fame and a Government office by comparing that old sinner, the great Marlborough, to an angel, who,

> " . . . pleased the Almighty's orders to perform,
> Rides upon the whirlwind, and directs the storm."

But poets have ever been exempt from a criticism of this nature. Common sense may be freely sacrificed for the sake of poetry. In fact, the rule has been, we think, the less common sense, the greater the poet.

Examples in support of our argument could be produced without end. But we will limit them to a few famous sayings, which are found in most of the School Readers, and consequently are familiar to all.

Daniel Webster cheered the watchers at his bedside when he cried triumphantly, "I still live!" but in the next second he was dead.

Richard III. shouted, "My kingdom for a horse!" when Bosworth field was wholly lost. Therefore he had no kingdom to offer.

Patrick Henry electrified the Virginia Legislature and immortalized himself by exclaiming, "Give me liberty or give me death!" Yet he continued for many years to take his chances of securing liberty rather than seek certain death.

Nero, the infamous, cried out, "When I am dead let the world return to chaos!" But he overestimated his importance. The world is farther from chaos to-day than when Nero tortured his subjects with impunity.

Those who have followed us will admit, we believe, that our initial proposition was well founded. But would these Famous Sayings have been better unsaid? Certainly not. We are a poetic people, and like to be startled. But plain *business men* should avoid creating these Famous Sayings. Although they have in some cases preserved the authors from oblivion, they have frequently left an unfavorable impression of a man whose many estimable qualities were forgotten—*vide* Jim Fisk, who explained his lack of assistance to his associates on Black Friday by stating that it was "Every man drag out his own corpse." William H. Vanderbilt also will be longer remembered for having said "The public be damned" than for his numerous good works.

We have now cracked the shell and arrive at the kernel of our remarks: When Mr. Charles A. Coffin said, "*We are going to do this business; you may as well fold your tents and get out,*" he was talking through his hat.

This famous saying is all four—untrue, misleading, vague and inaccurate. Untrue, because they (the Trust) are not going to do this business; misleading, as it is calculated to give the ignorant a false impression; vague, because it does not specify where the Independents may get to; inaccurate, for the reason that the Independents do not live in tents. A great many of them are right here in the heart of the metropolis. ELECTRICITY'S main office is less than a mile from 44 Broad Street. In Philadelphia the Heisler Company hold forth in the marble palace of the Drexels. In Boston the Beacon Company own a strong building of brick, and will be pouring hot shot into the camp of the Trust before many weeks have passed; the Mather Company are in the centre of the town, and ELECTRICITY'S flag floats from the very citadel of monopoly, 620 Atlantic Avenue. The Westinghouse Company has a solid fort at Pittsburg, and Chicago has the Standard, Western Electric, Siemens & Halske, and many other companies, and will call out the militia to protect them if necessary. Hundreds of cities and towns have their companies, all secure in habitations of brick and stone. Not one of them lives in a tent. How can they, therefore, "fold their tents and get out?" Bosh!

We submit, in closing, that this particular famous saying would have been better unsaid; that Mr. Coffin would have been more highly respected if he had never said it; that his descendants will blush when they read it; that Elihu Thomson and every other honorable man in the service of the General Electric Company is ashamed of it for Mr. Coffin's sake; that when Mr. Coffin finally retires to Lynn, he will wish that he had not said it; and further, that he will yet wish that his company had stuck to their own legitimate business, and had not incited the infamy which is now theirs.

* * *

"LIFE is not so short but that there is always time for courtesy," and the representatives of the General Electric Company will be cordially welcomed at the headquarters of ELECTRICITY during the Convention.

* * *

THE most striking episode in the National Republican Convention of 1884 was when Mr. Daniel Webster Flannagan, of Flannagan's Mills, Texas, his trousers in his boot tops, jumped up on a chair, extended his massive right arm like the branch of a mighty oak, and shouted "What in hell are we here for?"

What Flannagan will arise at St. Louis and ask this question for the independent supply men and manufacturers?

* * *

WE GIVE it as our honest opinion that if the *Electrical World* and the *Electrical Engineer* had done their full duty in discussing the conspiracy to ruin all the smaller manufacturers and supply men, the Electric Trust would have been driven to the wall long ago.

* * *

We fear that too many of our friends who write us letters of encouragement and commendation, hold that virtue should be its own reward. We contend that virtue, in order to be of any substantial benefit to the world, must have something substantial to live on.

* * *

A few direct statements (under oath) from Mr. Charles A. Coffin and Mr. Frederick L. Ames, before a Congressional Committee, would be a valuable contribution to the stock of public knowledge.

* * *

THE ELECTRIC TRUST COULD NOT SURVIVE AN IMPARTIAL AND FAITHFUL INVESTIGATION BY A CONGRESSIONAL COMMITTEE, WHAT CAN YOU DO TO BRING THIS INVESTIGATION ABOUT ?

* * *

How many securities of electric roads in the South and Southwest which have gone into receivers' hands were transformed, by removal to the far East, into first-class collateral?

* * *

When Messrs. Barstow, of the Brooklyn station, Edgar of Boston, and Smith of New York, return from their European trip, it may be found that they have learned something of interest to other Central Station men.

* * *

No man should buy one dollar's worth of supplies of the Trust which can be purchased elsewhere. Independent concerns should be aided in every practical way, and there is no more practical way than this.

Trust Methods.

Syracuse is "Bottled Up."

Everybody is Satisfied.

In our issue for December 28 we devoted some two columns to the very interesting situation in Syracuse.

We are now advised that, as far as the Onondaga Company and the Syracuse Electric Light Company are concerned, matters have been "arranged" in a highly satisfactory manner.

If our information is correct, and we have no reason to doubt it, a use has been found for a portion of the $750,000 of bonds of the Syracuse Electric Light Company, $200,000 or $300,000 of which ELECTRICITY suggested might be used among the "proper people" in securing a franchise for the company. Mayor Amos did not approve of granting a franchise in a hurry; meantime the bonds were unsalable.

It seems that the franchise granted to the Onondaga Company was not without "riders." It did not give the company all they wanted by any means. There was likely to be a good deal of friction.

Our advices state that the Onondaga Company realized this fact, and when offered $200,000 of the bonds (4 per cent.) of their other company for their franchise and capital stock, accepted promptly. The capital stock was $250,000, one-third of which ($83,333) was claimed to have been paid in, but probably not in cash. Thirty thousand dollars would be a fair estimate of the actual cash required in securing the franchise.

The $750,000 of bonds now have *some* value, and Mr. Kirk and his associates could probably unload at a fair profit. It is easy to see where the profits of Mr. Garfield, R. T. McDonald and their associates come in. Uncle Ellery's fine hand was not "bundled up in an old New England mitten," and the records do not show that Mr. McDonald was caught napping.

The probable evolution of the remainder of these bonds into gilt-edged securities, held by the New England investing public, or perhaps the clergy of Central New York, would make a good story, and we trust that the *Standard*, *Courier* and *Herald*, of Syracuse, will work it up. We suggest an interview with Mr. Garfield or Mr. McDonald on the subject. The chief characteristic of both these gentlemen is frankness and freedom from guile, and they could no doubt give the information.

We suppose the true state of affairs has not escaped the notice of Mayor Amos, the taxpayers and the daily press of Syracuse.

There will be no competition between these two companies, and we leave it to our readers to judge whether the Hon. W. B. Kirk and his associates have been outclassed or not.

We again venture a prediction—i. e., that the subject of a *municipal* plant will receive careful study in Syracuse before the time has arrived for making another contract for city lighting. Mayor Pingree of Detroit is in position to favor Mayor Amos with a good deal of information as to the methods of the combination which now controls *all the electric lighting and a large block of the surface roads* of the latter's city.

Syracuse is an A1 city to be squeezed.

The United Electric Securities Company.

What Is There Behind Its Issues of Bonds and Stocks?

The following question and answer recently appeared in one of the daily papers of Boston:

> The United Electric Securities Company offered by advertisement for subscription $750,000 7 per cent. preferred stock.
>
> To what amount has the offering for subscription been increased since, and has it all been subscribed for?
>
> Query—How can that company afford to pay 7 per cent. for the money, and is there anything behind the stock but the capital of the company. If yea, what?
>
> MANY INTERESTED.
>
> Boston, Feb. 16, 1893.
>
> The United Electric Securities Company has a capital of $2,000,000. Of this $1,000,000 is a 7 per cent. accumulative preferred stock, all of which was offered for subscription, was underwritten, and has all been taken. The common stock is all of it held by the General Electric Company. The company does practically a banking business for the General Electric Company, and is earning large dividends on the stock. In fact it is hinted that the common is earning upwards of 20 per cent. per annum. The company buys the bonds which the General Electric Company gets in trade from electric light, railway or power companies which they have equipped, provided they are sufficiently good. These bonds are examined with great care, and if they come up to requirements are taken by the Electric Securities Company at 80, the company issuing their own debentures against them. As these bonds are afterwards sold at 92, 93, 94 or 95, the debentures issued against them are taken up, the company netting the profit between the original purchase and the selling price. Some bonds were sold the other day at as high a figure as 101, which had been originally taken at 80. Between 93 and 95, however, is considered a fair price to obtain for this class of bonds. By this management the General Electric Company, which of course receives through its holdings of the common stock of the Electric Securities all profits over the 7 per cent. on the preferred, saves a good deal of money. Each series of debenture bonds has fixed collateral behind it and it is not allowed to change the collateral. The bonds, however, can all be drawn at 105. There are eight series of these debentures listed at the Boston Stock Exchange—the first two due in 1920, the next three in 1921, the last three in 1922. Of the first series the amount is only $118,000; second, $101,000; third, $268,000; fourth, $287,000; fifth, $710,000; sixth, $795,000; seventh, $1,000,000, and eighth, $78,000. The Electric Corporation, the new company just formed, will take more ventures than this company. It will take greater risks, and at the same time possibly chances for greater profits. By arrangement with companies like these, the receipts of the General Electric Company are reduced from a credit down to nearly a cash basis.
>
> RIALTO.

The proof of this answer was no doubt submitted to the Press Agent at 620 Atlantic Avenue for his O. K. before publishing. It contains some truths, and we believe no untruths. It has been known for some time that the pace of the United Securities Company was not rapid enough for Mr. Coffin. He demands immediate "action" on his money, and would like to abolish "splits" as an unnecessary delay.

The only fault we have to find with "Rialto" is that he is all too brief. He does not crack the shell and give us the milk of the cocoanut.

If the financial editors of the Boston daily press wish to perform a real service to the investing public of New England and New York, and to the bamboozled clergy of Central New York, they will devote more investigation to this matter. It will take time, and very shrewd work; it is a closely guarded secret. But we believe our New York newspaper men would get to the bottom of it in a week. Is it possible that the Bostonians are too slow, or are they rank cowards?

One interesting line of investigation would be to find out *what collateral* is behind each of these issues of debenture bonds? The various lists must be attainable. When these lists are before you, then engage three or five electrical experts to visit the various plants against which the collaterals were issued, and appraise their value. Tell us why it was that these local securities could not be floated in their respective towns; why the glamour of mystery surrounds them; if, for instance, there are any Little Rock or Syracuse bonds among them.

A complete and impartial narrative would fill many columns of the Boston *Advertiser*, and would be worth a hundred dollars a column to any enterprising daily.

Legal Notes.

The decision of Chancellor Carroll in the case of the Thomson-Houston Company of Chicago against the Little Rock, Ark., Electric Street Railway Company and the First National Bank of Little Rock, for the appointment of a receiver, denies the application. The attorneys for the plaintiff after hearing the decision dismissed their bill, with all interventions. The court further ordered that the National Bank of Commerce of St. Louis be enjoined from negotiating income bonds transferred to it by the City Electric Street Railway.

Attachment papers were issued against the Street Car Company by Attorney George B. Rose, for the Thomson-Houston Company, after the delivery of Chancellor Carroll's decision. The amount of the first one was $186,631.46, of the second $6,365.43. The complaint alleges that the money due is for promissory notes and open account. There are twenty-three notes. The writs were placed in the hands of the Sheriff and served.

In the consolidated cases of William Harriman et al. against the People's Street Railway, Electric Light and Power Company, at St. Joseph, Mo., Judge Ramey recorded the decree ordering a sale of the lines. The court has found the bills of complaint of the Central Trust Company of New York are true, and ordered the property to be sold as an entirety and without appraisement, under the supervision of the special master already appointed, on a day to be named by him. The sale is to be advertised for six weeks in the St. Joseph and New York papers, and the master is instructed to accept no bid for less than $100,000, and to require a deposit of $50,000 in advance. The proceeds of the sale are to be applied to the costs of the suit, to the payment of claims prior in equity to the lien of outstanding bonds and coupons secured by mortgage, and then to the principal and interest of the bonds and coupons.

Note.

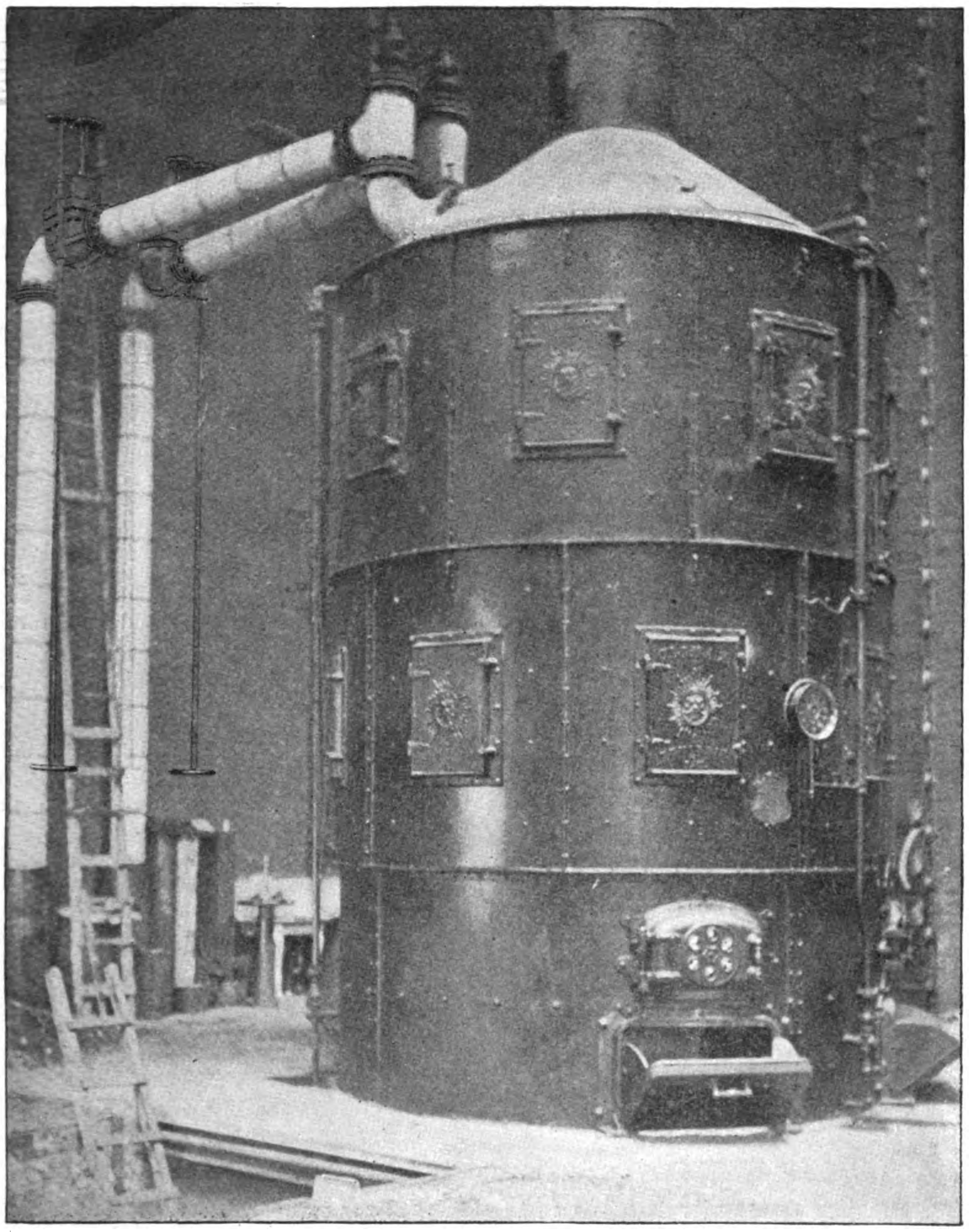
If Mr. F. T. Hardwick will kindly send us his address we will communicate with him.

A Model Lighting Station.

Where Current is Supplied at a Profit.

The Brooklyn Edison Illuminating Company's New Plant on Gwinnett Street.

The Edison Illuminating Company, of Brooklyn, although in operation only a little less than four years has found the demand for incandescent lighting in that city so large that to-day it is operating three stations whose underground system of mains from which the service wires are taken covers a distance of fifty-three miles. Of this, forty-five miles are operated by the first and second district stations and eight miles by the third district station on Gwinnett street. The latter plant, which has been built during the past year, embodies the most recent engineering practice in central station work, and the arrangement of the machinery is such as to make this the most compact plant for its capacity that can be designed, and to reduce the attendance to a minimum.



A MODEL LIGHTING STATION. (FIG. 1.)

The present building is 175 feet front and 75 feet deep and is divided into two main rooms. The boiler room in the front of the building is 52 feet 8 inches by 70 feet in area, and contains two Climax boilers, one of which is shown in Fig. 1. These are of the vertical type and contain 360 tubes 9 feet 2 inches in length and 2½ inches diameter. The boilers are rated at 250 H. P. each, and are connected to the engines by a duplicate system of piping and run at from 160 to 185 lbs. pressure according to the load on the station.

They were built and installed by the Conbrock Iron Works, and are placed so as to occupy only one half of the present boiler room space.

The steam and exhaust piping, condenser, feed water heater, etc., are situated in the basement of the building, and their general arrangement is shown in Figs. 2 and 3. The steam mains are 12 inches in diameter and are disposed so that either engine may be supplied by either main. The two pipes shown in Fig. 1 lead to the mains below, which run along the length of the building and rise directly beneath the engines. The boilers are fed by two Smith-Vaile 10" x 7" x 12" duplex feed pumps and are equipped with the Locke automatic damper regulator. The coal and ashes will be handled by a conveyor which is being put in place at present. The coal storage vaults are situated in front of the building just under the entrance, and have a capacity of about 300 tons. From these the conveyor delivers the coal to two 12 ton hoppers situated one over each boiler. By closing the coal chutes, the same conveyor is able to carry the ashes which are carried to a bin and delivered through a chute in front of the building. The conveyor was built by C. W. Hunt of New York.

A 600 horse power Conover jet condenser is used, and is supplied by four driven wells with condensing water. These wells are capable of supplying 1,500 gallons of water per minute. The stack, which is of steel, was manufactured by the Connery Boiler Works of Philadelphia. It is 7 feet 6 inches in diameter, and extends 115 feet above the grate level, and is self-supporting, there being no guy wires or other support than its connection with the foundation and station wall.

The main exhaust pipe is 16 inches in diameter, and its general arrangement and connections will be seen in Fig. 4. The condenser and Goubert feed water heater, shown in solid lines, are installed at present, and the dotted lines represent the provision that has been made for future extensions of the machinery. The James W. Birkett Manufacturing Company, of Brooklyn, were contractors for the entire steam fitting work of the station, and the valves were supplied by the Chapman Valve Company.

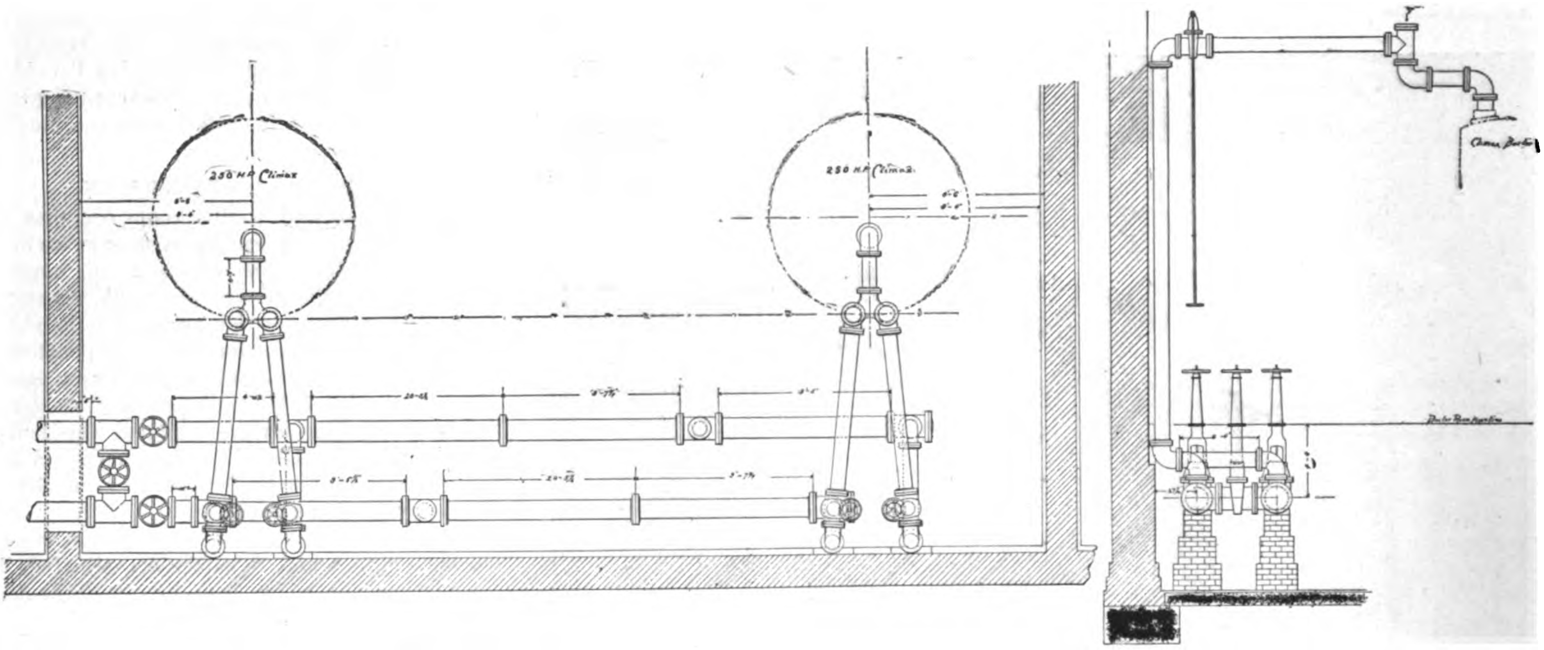
THE DYNAMO AND ENGINE ROOM.

The dynamo and engine room occupies the rear of the building, and has a floor space of 41 feet 4 inches by 70 feet, of which only one-half is occupied by the present plant. A fifteen ton travelling crane spans this room at a height of 31 feet above the floor line, and is supported on brackets built into the wall capped by bluestone slabs. The roof is constructed of steel and has a ventilating skylight running the length of the building provided with swinging sashes. This work was done by the Berlin Iron Bridge Company of Connecticut.

In one end of the room the two direct connected engines and dynamos are situated, the foundations for which are built up to the floor level. Our Frontispiece gives a general view of these machines. The smaller engine shown on the left of the cut has a capacity of 350 H. P., and the large one is rated at 850 H. P. These are both triple expansion engines of the same pattern, and were manufactured by the Lake Erie Engineering Company. The 350 H. P. engine has a stroke of 20 inches, and the cylinders measure respectively 10 inches, 16 inches and 25 inches. The large engine has a 32 inch stroke, and the cylinders are 15 inches, 24½ inches and 38 inches in diameter. The former runs at 172 revolutions per minute and the latter at 120 revolutions. Upon the same bedplate and connected upon each end of the shafts of these engines are two multipolar dynamos of the type manufactured by the Edison Company. These machines are 100 K. W. and 200 K. W. capacity respectively, the two of equal size being run on opposite sides of the three-wire system. The armatures are of the gramme ring type and the sections are connected in multiple. The operation of these machines is remarkably noiseless, and not the slightest sparking is to be seen at the brushes. The absence of belting and the slow speed at which the engines are run make it impossible to distinguish the least sound of running machinery in the adjoining room.

THE SWITCHBOARD.

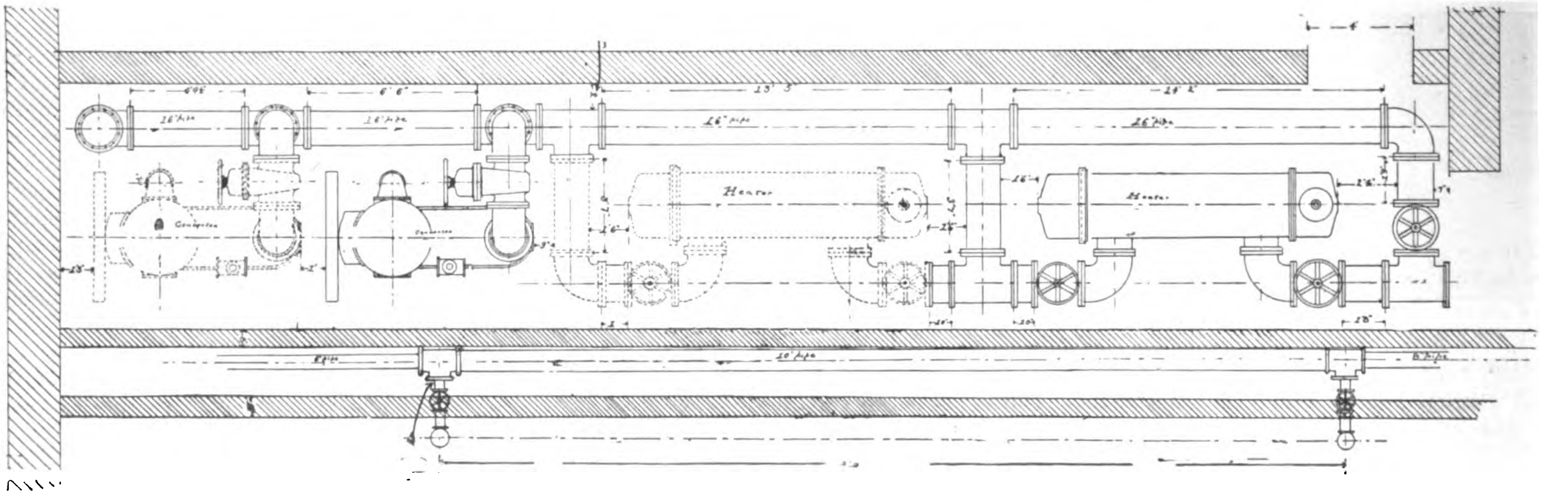
One of the most interesting features of the dynamo room, although perhaps the least conspicuous of any, is the switchboard, a view of which will be seen in Fig. 4. This is built of polished black marble, supplied by the Sullivan Mineral Insulation Company, and, as will be seen, nothing but the dials of the instruments and the switches appear on the front of the board. There are three double switches for connecting each of the dynamos with the main and auxiliary bus bars which are run behind the board, and another set of switches is used to connect the second and third district stations, so that an overload on either may be taken by the other station, the two being connected by three special cables of 1,000,000 circular mils section, and 8,290 feet in length. The first and second district stations are similarly connected, so that the chance of shutting off the lights due to accident or the overloading of either station is reduced to a minimum. The rheostats, shown at the right hand in Fig. 4, are merely temporary arrangements for adjusting the voltage of the machines, as there is in preparation a device for controlling the pressure at the dynamos entirely automatically. In changing the load from one station to another, the attendants make the necessary adjustments by communicating by telegraph. This has been found more efficient than the telephone, as the latter is liable to trouble on account of induction. The telegraph also has the advantage that the sounder may be heard while the operator is at work in any part of the room.



A Model Lighting Station—Diagram of Steam Piping. (Fig. 2.)

The instruments used throughout this station are of the Edw'd Weston make, the pointers moving over the glass dials, which are illuminated by incandescent lamps placed behind them. This makes it possible to observe the reading of each instrument from a considerable distance.

The accuracy of these instruments permits the current to be measured in a way not hitherto employed in central station practice. There are no contact joints on the board, the cables being soldered at the lugs of the switches, and connected to the bus bars without passing through the ampere meters. Two pressure wires are connected to each of these cables, at a distance of 2.8 feet, and these wires are led to a voltmeter. The latter measures the drop of potential in this 2.8 feet of cable, and is calibrated so as to give the readings directly in amperes.



A Model Lighting Station—Diagram of Exhaust Piping. (Fig. 3.)

These cables have a section of 750,000 circular mils. It has been found that a thousand amperes gives a drop of .024 volts in 2.8 feet. These readings have been compared with those of a standard instrument, and found to be identical throughout the whole scale.

THE UNDERGROUND SYSTEM.

The method of distribution adopted for the underground system of this station is somewhat different from that employed in the older stations, as is also the kind of cable employed.

Several centres of distribution are located, and three special trunk feeders, a positive, negative and neutral, each in a separate tube, are led from the station to these centres. From these points several sub-feeders radiate, whose ends are all connected by a tie line of the same size. The mains are then taken off any point on the sub-feeder system. The object of this method of distribution is to reduce the number of trunk feeders, and in consequence the cost of material and labor in laying the system.

The cables employed are called reversible, as each being in a separate tube anyone of them may be used as the neutral in case it should be burned out. This acts still further against the danger of a shut down. There are already 15,000 feet of trunk feeders laid and 6,000 feet of sub-feeders of 500,000 circular mils section. The mains are connected to the latter, and, as stated above, have a total length of eight miles.

The foregoing description and illustrations will serve to show the remarkable compactness of this plant, in which respect it is second to no other station in the United States. The space which has been reserved in this building will allow the present capacity of the plant to be more than doubled, as considerably larger units than the present ones can be used.

The operation of the station is also so simplified that but three or four attendants will be needed, and this economy in the cost of labor and the efficiency of the machinery employed account to a great extent for the satisfactory dividend paying basis upon which this company has operated.

Mr. Barstow, the General Superintendent, is at present in Europe, where he expects to study the application of the accumulator system, as well as the most recent developments in central station engineering practice, with a view to incorporating any improvements found in the future extensions of the company's works.

The officers of the company are:

Ethan Allen Doty, President.
Edwin Packard, Vice-President.
Royal C. Peabody, Secretary and Treasurer.
W. S. Barstow, General Superintendent.

Among those who have been actively engaged in the construction of the new station are: Chas. H. Thompson, architect; R. Lindsay, electrician; John W. Wolff, steam engineer; Theo. Gilleaudeau, chief engineer in charge.

A Brief Sketch of the Company.

The Edison Illuminating Company of Brooklyn was incorporated March 10, 1887, with a capital stock of $500,000. The incorporators were: Charles E. Crowell, Eugene Crowell, George W. Nash, Edward H. Johnson, John C. Tomlinson, Spencer Trask, William D. Sargent, Charles F. Bound, Charles E. Chinnock, Wm. H. Richardson and Sigmund Bergmann. The first officers of the company were: President, Charles E. Crowell; Vice-president, Charles E. Chinnock; Secretary, R. C. Peabody.

With plenty of money in its treasury, and a natural anxiety to put a plant in operation, there was nevertheless an unusual delay in getting ready to turn on the current. The Brooklyn Board of Aldermen thought they saw an opportunity to increase their bank accounts, and stood out against a franchise with permission to open the streets for subways. The Board had passed an ordinance in 1886 forbidding the granting of permits to open the streets without their consent. Of this ordinance the Brooklyn *Eagle* said: "This was thought to be an effective stopper of the spectacle of corporations getting a chance to do business without proper consultation with the representatives of the Anti-Poverty Society."

The matter was finally carried to the courts. A special bill was also passed by the Legislature, but was vetoed by Governor Hill. At length the matter was brought again before the Aldermen in October, 1888 (during the gubernatorial campaign), when in deference to the public sentiment the Board yielded. They had not been able to squeeze the orange.

There were, it may be remembered, two companies already in the field, the Municipal and the Citizens', both of which, however, were chiefly for arc-lighting.

The Edison Company's main plant in Pearl street was begun in March of 1889, and the lights were turned on September 1 following. The original capacity of this plant was 25,000 16 C. P. lights, which has been increased to 75,000 at the present time.

In 1891 a branch station was built in Lexington avenue, chiefly for residence lighting, with a capacity of 15,000 lights.

The Brooklyn Company is now second in the list of incandescent lighting companies in this country, the New York Company alone exceeding it in total capacity. In addition to the incandescent lighting business, it is doing an increasing business in arc lighting, running at the present time about 2,000 Ward arc lamps.

The capital stock of the company has been increased to $1,500,000, and a majority of the stockholders have voted for a further increase of $1,000,000. Dividends have been paid since 1891. Following is a summary of the last annual statement, submitted in January of the present year:

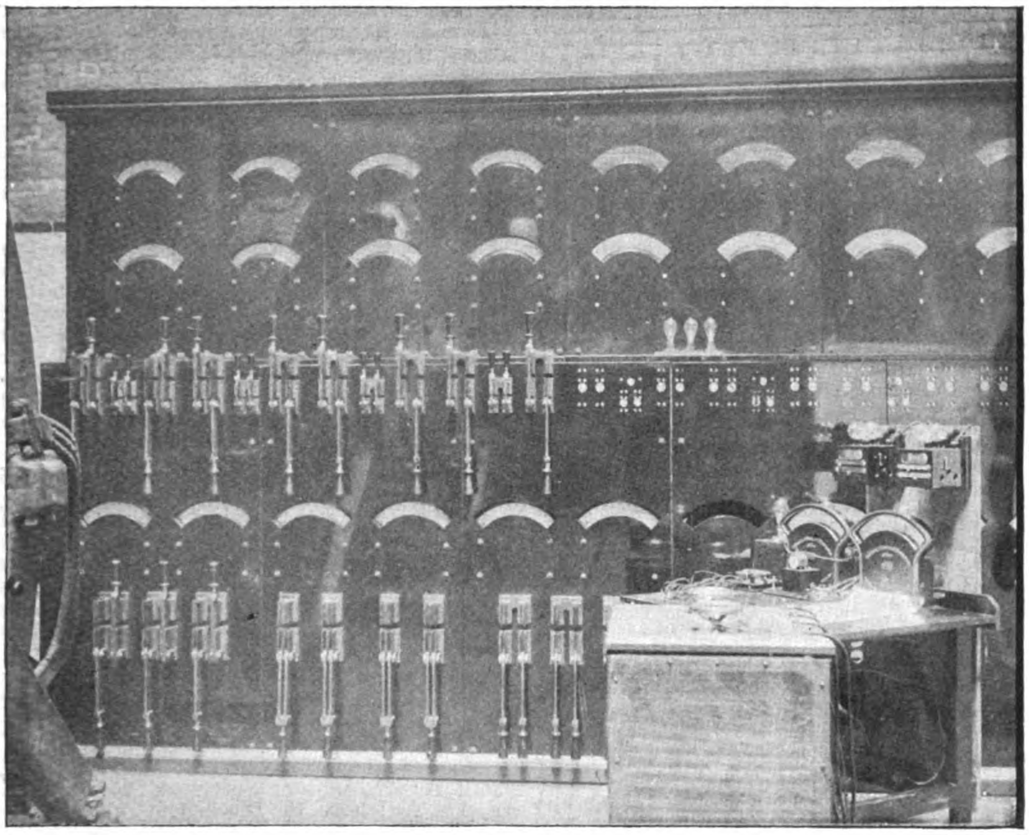
	Gross Earnings.	Operating Expenses.	Net Earnings.
First six months....	$ 98.106 59	40.919 87	57.186 72
Second six months..	1 2,804.89	62,927.92	69,966.96
	$231.011.48	108,847.80	127,153.68

Net result 12 months, first district..........	$102 606 56
Net result 12 months, second district........	23 058 05
Net result 6 months, third district..........	1.489.07
Total..............................	127.153 68
Income from all other sources................	38.445.08
Total..............................	165,598 76
Less general expenses, taxes and fixed charges..........................	64,317.01
Net income for 1892................	101.281.75

This was an increase in net earnings of 54 per cent. over the previous year.

The price of the stock has increased from par (100) to about 130.

The success of the Brooklyn Edison Company, and the sources of it, are worthy of careful consideration by central station men everywhere. It has been managed from the start by business men of high standing, who have conducted its affairs with due consideration for the rights of the public. In station equipment and accessories no money has been spared to get the best, and the three stations of the company are in the front rank of the world's central lighting stations.



A MODEL LIGHTING STATION. (FIG. 4.)

Electricity for the Paris Abattoirs.

The *Abattoirs* at Paris are about to be lighted by electricity. The City Council has recently voted a sum of money for that purpose. At present the slaughter houses and grounds are lit by gas at a cost of £6,920 ($34,600), and by adopting the "new" light, a saving of £620 ($3,100) will be effected annually. The electric light company that has mains which pass by the abattoirs is the promoter of the scheme, which comprises 91 arc lamps, 237 16 C. P. and 40 10 C. P. incandescent lamps. In the adjoining grounds and market there will be 51 arc lamps, 268 16 C. P. incandescent lamps, also 26 of 10 C. P., making a total when all lights are burning of 7,704 C. P., which will cost only £6,298 per annum. The cost of this installation will amount to $82,200, and $51,200 is to be spent on the generating plant, while $30,000 is the estimate for wire, fittings, etc.

Official Programme.

Sixteenth Convention, National Electric Light Association, St. Louis, Feb. 28, March 1 and 2.

TUESDAY, FEBRUARY 28TH.

Meeting of the Executive Committee at 9 o'clock, [illegible] parlor, Southern Hotel.

Morning Session, 10:30 o'clock.—Address of Welcome, Hon. E. A. Noonan, Mayor of St. Louis.

Address, President, James I. Ayer.

Report, Committee on Data.

Afternoon Session, 2 o'clock.—Report, Committee on Safe Wiring.

Report, Committee on World's Columbian Exposition.

Paper, A. D. Adams, "Wrought versus Cast Iron for Field Magnet Frames."

WEDNESDAY, MARCH 1ST.

Morning Session, 10 o'clock.—Paper, H. C. Meyers, "Preservation of Poles and Cross Arms."

Paper, Chas. S. Bradley, "Long Distance Transmission of Power."

Paper, L. B. Stillwell, "Under What Conditions Is the Use of Water Power Economical?"

Afternoon Session, 2:30 o'clock.—Paper, E. A. Armstrong, "Morals of Corporations."

Paper, R. H. Sterling, "Some Experiences with the Alternating System."

Paper, William Brophy, "Relation of Insurance to Electric Lighting and Power."

Evening Session, 8 o'clock.—Lecture by Nikola Tesla.

THURSDAY, MARCH 2D.

Morning Session, 10 o'clock.—Paper, W. H. Browne, "Underground Conduits and Conductors."

Paper, Calvert Townley, "Incandescent Lamp from a Commercial Standpoint."

Paper, Louis Bell, Subject to be announced.

Executive Session.—Report, Secretary and Treasurer.

Election of Officers.

The St. Louis Electric Club announces the following programme, subject to change:

MONDAY.

Afternoon.—Special Committee to meet incoming Vandalia train at East St. Louis, or farther out, if possible.

Evening.—Reception Committee at Union depot and all hotels. Informal reception at Electric Club rooms.

TUESDAY.

Evening.—Visits in carriages to the Missouri, Municipal, and Union Depot electric plants.

WEDNESDAY.

Afternoon.—Theatre party for the ladies accompanying delegates.

Evening.—Tesla lecture. Reception immediately afterward.

THURSDAY.

Afternoon.—Carriage drive for ladies through West End, Tower Grove Park and Shaw's garden.

Evening.—Theatre parties for delegates and ladies.

FRIDAY.

Morning.—Meet at Electric Club rooms at 10.30, take suburban electric cars to DeHodiamont; inspect power station; proceed out suburban road to Ramona lake; thence return by Union avenue branch to Forest Park; take carriages to Jockey Club at Fair grounds for lunch. Return, if time will permit, via Benton-Bellefoutaine Railway station, reaching hotels at 5.30.

At West Lynn, the other day, a locomotive was coupled to a large electric car and power was applied to them in opposite directions. For some time neither gained an inch, but finally with the aid of sand thrown on the track the electric came off victorious.

The best lighted city in Europe is Milan. American machinery only is employed in its two central stations. A curious feature of the system of distribution is that the wires, instead of being carried on poles, are suspended from the brackets under the eaves of the houses.

Spirit of the Foreign Electrical Press.

At the meeting of the Société Française de Physique on the 6th ult., M. Guillaume presented, on the part of MM. Sarasin and De la Rive, a large photograph of their new apparatus for the study of electric waves in the air. In a first series of researches, carried out in 1890, the authors showed that the internode or wave-length of oscillation observed along a pair of wires depends only on the resonator and not on the exciter, a phenomenon of which M. Poincaré has given the theory verified later by M. Bjerknes and M. Pérot. According to experiments which M. Sarasin has repeated before members at the central laboratory, MM. Sarasin and De la Rive showed, by small resonators, that the speed of propagation of electric waves is the same in the air as along wires. M. Blondinot has already shown the beautiful application he has made of this principle to the direct measurement of this speed. But for long waves the equality of speeds has remained without experimental demonstration, the experiments of Hertz on this point not being sufficiently clear, and indeed had led their author to believe in the possibility of a different speed. The narrow dimensions of the Hertz reflector and the first reflector used by Sarasin and De la Rive did not allow of more than one node, using a reflector with circles of more than 50 cm. diameter. After having extended their laboratory, the authors found their first results confirmed, but only obtained moderate sharpness in the phenomena; they therefore decided to work on a still larger scale, and set up in the building of the Geneva waterworks a zinc reflector of eight metres by sixteen metres; on a perpendicular raised to its centre, and at fifteen metres distance, was placed the exciter, whose large spheres were 0.8 metre diameter. The small spheres were immersed in oil. Between the exciter and the reflector a funnel was mounted to permit of observations being made in the dark as before; the observations were made by measuring, for a series of points between the exciter and reflector, the explosive distance on an interruption of the resonator; these distances, plotted as ordinates (the line joining the exciter to the centre of reflector being the abscissa), form an undulating line on which it is easy to measure wave length. The results obtained with circles of 50 cm. and 75 cm. diameter were as follows: "The wave length of a resonator is sensibly equal to eight times its diameter. In the case of normal reflection, the first node is exactly at the reflector. The speed of propagation in air is the same as along the wires." This experiment, carried out under such perfect conditions, is identical in principle with the beautiful experiment of Lippmann on the photography of colors. The air in front of the reflector is the seat of movements analogous to those which in the film of collodion determine the formation of layers giving rise to the perception of colors. Pursuing the analogy, M. Guillaume thinks that a series of semi-transparent mirrors (metallic woven fabric or wetted cloths) arranged parallel to the reflector at equal distances, would give, by reflection, as in M. Lippmann's films, perfectly pure waves. The comparison of these waves with those of the exciter would show the degree of purity of the latter.—*London Electrical Engineer.*

Personal.

Capt. William F. Rossem, formerly engineer member of the Board of Commissioners of the District of Columbia, has been chosen as Vice-President and General Manager of the General Electric Company, with headquarters in Boston.

The decision of the Common Pleas Court of Chester County, Pa., under which the city of Chester recovered license moneys for telegraph poles erected there and operated by the Western Union Telegraph Company, was affirmed by the Supreme Court.

General News.

What is Going on in the Electrical World.

Fall River, Mass.—The Fall River Electric Lighting Company has petitioned for permission to furnish power as well as light.

Riverside, Ohio.—An application has been made to the council for permission to establish an electric street railway within this town.

Youngstown, Ohio.—The project of building an electric car line from Youngstown to Canfield is now in a fair way of being carried out.

Richmond, Va.—There is a report here that the Richmond Railway and Electric Company intends to buy out the Richmond and Manchester Railway Company.

Fort Worth, Tex.—The telephone line (metallic circuit) from this city to Sherman is completed to Dallas.—A new line is under construction between Dallas and Corsicana.

Toledo, Ohio.—The indications are that an electric railway will be built from Manhattan to Point Place, following the Ottawa from the bridge at Kramer's to the Point.

Binghamton, N. Y.—Every street car in the city will soon be operated by electricity. Arrangements have been made by the Court street and East End Company whereby they will, in a few days, change their motive power from horses to electricity.

Boston, Mass.—It is reported that the Thomson Electric Welding Company has secured control of an electric loom, which is expected to revolutionize the present manner of weaving textile fabrics.

Tacoma, Wash.—The Light and Water Committee of the City Council are said to be inclined to advise the city to purchase the electric, gas and water plants of the Tacoma Light and Water Company for $1,900,000.

Odin, Ill.—A company is being organized to build and operate an electric street car line connecting the four towns of Centralia, Sandoval, Odin and Salem. It is also intended to furnish electric lights to the towns.

Oakland, Cal.—Work has been begun on an electric road on Twelfth street, the original franchise of which was granted to Grossmeyer and others and which has been purchased by W. F. Rudolph, Warren Olney and others.

Augusta, Ga.—A new electric railway line proposed is to extend to Murray Hill, and a beautiful surburban residence section will thus be brought within easy distance of the city. The length of the proposed line is six miles.

Southbridge, Mass.—The directors of the Worcester, Leicester and Spencer Street Railway Company have been notified that they have been granted a franchise for their electric line to Southbridge through parts of the town of Oxford.

Lancaster, Pa.—The extensive improvements at the Edison electric light station in this city are rapidly nearing completion, and in a short time Lancaster can boast of one of the most complete electric lighting and power plants in the country.

Bellaire, Ohio.—Steps are being taken toward building an electric railway from the upper end of Martin's Ferry to the lower part of Bellaire and the Wheeling Creek coal works, four miles west of Bridgeport. Pittsburg capitalists are said to be back of the project.

Greenport, L. I., N. Y.—It is proposed to increase the capital stock of the Greenport Electric Light and Power Company so as to build an electric railway between Greenport and Orient, and use the improved plant of the company to supply the motive power for the road.

Lowell, Mass.—The contract with the local electric light company being about to expire, the mayor has sent out a circular to a large number of cities and towns asking for information relative to the cost, etc., of electric lighting under the various systems adopted by them.

Toronto, Can.—An automatic street indicator is being introduced on the Toronto Electric Street Railway cars. Instead of calling out the name of the streets the car is provided with an indicator so that when a car leaves a corner a bell rings and the name of the street is shown.

Phœnixville, Pa.—A site has been purchased for the etablishment of an electric light plant by a company composed almost entirely of Philadelphians. The same company, it is stated, will construct and operate an electric railway in the borough, plans for which are now being arranged.

Brooklyn, N. Y.—Noah L. Cocheu, president of the State Electrical Light and Power Company, has offered $10,000 for a franchise to do business in Brooklyn. Mr. Cocheu promises, if he is granted a franchise, to furnish electric light at twenty cents per lamp less than the price now paid.

Wilmington, Del.—The rivalry between the Wilmington City Electric Railway Company and the Wilmington and New Castle Company, which were asking a charter for an electric line between this city and New Castle, having been terminated by compromise, the road will be built by the latter company.

Atlanta, Ga.—Five electric lines of street railway are proposed and under way here: the East Lake line, the White Electric line, the Traction line extension, the line to Decatur, and a line to run out Mangum and West Hunter streets toward the Atlanta University. The line to Decatur will be completed by the 1st of May.

Kalamazoo, Mich.—The General Electric Company has been granted a franchise to construct, own and operate a single or double track electric street railway with all the necessary curves, turntables, switches, turnouts, etc., in, through, over, upon and along the streets, avenues, highways and bridges in this city.

West Chester, Pa.—The projectors of the new electric railway from West Chester to Downingtown, via Cope's bridge, on the Brandywine, have organized by electing Thomas Pennypacker, of Marshalton, president, and Joseph H. Baldwin, Secretary and treasurer. It is proposed to commence building this line in a few weeks.

Allentown, Pa.—There is a report here of the formation of a company to be known as the Lehigh Valley Traction Company, the leading spirits of which are A. Johnston, of Cleveland, and John K. and Howard Page, of New York. The purpose of the company is to build an electric railway beginning at Egypt and passing through Allentown, South Allentown, Ainesville and up the Lehigh Mountain, terminating at South Bethlehem.

Paterson, N. J.—The *Call* says: "The officers of the Central Electric Railway Company expect to have cars running through to Little Falls in a short time, and then good-bye to the old stage that has done duty for so many years. It ought to be sent to Chicago for exhibition along with the Columbus caravel, the exploring boat of the Norsemen and the first passenger coach on the Pennsylvania Railroad."

Providence, R. I.—The *Journal* says: "It is not improbable that the present generation will see Providence connected by electric railway with cities, towns and principal suburbs within a radius of about forty miles. Warren, Bristol, Fall River, Taunton, Worcester, Boston, Woonsocket, Attleboro, the Blackstone Valley villages and those of the Pawtuxet Valley, and others along the Moshassuck and Woonasquatucket—in fact, wherever a steam railroad is now in operation, or projected, an electric line may parallel it or cut across country, tapping every point of importance or of promise."

McKeesport, Pa.—The present contract of the McKeesport Light Company with the city will expire June 1 next. The whole number of arc lights in the streets is 113 and of incandescent lights 57. The city pays $100 each for arc lights and $13 for incandescent lights.—A syndicate, believed to be the Widener-Elkins McKee combination, has secured options on the property of the McKeesport and Reynoldton Passenger Railway Company and the White Traction Company, with the idea of consolidating these companies in a scheme that reaches to Homestead and from there to the heart of Pittsburg.

New York.—Judge Andrews has overruled a motion to strike out a demurrer put in by John T. Zebley & Co to the complaint in the suit brought by the Edison General Electric Company to recover $31,949.74, and about a year's interest from the Eastern Electric Company, on promissory notes. John T. Zebley & Co indorsed the notes and demurred to the complaint on the ground that they were not liable.—The report of the Board of Electrical Control for the month of January sent to the Mayor's office to day, showed that eighty-eight poles and 104 miles of

wire have been removed during the month from the streets of the city. The Department of Public Works removed sixty-three miles of the wire and the electric companies the remainder.

"Okonite."

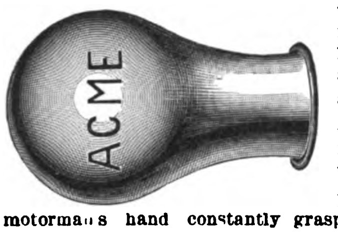
Before the National Electric Light Convention, now holding forth in our midst, has drawn to a close, we will have heard a great deal about "Okonite." "Captain Candee," "Geo. T. Manson" and the Okonite Company (Limited). There is a good reason for this. "Okonite" is rated above par as an insulating medium. "Captain Candee" and "Geo. T. Manson" are jolly good fellows, bright lights, who would be sorely missed at any gathering of the electrical fraternity, and the Okonite Company (Limited) is one of the best known and most pushing, enterprising concerns in these grand and glorious United States.

The "Captain" has just returned from a six weeks' trip abroad, whither he stayed in the interests of that wonderful compound, Okonite, and reports the affairs of the company at the London headquarters in a flourishing condition.

"Okonite" has made a grand record in this country, and is undoubtedly the most popular insulating material made. It is regarded as the highest insulation known. If you use "Okonite" insulated wires and cables you use the best. They are very tough and tenacious and are not affected by extreme changes in temperature. For electric light, telephone and telegraph purposes they stand unrivalled. If you are at all skeptical on this point, tackle the "Captain" or "Geo. T."—but be careful how you do it.

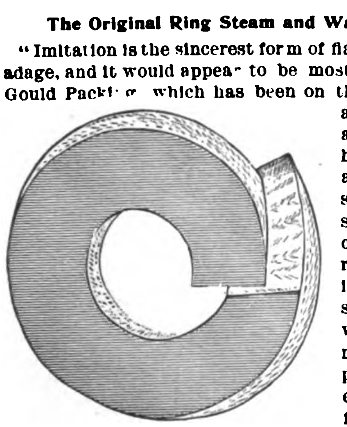
Something New for Motormen.

Since the introduction of the electric street-car system various improvements have been made tending to greater comfort and safety for the men operating the cars. Notwithstanding these changes and advances, however, motormen are subjected to inconveniences and discomforts that ought to be got rid of. Among these are occasional shocks from the electric current which will, at times, find its way through their bodies by way of the handle by which they control the current. This thing is liable to occur on any car equipped by any system. As these handles are almost invariably made of brass, it has been proven that the motorman's hand constantly grasping the handle is liable to blood poisoning should he have any scratch or skin abrasion on the hand. There have been quite a number of such cases in Boston alone, where motormen employed on the electric cars have had to lay off and even been treated in hospitals for this very thing. Any device, therefore, that is likely to ensure the men from these mishaps and painful experiences is sure to meet with speedy recognition. Such a device is the "Acme" shield, a cut of which we herewith publish. It is made of rubber to conform to the shape of the handle; can be easily slipped on and off, though it clasps the handle very tightly when in place; is a thorough insulator, and being finely finished, soon pays for itself in the saving on the wear and tear of gloves or mittens such as motormen usually wear. It is manufactured and sold by Mr. C. C. Lewis, rubber and oil-goods manufacturer, corner of Cornhill and Washington streets, Boston, from whom they can be had at fifty cents each, or three dollars per dozen. Boston motormen are in love with them.



The Original Ring Steam and Water Packing.

"Imitation is the sincerest form of flattery," says an old adage, and it would appear to be most applicable to the Gould Packing which has been on the market now for about thirteen years and continues to hold its own against all comers. Novel in shape, as may be seen from the accompanying cut, rendering this packing adaptable to any service in steam or water; made of a material specially prepared and treated scientifically before being shipped it is not to be wondered at that this specialty should have become absolutely indispensable in every electric light and power station, as well as with every engineer throughout the country.



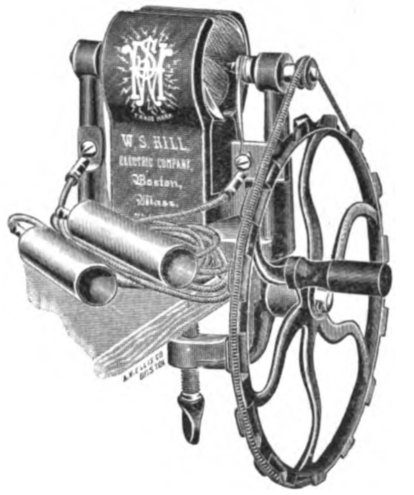
That the Gould Packing is the only "original" ring packing is proven by the fact that it was patented, manufactured and in general use no less that six years before any similar packing was dreamt of.

This packing is made by the Gould Packing Company, Cambridge, Mass., in all sizes from the largest to the smallest, hence meets every conceivable requirement.

What is Electricity?

Such is the heading given to a very handsome circular just issued by the W. S. Hill Electric Company, Boston, which title is followed by a brief dissertation answering the above cogent query.

Although covering less than a single page of said circular, the explanation will be found of exceeding interest to every one, as will also be the brief description of the powerful generator, a cut of which appears herewith. The president of this prosperous company is also the inventor of what is, without doubt, not only the most elegantly designed, but the most powerful little electrical generator now on the market. It is only a few months since this novelty was first placed on the market, and the demand instantly became phenomenal, for it was purchased in large quantities for Christmas presents, and in innumerable homes during the recent holidays this device furnished more excitement and fun than all the rest of Santa Claus' presents put together. No end of funny experiments can be performed with this miniature machine, rendering it a most welcome auxiliary to every enterprising boy's mechanical and scientific equipment and budget of fun. But not only so. It is a real scientific apparatus of great practical utility, and as such is being used extensively by medical men and others as a remedy for various ailments. It far excels the old fashioned magnetic machines for use in cases of nervous and other affections; and the manufacturers are in receipt of many strong endorsements from medical men of eminence, who now use this machine or instrument regularly in their practice with most gratifying results.



The price is only *nominal*, the demand is *phenomenal*; indications warranting the belief that there is likely to be difficulty in shipping them fast enough to keep pace with the constantly increasing demand.

Insulation.

The subject of a perfect insulating compound for electrical purposes has long held paramount sway in the minds of those engaged in nearly every department of the business, and such a preparation is a desideratum. Thus far many different substances have been used with varying degrees of success. Considering the exacting nature of the service to be rendered, and the trying conditions to be provided for, it is gratifying to know that many difficulties in this department have been overcome and a measure of perfection attained.

And among those who have made a special study in this department of practical electrical science are certain gentlemen identified with the Massachusetts Chemical Company, a Boston corporation which, after long, patient and costly research, and the most thorough scientific analysis, have possessed themselves of a preparation already widely known as "Insullac," which, since its introduction only a few months ago, has grown into all but universal demand. Not only has this new insulation been applied to the most exacting uses, and placed under the hardest possible conditions, but it has been severely tested time and again by several of the leading electrical engineering firms in their laboratories, with the unvarying result of proving itself to be a perfect insulator in every respect.

The indorsements it has received from many quarters have been of such character that the demand has become quite phenomenal, and the manufacturers have found it necessary to quadruple their facilities for producing it. Nearly every electric light and power company as well as manufacturing firm in the country, use it almost exclusively and are more than satisfied with it.

From time to time the manufacturers receive warm commendation from their customers, and they have permitted us to publish the following communication from Mr. Barton L. Peck, of Detroit:

"I have tested your Insullac and find it even better than you claim. Some time ago I insulated a Commutator with canvas which had been treated with Insullac, and the owners claim that the machine runs satisfactorily for the first time since they owned it.

"The trouble has been with the oil soaking into the insulation and burning there, causing short circuits.

"The canvas when properly treated seems to be proof against either oil or water.

"The canvas should be first treated with a thin coat of Insullac and well dried, after which it may be cut up and placed in the commutator ends and the edges trimmed down flush with the collar. Heat the commutator quite hot, and while in that condition apply a heavy coat of Insullac to all exposed parts, and allow the same to dry hard before starting the machine."

Testimony even stronger than this foregoing letter may be found on page 6 of this issue.

The Consolidated Engineering Company of St. Louis.

This company was organized Sept. 10 last, and has built since that day, or has still in course of construction the following plants: Columbia, Ill., for the Eagle Electric Company, central station, 500 light alternator, 75 horse power Ideal engine and steam plant complete; station buildings, steam and electric plant, pole line, wiring for both commercial and arc circuits, as well as installation of all lights; plant completed Nov. 24. Marion, Ill., 30 light arc, 600 light alternator, Brush Electric Company make, being built for the Marion Electric Light and Street Railway Company; contract calls for complete plant, both steam plant, electrical apparatus, lines and installation of all lights steam plant 100 H. P. Ideal engine, boilers, etc. Fayette, Mo., municipal plant consisting of 160 light arc, and 650 light incandescent, Fort Wayne Electric Company make, together with the entire steam plant, buildings, etc., engine being 125 H. P. Ideal. Rothschild building, St. Louis, small electric plant and wiring of building for 250 lights. Globe Shoe and Clothing Company, 240 light arc, 2,400 light incandescent, of Standard and National make, also wiring of entire building for 800 incandescent and 80 arc lamps.

Interesting to Manufacturers.

During a recent tour among the celebrated manufacturing districts of Philadelphia, Pa., made in company with the Investigating Committee of the famous Franklin Institute, we visited the extensive chemical works and laboratory of Mr. G. W. Lord, the well-known and popular manufacturer of "Lord's Boiler Compound."

After explaining the object of our mission, we were cordially received by Mr. Lord in his private office; and the hospitality of his establishment was courteously extended to us.

Mr. Lord personally conducted us through the many departments of his plant, fully detailing and explaining the various processes associated with the manufacture and production of chemical bodies; and further, instructed us as to the chemical properties developed and augmented by the progressive manipulation presented to our observation. Subsequently we visited Mr. Lord's laboratory, where all the requisite implements and instruments were represented necessary to effect the chemical analysis of substances whose elementary constituents were to be ascertained. The specific details and progressive processes of chemical analysis were there intelligently and instructively explained to us, after which Mr. Lord supplemented his previous assertions by prosecuting some very interesting chemical manipulations with the foreign impurities of natural waters. During these demonstrations, Mr. Lord effected the complete precipitation, neutralization and decomposition of all the incrustating and corrosive impurities contained in the sample of water examined; which was subsequently affirmed by the incompetency of the usual reagents to effect any chemical reaction.

After completing our tour of Mr. Lord's manufacturing departments, we were shown through his shipping establishment; here his celebrated chemical preventive of incrustation and corrosion, known under the trade mark of Lord's Boiler Compound, practically existed in inexhaustible quantities. Countless numbers of packages of diversified capacity were apportioned off in car-load lots, then being delivered to our representative oil houses and mill-supply houses from ocean to ocean; the tons and tons of Compound here distributed best demonstrates the popularity and demand for this superior preparation.

Mr. Lord has gained a high reputation in the chemical treatment of water; his preparations are in exclusive use by the United States and most foreign Governments, and we find his preparations endorsed and recommended in our best modern treatises on steam engineering. Like all genuine and successful commodities to which attach good will and confidence, Lord's Boiler Compound has had to contend with numberless counterfeit and imitative articles on its onward march to success. Mr. Lord presented to us for examination many letters from steam-users all over the country, who complain of the unscrupulous and dishonest representation of dealers, who have imposed upon them spurious articles represented as Lord's Boiler Compound.

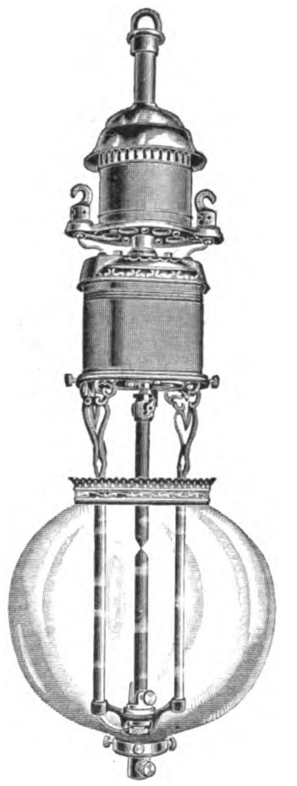
We would respectfully caution the trade against these impostors, and recommend their mailing their orders for Boiler Compound direct to Mr. G. W. Lord, 316 Union street, Philadelphia, Pa.

Unlike the many nostrums formulated by incompetent parties with which the market is flooded, and which usually consist of dangerous and inflammable oils, caustic alkalis and acids, compounded in various proportions to meet with the ideas of the manufacturer, Lord's Boiler Compound is formulated to fulfil the requirements of the individual steam-user, based upon an exhaustive analysis of the water used, and is composed only of such reagents, as are consistent with the highest chemical authority, and whose merit, both separately and collectively, has been confirmed by thirty years of usage. To those in need of a sure and effective preventive of boiler incrustation and corrosion, we are familiar with no preparation deserving of greater consideration than Lord's Compound. • • •

The New Kester-Atwood Arc Lamp.

The lamp herewith illustrated has recently been patented and placed on the market by the A. H. Atwood Electric Manufacturing Company of Chicago. The lamp is the invention of Mr. Kester, formerly of the Kester Arc Lamp Company, and has been designed especially for incandescent circuits of all potentials but the company also makes them for arc light circuit work.

The lamp is of a very neat and ornamental design, being highly finished of bronze metal and heavily lacquered. The frame work is very rigid, being made of steel and bronze metal. The feeding mechanism is exceedingly simple, being composed of a single lever clutch actuated by a single set of magnets. The lamps are made to operate on any system from 50 to 500 volts.


THE NEW KESTER-ATWOOD ARC LAMP.

COMMERCIAL PARAGRAPHS.

The Standard Electric Construction Company of St. Louis have recently placed a 150 light direct current machine of the United States type, in the Bauer-Walter Buggy and Carriage Company. They have also sold two 500 light generators to the Merrimac and Hyland Improvement Company.

Messrs. H. H. Cutler and E. W. Hammer have established a manufacturing plant at 313 So. Canal street for the purpose of manufacturing and designing electrical machinery and testing electrical apparatus. Both of these gentlemen have had a long and extensive experience in this line of work. Mr. Cutler is well known as the inventor of the Cutler non-inductive measuring instruments. Mr. Hammer has until recently been superintendent of the Chicago Electric Manufacturing Company.

The C. W. Hunt Company, 45 Broadway, New York City, is doing a big business. Its system of industrial railways for electric light and power stations and general manufacturing establishments, is becoming decidedly popular. We notice in the uptown power station of the Broadway Cable Road, New York, that the Hunt system is used for conveying coal and ashes to and from the boilers. The ash cars are run on a sunken track directly under the furnace doors and are of the latest improved pattern made by the C. W. Hunt Company.

The Weston Electrical Instrument Company, Newark, N. J., is habitually a very busy concern. Orders for the celebrated Weston electrical measuring instruments come thick and fast and continue to increase in numbers year by year. The demand for these goods from abroad is very large, the exhibit of the company at the Frankfort Exposition stirring up a general interest and call for them.

The improvements which have been made in the Fishkill-Corliss Horizontal Engine during the last few years adapt it especially for the exacting duty required in electric light and power stations, and it has come to be a very popular engine for such situations. The Fishkill Landing Machine Company, Fishkill-on-the-Hudson, N. Y., are the builders and report a lively demand for their specialty.

INCORPORATIONS.

The Camden and Princeton Connecting Road Company, Burlington, N. J. Incorporators: J. Randolph Appleby, Charles F. Blondin and James Benson, of New York City. The proposed road will be operated by electricity, and will take in a number of leading towns between Camden and Princeton, N. J. The principal office will be at Burlington.

Charters were granted at the State Department, Harrisburg, Pa., on the 20th ult., to the Phœnix Electric Street Railway Company, capital, $60,000; Interstate Traction Company, to do business in Gettysburg and Philadelphia, capital, $60,000.

The Fairview and Riverton Passenger Railway Company, Fairview, Pa. Capital stock, $25,000. Directors: Henry McCormick, James M. Cameron, Harry B. McCormick, Frank Martin and Lemuel Spong.

The consolidation of the Des Moines Water Power Electric Light Company and the Edison Light Company, also of Des Moines, has been consummated and the articles of incorporation of the new company filed. The capital stock paid up is $600,000. The title of the company under the new deal is that of the Des Moines Electric Company, and its corporate existence is to extend over a period of twenty years. The officers are: President, Fred D. Goode; vice-president, B. E. Sunny; secretary, J. A. Colby; treasurer, V. F. Newell. The officers named, together with Lowry Goode, J. I. Beggs and N. W. Jordan will constitute the board of directors.

The gas and electric light plants in the cities of Salt Lake and Ogden have been consolidated under the name of the Salt Lake and Ogden Gas and Electric Light Co. The names of the incorporators under the consolidation are: W. S. McCornick, George M. Scott, P. L. Williams, V. M. C. Silva, J. Elliot Condict, George F. Penhale and James Moffatt.

The Poulson Telephone Company, of Western New York, to operate in Erie, Niagara, Chautauqua and Cattaraugus Counties, the telephone lines to be private lines and not connected with any general office. Principal office in Buffalo. Capital $50,000. Directors: Herman W. Ladd, of Boston; George R. Taylor, Edward Smith, John C. Bains and Fred L. Bennett, of Buffalo.

The Western Telephone Company, Chicago. Capital stock, $50,000. Incorporators: J. E. Kellelyn, G. F. Stich, John F. Scanlon and Miles Kehoe. The company was organized for the construction of telephone exchanges in the United States. They claim to have control of thirty patents, covering various apparatus necessary to a complete exchange which will not infringe upon any other patents now in use by the Bell company after March 7.

Salt Lake and Ogden Gas and Electric Light Company, Salt Lake City. Capital stock, $1,500,000.

The Denver-Highlands Electric Company, Denver, Col., has filed an amended certificate of incorporation, by which it is empowered to manufacture and distribute electricity and gas.

Among the companies recently chartered at Harrisburg, Pa., was the Jersey Shore Electric Heat, Light and Power Company. Capital, $5,000.

Altoona Electrical Engineering and Supply Company, Altoona, Pa. Capital stock, $15,000. Incorporators: Wm. F. Taylor, Abraham B. Norton, Wyllis H. Markland and Edgar B. Green, all of Altoona, and Walter D. Antrim, of Camden. The objects of the corporation are to build, construct and equip electric light and power plants.

The Springfield (Vt.) Electric Company has increased its capital stock to $25,000.

The City Electric Light and Power Company, Nashville, Tenn. Incorporators: M. A. Spurr, J. N. Brooks, Jos. A. Humphreys, W. A. Wray and Wm. C. Collier.

The Adams Electric Manufacturing Company, Chicago. Capital stock, $[illegible]00,000. Incorporators: William B. Mather, William L. Sutherland, James S. Wheeler, Jr.

The Chicago Electric Supply Company has changed its name to the Kay Specialty Manufacturing Company.

Electric Light, Power and Heating Company, Springfield, Ill. Capital stock, $[illegible]0.000. Incorporators: Frank Reisch, George Reisch, J. H. Shuck, Charles Shuck, Clara Herman.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED FEBRUARY 21, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

491,988. Electric-Railway Trolley. Alfred Dickinson, Darlaston, England. Filed Feb. 9, 1892.

492,106. Conduit Railway. Frank B. Rae, Detroit, Mich., assignor to the Detroit Electrical Works, same place. Filed April 11, 1891.

492,265. Conduit Electric Railway. Fred W. Brann, Oakland, Cal. Filed May 16, 1892.

492,301. Coupling for Trolley-Wires. William H. Keckeley, Covington, Ky. Filed Dec. 10, 1892.

DYNAMOS AND MOTORS.

491,982. Electric Motor and Controlling Apparatus for Cars. John V. Capek, New York, N. Y., assignor of one-half to Edward H. Johnson, same place. Filed Nov. 14, 1891.

491,990. Multipolar-Dynamo-Electric-Machine Armature. George E. Dorman, Chicago, Ill. Filed Jan. 4, 1892.

492,036. Automatic Circuit-Breaker for Motors. Robert T. Lozier, New York, N. Y., assignor to the Edison General Electric Company, same place. Filed April 4, 1892.

492,151. Dynamo-Electric Machine. Wallace E. Freeman, Long Island City, assignor to Lawrence M. Closs, New York, N. Y. Filed July 8, 1892.

492,176. Commutator for Dynamos or Motors. Joseph A. Williams, Cleveland, Ohio. Filed May 2, 1892.

492,244. Method of Construcing Armature-Cores for Electric Motors or Dynamos. Albert W. Smith, San Francisco, Cal. Filed Feb. 20 1892.

492,274. Street-Car Motor. James A. Currie, Springfield, Ohio. Filed June 10, 1892.

492,291. Commutating Apparatus for Dynamo Electric Machines. Edward J. Houghton and William White, London, England. Filed March 26, 1892.

492,355. Magnetic Core for Armatures. Thomas H. Hicks, Detroit, Mich. Filed Oct. 6, 1892.

ELECTRIC LIGHTS AND APPLIANCES.

491,992. Cut-Out for Incandescent Electric Lamps. Thos. A. Edison, Llewellyn Park, N. J. Filed Nov. 12, 1891.

492,008. Pole-Standard for Arc Lamps. Frederick D'A. Goold, Schenectady, assignor to the Edison General Electric Company, New York, N. Y. Filed April 15, 1892.

492,124. Duplex Electric-Arc Lamp. Barton B. Ward, New York, N. Y. Filed May 17, 1892.

492,150. Process of Coating Conductors for Incandescent Lamps. Thomas A. Edison, Menlo Park, N.J., assignor to the Edison Electric Light Company, New York, N.Y. Filed Oct. 26, 1882.

492,200. Electric-Arc Lamp. Henry Harper, London, England, assignor to himself, John Tryon and Thomas George Poole, same place. Filed July 10, 1891.

492,215. Hanger for Electric Incandescent Lamps. Samuel O. Larkins, Blair, Neb. Filed Feb. 17, 1892. Renewed Dec 17, 1892.

492,295. Incandescent Gas-Lamp. Joel G. Jackson, Minneapolis, Minn., and Addison L. Daniels, Marion, Iowa. Filed Feb 24, 1892.

492,312. Electric-Arc Lamp. John Thompson, New York, N.Y. Filed May 17, 1892.

TELEPHONE AND TELEGRAPH APPARATUS.

492,110. Automatic Individual Telephone-Call Apparatus. Joseph Sack, Berlin, Germany. Filed Sept. 18, 1891.

492,019. Magneto-Telephone Switch. William Humans, Cambridge, Mass., assignor to the American Magnetic Electric Company, Jersey City, N. J. Filed July 23, 1885.

MISCELLANEOUS.

492,011. Electrical Indicator. Henry J. Haight, New York, N. Y. Filed June 1, 1892.

492,160. Electric Elevator. Frank E. Herdman, Indianapolis, Ind. Filed March 8, 1892.

492,219. Lightning Conductor and Arrester. Adelvin B. Lyman, Cleveland, Ohio. Filed Oct. 28, 1892.

492,245. Magnetic Tool. Jacob F. Standiford, Muscogee, Ind. Ter. Filed July 14, 1892.

492,247. Electrical Foot-Warmer. William E. Ulmer, Hoquiam, Wash. Filed April 27, 1892.

492,309. Electric-Bell Alarm. Gustaf L. Reenstierna, Boston, Mass. Filed Oct. 12, 1892.

492,330. Electric Burglar-Alarm. Julius Kemsler, New York, N. Y. Filed Dec. 15, 1892.

492,377. Electric Reduction of Refractory Metallic Compounds. Thomas L. Wilson, Leaksville, N. C. Filed Aug. 9, 1892.

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ELECTRICITY.

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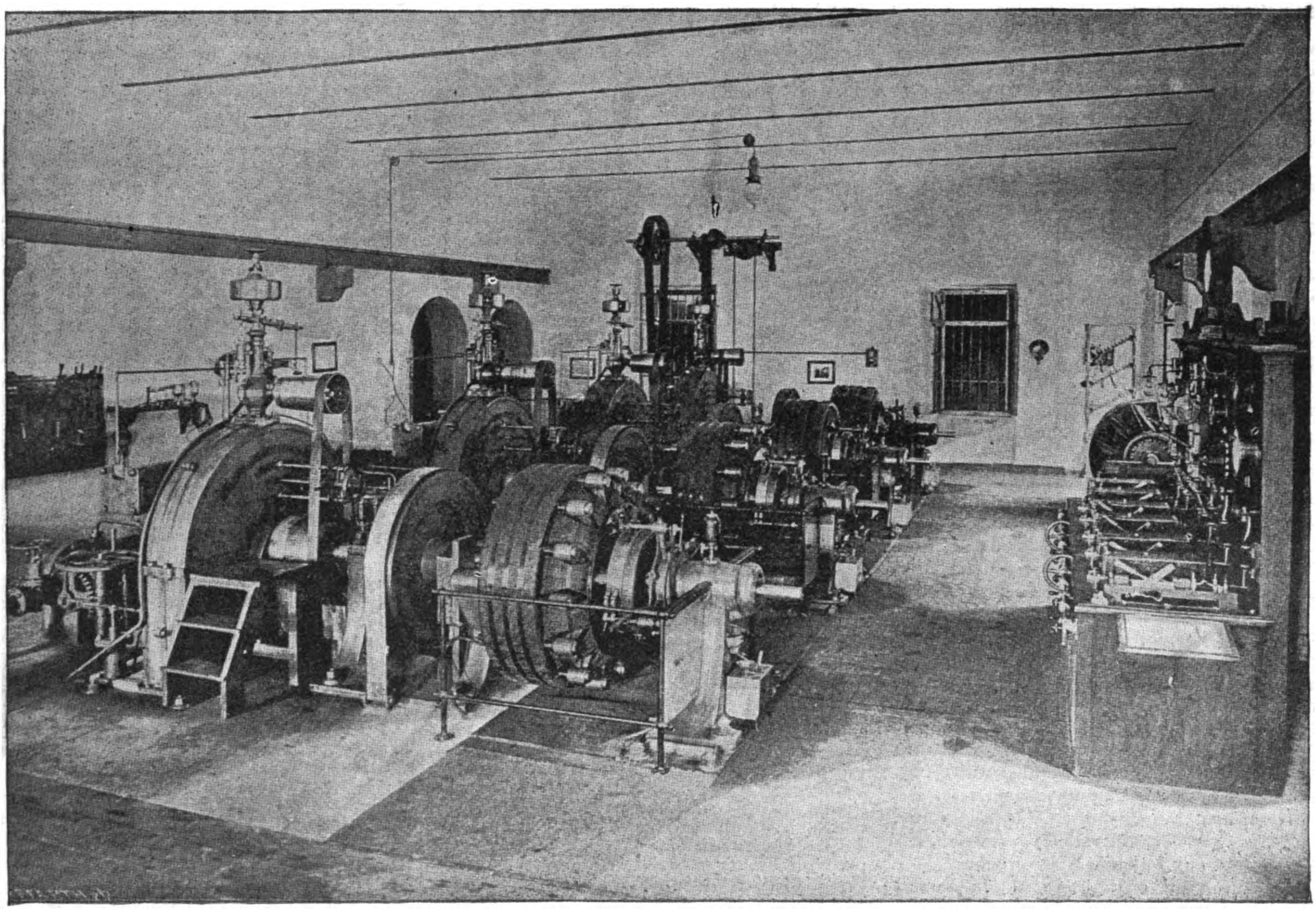

A FIVE WIRE STATION. (SEE PAGE 101.)

St. Louis Convention.

Sixteenth Annual Meeting of the National Electric Light Association.

Report of Proceedings.

The sixteenth meeting of the National Electric Light Association was held in the Bell Telephone Building, Olive and Tenth streets, St. Louis, Mo., February 28th, March 1st and 2d, 1893.

President Ayer called the meeting to order at 10:45 o'clock on the first morning, and introduced Hon. E. A. Noonan, Mayor of St. Louis, who welcomed the delegates to St. Louis in a brief address in which he said: "In the four years of my official term I have had occasion to address bodies of gentlemen representing in convention the great forces, I might say, of modern civilization; but at no time have I had the pleasure to address those concerned in what to my mind is now the greatest, the most wonderful, the most far-reaching, of all forces known to man—the force of electricity.

"You have come together in council in the greatest electric city of the world. Although somewhat in the far West from where energy is supposed to reside—along the Atlantic seaboard; although we are in a great valley where we are charged with lethargy and the taint of the lassitude that comes with a southern breeze; notwithstanding that, we find in this city of more than half a million people the greatest electric plants in the world. The birth of this great power took place before the Christian era; I am wrong—it was born with the primitive and primeval forces; it was born when light was born—when Ayer came. I mean to say that it was discovered or rather known to men earlier than the Christian era, but that its development is modern.

"I will not delay this representative body of gentlemen. You are familiar with the subject; you are masters of a science that to the layman is much of a mystery. Neither time nor opportunity has permitted me to become even in the way of an amateur familiar enough with the subject to warrant me to go any distance into that strange and remarkable field. Therefore, permit me modestly to retire from it, and leave it where it belongs—to the men who have mastered it, who are making it the study of their lives, who are giving to it all that the artist can give, all that the enthusiast does give. Let me rather go into the channel which I should follow; the channel that brings me here; the channel of hospitality, of reception, of entertainment.

"I represent the people of St. Louis. On this occasion especially have the public press announced, and in a hundred different ways it has come to me, that so far as this particular convention is concerned, St. Louis will outdo herself in making life pleasant and agreeable for the gentlemen who have come here to deliberate in our midst upon these important matters.

"Now, gentlemen, in all seriousness, this is the most important convention, in my humble judgment, that St. Louis has ever had; not in numbers of delegates, not in the great acclaim that has attended your arrival, but in the light of what you represent, in the sense of what will be accomplished by reason of your sessions here.

"Gentlemen, the City of St. Louis is yours, your wives, your daughters and your sweethearts —if you have any with you."

President Ayer then introduced Mr. Robert McCulloch, President of the St. Louis Electric Club, who said:

"Mr. President, Ladies and Gentlemen: I did not expect this of Mr. Ayer. He has followed the Mayor's directions and begun his paralyzing. I can only repeat what the Mayor has said, and that is, that the city belongs to yourselves, your wives, your daughters and your sweethearts."

Address of the President.

Gentlemen of the National Electric Light Association:

Since the first meeting in 1885 at our sister city by the lakes we have spread upon our records evidence of the wonderful progress of the great industry which we represent, and while as measured by time the years are few, the progress is marvellous. No art, no industry, no science can compare with it; and in no more forcible manner can it be presented than by stating that there is more capital invested in St. Louis in the application of electricity to-day than the sum total of investments throughout the United States for the production of apparatus and its use when this Association was born. These are facts well known, yet hardly realized by those of us who are engaged in promoting this remarkable development.

Since our last meeting much has transpired of interest to the members of the Association. Important developments have been announced from time to time through the press, as the result of the work of inventors, and many valuable items of detail have been brought out to add to the efficiency and satisfactory working of existing apparatus. The commercial development, however, has been confined to improvements in well-known apparatus and not to radical departures in character of generators as many were led to expect a year ago. More light will doubtless be given us in this direction through some of the papers we will be favored with; but there seems to be little likelihood of the introduction of new methods soon which will affect the quality of investments in existing apparatus, though there is reason to expect in the very near future that which will likely solve the problem of long distance transmission in a satisfactory manner. The much desired power motor for simple alternating circuits we are still anxiously looking for, and for some applications such motors as are known to be practical should be produced.

The recent patent decisions have introduced a new condition to many, brought anxiety and trouble to some, and satisfaction to others. To those of us who were lulled into security by the tedious delays of the courts and the persuasive arguments of our friend the salesman, who had so many advantages to offer, comes anxiety. To those of us who have only recently entered the field, and who heard very little of claims for "Foundation Patents," it is a new condition we can hardly realize, and we doubt its reality; and and we are strengthened in our doubt by those who don't want it so. To those of us who considered carefully and believed in the ultimate establishment of the inventor's claims and rights and who gave evidence in support of this faith by paying, in addition to a fair market price for the apparatus, an additional sum for the right to use it, and who have waited many years to receive the protection we paid for, comes the feeling of satisfaction.

That such a condition as exists to-day can be brought about calls for prompt action, that the rights of the people may be better protected. That the inventor can be so long deprived of his rights that many are led to believe by the delay that he has none, and to such an extent that millions are invested in developing a business made possible by his invention without regard to his claims, is clear evidence of the need of reform in our laws which will provide adequate protection for the investor as well as the inventor; and we earnestly recommend some action on the part of this Association, that our properties which have been so long regarded with distrust and suspicion by the financial world may not have added to their burdens the question of their right to use devices which are vital to their success; and to so place the station manager that he must not add to his other essential qualifications that of being able to divine what the courts may do in the far future. At previous conventions this topic has been considered, and efforts made to have Congress take such action as would give relief. Work in this direction should be taken up again by this body and vigorously pushed to completion.

In the past year much work has been accomplished by our secretary, and the showing for the year will, I feel, be very satisfactory when his report is read. Three volumes of the Association proceedings have been edited, published and delivered to members within the year, bringing this work down to date.

The interest in the procedings of the Convention evinced by the educational institutions throughout the country is one of the encouraging signs of the times, and justifies the statement (which is evidenced in many other ways) that the power and influence of the Association are extending. The increase of membership is flattering. With this condition existing there will come up for your final consideration the question relative to the reduction of dues.

From the beginning until to-day every producer and operator in the electrical field has had before him the serious problem of how to get men sufficiently skilled to execute in a satisfactory manner the duties assigned them. Undoubtedly this business has attracted in all departments the most ambitious elements from other lines of work, but as we can all testify, their education in the new field has been enormously expensive to their employers. But the future outlook is promising. While within the past three years this army has more than doubled, and the new element had little or no previous training or knowledge of the work, yet there have been established more rapidly than ever clubs, societies, trade guilds and labor organizations, with the principal avowed object of self-education. Their objects and efforts in this line are to be commended, and form a pertinent topic for this body to consider.

Within the past year there has been organized the National Association of Electrical Workers, with headquarters in this city, and having branches in many towns and cities. This organization is largely composed of linemen, though it expects to embrace in its membership electrical artisans or workers in every department. Their principal object, as stated in the first number of their journal, is to band themselves together for mutual education and improvement; to establish rooms and provide instructors, and adopt such other methods as may improve the standard of electrical labor. This organization is capable of accomplishing a vast amount of good if maintained on the high plane outlined. If the effort is earnest and honest we can all lend them a helping hand and will do it gladly. The wage question will never be an element to make a breach when the rank and file of electrical workers have mastered their business. But until that time arrives those who are among them as leaders should keep in mind that satisfactory work performed in a conscientious manner is the first essential to pleasant mutual relations between the employer and the employed, as well as the strongest lever to raise wages that can be produced.

During the year that has passed death has claimed an unusual number whose names have been prominently identified with the active promotion, development and application of electricity in its various branches. Those particularly interested in the department of telegraphy were: Cyrus W. Field, Wilson G. Hunt, F. M. Gisborne, Jay Gould and Norvin Green. In electric lighting and railways: C. J. Van Depoele, E. T. Lynch, Jr., M. M. Slattery, and in Europe, Werner Von Siemens. In this list are the names of those who have borne much of the heat and burden of the day and were among the few pioneers who hewed the path and assisted to broaden the road by overcoming difficulties which we, who find it so comparatively smooth to-day, little appreciate.

To our guests who have assembled with us and honored us by their presence, and who will further honor and instruct us with their words of wisdom, I want to express our thanks; and I trust that the members will by their presence at the different sessions demonstrate the sincerity of this expression on their behalf.

At the conclusion of his address, the President declared the Sixteenth Convention of the National Electric Light Association formally opened.

The President announced the burning of one of the largest stations under the management of Ex-President Huntley, at Buffalo, and read the following telegram:

"I regret my inability to be present. You have my best wishes for a successful convention.
"C. R. HUNTLEY."

The paper by Mr. A. D. Adams on "Wrought versus Cast Iron for Field Magnet Frames" was the first paper on the programme, after which, there being no discussion on this paper, the Secretary made the following announcements:

Letters of regret were read from Prof. Henry T. Bovey, Montreal, Canada; Prof. Ed. L. Nichols, Ithaca, N. Y.

Letters of invitation to participate in courtesies were read from Merchants' Exchange, St. Louis; Bell Telephone Company, St. Louis; Pastime Athletic Club, St. Louis; Knapp-Sellner Chandelier Company, St. Louis.

An invitation to hold the next meeting of the Association in Omaha, Nebraska, was read from Hon. G. P. Bemis, Mayor of Omaha.

On motion of Mr. Armstrong the latter was referred to the proper committee, and the former were accepted with the thanks of the Association.

The President stated that the Knapp-Sellner Chandelier Company would make quite a display of fixtures, and it was desired that as many of the delegates as possible would avail themselves of the invitation. Also that there would be open house at the Electric Club at all times of the day and night, where a buffet lunch would be served, and all in attendance at the Convention might resort at any time.

The President read the programme of entertainment provided by the local committee, a copy of which will be found elsewhere in this issue.

Mr. E. A. Armstrong then read the report of the Committee on the World's Columbian Fair, the Chairman, B. E. Sunny, not being present.

REPORT OF THE WORLD'S COLUMBIAN EXPOSITION COMMITTEE.

The Paris Exposition of 1881 was lighted in part by 1,383 arc lights, and was the first arc lighted Exposition. The Louisville Exposition of 1882 was lighted by 5,000 incandescent lights of 16 C. P. each, and this was the first use of incandescents for Exposition lighting. The New Orleans Exposition was lighted by both arc and incandescent.

The Paris Exposition of 1889 made the largest use of electricity up to that time. There were for public lighting service 1,093 arcs and 8,837 incandescents.

For private lighting there were used 623 arcs and 4,010 incandescents. The total of the service installation aggregated 3,125 H. P. capacity, and with small installations the grand aggregate capacity reached nearly 4,000 H. P. There was practically no use made of electricity as a motive power.

The World's Columbian Exposition has placed contracts for 4,500 arc lights, of 2,000 nominal candle power each, and received donations from miscellaneous exhibitors of about 700 additional. They have placed contracts for about 80,000 incandescent lights and received donations as special exhibits of about 10,000 additional. They have placed contracts for 2,900 H. P. capacity of power generators and received donations of 1,600 H. P. capacity.

They have made contracts for electrical fountains requiring an installation of 900 H. P. capacity. The aggregate of power generators and fountain plant (the latter will be used particularly for charging the storage batteries of the electric launches) is 5,300 horse power.

The total aggregate of the electrical installation therefore amounts to 19 500 horse power. The total aggregate of boiler capacity employed is 18,000 horse power on the standard rating of 30 pounds of steam per horse power. With such efficiency as should be expected from the engines installed, this represents an effective total of about 24,000 horse power.

The most interesting point of this plant will be the use of oil as a fuel. From the time the crude petroleum is emptied from the railroad tank cars into the World's Fair storage tanks, at the extreme southeast corner of the grounds, this oil becomes part of the power plant, the pressure upon the delivery pipe being automatically controlled by the steam pressure in the boilers. Delivery to boilers is made by pipes laid underground from the storage tanks to the boiler house, and the oil introduced into the furnace through an atomized jet.

A point of exceeding interest in the engine and dynamo room will be the very large adaptation of dynamos to Corliss and medium speed types of engines in direct connected combinations. The largest of these will be a set of vertical triple expansion engines with two connected armatures. At 160 pounds steam pressure this single unit will give most economically 1,200 horse power, with a capacity for continued service of 1,500 horse power output.

Next to the universal distribution of electric power for all points of the ground, the most marked advance of the time is the application of electricity to the transportation service of the Exposition. This service will be by a three mile double track elevated railroad, following all the precedents and best practices in block signalling systems, power brakes and all other safeguards of the modern steam railroad used in exclusively passenger traffic. The entire operation will be, however, by electric power drawn from an independent power plant of more than the aggregate capacity installed at the Paris Exposition. In this power house will be found the latest examples of the large range of direct driven power generators, five in number and aggregating 3,500 H. P. capacity.

To those who have not had an opportunity of informing themselves of the part that electricity is expected to play at the Exposition, these figures will be interesting and will indicate to all how much greater by comparison with preceding Expositions the Columbian Exposition is bound to be.

The sensational reports telegraphed from New York that many of the prominent electrical firms in that State had decided to abandon the space allotted to them and make no exhibit, were found on inquiry to be based on the fact that three small concerns had gone out for reasons that were personal to them. Every foot of space in the great building has been taken and every electrical concern of any consequence in the world will be fully represented.

The active work of preparing for the exhibits has been going forward for some weeks and many of the electrical firms have made substantial progress in the erection of their booths.

The intellectual programme under the auspices of the World's Columbian Auxiliary promises to be of remarkable interest. As you know, Prof. Elisha Gray is at the head of the electrical branch and he now has assurance that the gathering of electricians from all parts of the world will be a grand one.

Respectfully submitted.
B. E. SUNNY, Chairman.

At the conclusion of the reading of the report, the meeting adjourned until 2 o'clock.

AFTERNOON SESSION.

The President called the meeting to order at 2:30 P. M. The first business of the session was the reading of the paper on "Relation of Insurance to Electric Lighting and Power," by Mr. William Brophy. At the close of the discussion on this paper, Col. Meyer announced that President Scullin of the Union Depot Railroad would provide special cars for such of the delegates as desired to visit the power station of the company in the evening. The paper by Mr. R. H. Sterling was then read, on "Some Experiences with the Alternating System." After which the Convention adjourned until Wednesday morning.

Wednesday, March 1, 1893.

MORNING SESSION.

President Ayer called the meeting to order and announced the first business to be the paper by Prof. George Forbes, of England, on "Thermal Storage for Central Stations," which was discussed at considerable length during the morning session, after which the meeting adjourned until 2 P. M.

AFTERNOON SESSION.

After Mr. Charles S. Bradley, of Rochester, N. Y., read to the Convention his paper upon the subject of "Long Distance Transmission of Power," the President stated that there were three papers on this particular subject, one by Mr. Bradley, one by Dr. Louis Bell, and one by L. B. Stillwell. The subject was treated by the three gentlemen from three different standpoints and could most profitably be discussed after listening to all of them.

The next paper on the programme was that by Dr. Louis Bell, entitled "Power Transmission for Central Stations," which was followed by Mr. L. B. Stillwell, of Pittsburg, who read his paper, "Under What Conditions is the Use of Water Power Economical?" After the discussion of these papers the President then laid before the Convention an invitation from the Seigel Gas Fixture Company to visit their establishment at 219 N. Broadway and inspect their stock of gas and electric lighting fixtures, and also an invitation from Mr. Henry Sylvester to inspect at 113 Chestnut street a model of a special type of underground subway which in the opinion of Mr. Sylvester might be of interest to some of the members and which he would be happy to exhibit. Also a communication from the Columbian Underground Electric Traction Company inviting the Convention to inspect a new street-railway system, underground conduit. Also an invitation from the St. Louis Car Company to examine a new model president's car constructed by it for the New Orleans street-railway system, costing about $9,000, and at the same time offering the use of carriages to convey such of the members as signified a desire to examine the car mentioned.

The Convention then adjourned until 10 A. M. Thursday, March 2, 1893.

Thursday, March 2, 1893.

MORNING SESSION.

The Convention was called to order at 10 A. M. by the President, who announced first that any of the members of the Association who might desire to visit any of the theatres of the city of St. Louis this evening would be provided with tickets for that purpose upon application to the Secretary; and second, that the first order of business of the day would be the reading of a paper by Mr. W. H. Brown, of New York, upon "Underground Conduits and Conductors." Mr. Brown not being present in person, the President called upon Mr. William Hammer to read Mr. Brown's paper for him.

Mr. William Hammer, in response to the request of the President, then advanced to the platform and read to the Convention Mr. W. H. Brown's paper, entitled "Underground Conduits and Conductors, and the Experiences of the Electric Lighting Companies of New York City." This was followed by a lengthy discussion by Messrs. DeCamp, Francisco, Moore and others. The next paper on the programme was "The Incandescent Lamp from a Commercial Standpoint," by Calvert Townley.

Mr. Townley on introducing this paper said: "Before beginning to read the subject matter of this paper I want to ask your indulgence to one thing. In listening to papers at gatherings similar to this one, I myself have found it impossible, wherever there was any considerable amount of mathematical formula presented in the paper, to follow the formula while the paper was being read. In preparing this paper which I am about to read to you I obtained some results which appeared to me rather remarkable, and which I do not feel justified in presenting to the Association without giving a certain amount of mathematics to show that they are correct. It has therefore been necessary to insert in the paper a number of mathematical formulæ which are more or less of a complicated nature, and in order to make the intelligence of the paper continuous I shall have to read them, but as the paper is printed those who care to do so can consider such formulæ at their leisure afterwards."

The paper on "The Incandescent Lamp from a Commercial Standpoint" was then read by its author, Mr. Calvert Townley, after which a recess was declared until 2 o'clock.

AFTERNOON SESSION.

Vice-President Armstrong called the meeting to order. The first business was the reading of the paper of Mr. H. C. Meyers on "The Vulcanizing Process for the Preservation and Strengthening of Poles, Cross Arms, Ties, etc.," after which the paper of Mr. E. A. Armstrong on the "Morals of Corporations" was read.

The discussion on the paper of Mr. Calvert Townley, on "The Incandescent Lamp from a Commercial Standpoint," which was read at the morning session, and discussion on which was postponed until the afternoon session, was then taken up.

A rather general discussion was participated in on the relations of the supply companies to central station men which was incidentally introduced. Prof. Weston gave a description of the successive stages through which the incandescent lamp has passed as regards the production of the carbon and guarding against the rapid destruction of the lamp.

The general discussion concerning the supply companies was participated in by Dr. Bell, A. J. DeCamp, T. C. Smith, J. J. Burleigh and W. S. Howell.

The question was referred to the Committee on Relation Between Manufacturing and Central Station Companies.

Mr. Armstrong offered the following resolution:

Resolved, That the sincere thanks of this Association are due and are hereby tendered to the citizens of St. Louis, the Electric Club, the Electrical Exchange, the Bell Telephone Company and the city press for their very full reports, as well as to many others, for the very elaborate courtesies they have extended to us, which have rendered our stay here so exceedingly pleasant. We have discovered that the kind proffer of His Honor the Mayor in his welcoming address has been liberally realized. St. Louis and all that she has is ours.

The resolution was unanimously adopted.

Mr. Armstrong also offered the following:

Resolved, That we extend as an Association and individually our thanks to our esteemed President, James I. Ayer, for the ability and courtesy with which he has discharged the responsible official duties of his position. As individuals we want put on record the fact that from our experience here in St. Louis at this Convention we have learned that his affability is perfectly generated, is of the highest efficiency, the lines are innumerable and are all overground, the current is sent out without a drop or flash, and on these lines there is no switchboard, throw-out, cut-off or arrester; and against its power no amount of trouble has been able to act as an insulator.

The resolution was unanimously adopted.

President Ayer responded to the resolution and expressed himself as pleased to know that the delegates had been so well provided for; and said that he in turn was indebted to the citizens of St. Louis for the earnest efforts they had put forth on this occasion.

He thanked the gentlemen for the attention they had given to the meetings of the Association.

At this point the regular sessions closed, and the meeting went into executive session.

An interesting feature at this time was the passage through Tenth street of the vehicles used in the service of the Municipal Electric Light and Power Company of Missouri, of which Mr. Ayer is general manager. The procession consisted of the superintendent's light wagon, pole wagon, dynamo wagons for the handling of heavy machinery, linemen's wagons, trimmers' carts, inspectors' carts, line repairers' carts, metermen's carts, and one or two other kinds of carts, the whole aggregating about eighty. The company serves a territory of upwards of sixty square miles in St. Louis and East St. Louis, and finds these vehicles necessary in the conduct of its business.

In the executive session the Secretary's report was read, which showed the Association to be in a most healthy financial condition.

There were thirty one new active members gained during the year, and the total membership of all classes is now 250.

Nikola Tesla and James I. Ayer were elected as honorary members of the Association.

A hearty invitation was given to the Association by Dr. E. C. Kilbourne, of Seattle, Wash., for the Association to meet there next year. The invitation was most cordial, and went to the extent to state that the expenses of every one in attendance at the meeting would be paid by the citizens of Seattle.

The following were elected the officers of the Association for the ensuing year:

President, E. A. Armstrong, Camden, N. J.
First Vice-President, M. J. Francisco, Rutland, Vt.
Second Vice-President, C. H. Wilmerding, Chicago, Ill.
Secretary, George F. Porter, New York.
Members of the Executive Committee:
J. A. Seeley, New York.
E. F. Peck, Brooklyn.
A. J. DeCamp, Philadelphia.
W. A. Morrison, Woodstock, Conn.
H. J. Smith, New York.
C. H. Blaxter, Pittsburg.

The place for holding the next meeting was referred to the Executive Committee.

The Convention then adjourned.

Wrought versus Cast Iron for Field Magnet Frames.

BY A. D. ADAMS.*

The modern bi-polar dynamo may be broadly divided into two essential parts, the field magnet and the armature.

The office of this armature is to conduct magnetism through its core, and cut or cross this magnetism by means of its windings or inductors.

The office of the field magnet is to conduct magnetism from one side of the armature to the other, and usually to carry the field coils.

It is entirely possible to draw a current from an armature when revolved within an exciting coil, even though it have no field magnet to complete the magnetic circuit.

One objection to such an arrangement would be the excessive amounts of copper and energy required in the exciting coil for a given effect, as the lines of magnetism would have to pass through the air in order to complete the magnetic circuit from one side of the armature to the other.

The great advantage of the combination of the armature and field magnet over the above arrangement lies in the fact that the field magnet forms a magnetic path of much less resistance than the air.

The same reasoning that leads to the completion of the magnetic circuit through the field magnet seems to indicate that the best metal for this purpose is that having the greatest magnetic carrying capacity and permeability per unit of area and cost.

The aim in this paper is to point out some of the advantages of wrought iron over cast iron for the field magnet frames of bi polar dynamos.

The researches of Prof. Ewing and Dr. Hopkinson show that the same magnetizing force per unit of length, as measured in ampere turns, which produces in good hammered scrap iron a magnetization of 100,000 lines per square inch, produces in good gray cast iron only about 42,000 lines per square inch, and these values are about as high as we can go in either of these metals and get anything like a proportionate increase in magnetism for increase in magnetizing force.

If, then, the same number of ampere turns are to be used for a given length of magnetic circuit, cast iron must be about two and a half times the section of wrought iron.

Since the field magnet, to have the same magnetic carrying capacity at the same permeability must have about two and a half times the section when made of cast as when made of wrought iron, the weight of cast iron for the same type and capacity of machine will be about two and a half times that of wrought.

In order to compare the relative amounts of copper required in field magnet windings for machines of the same capacity, but with different metals in the field magnet, the same wattage or exciting current must be assumed for all types.

Take two machines of the same type and capacity, with the same length and section of air gap between the armature core and pole pieces, and let one field magnet be made of wrought and the other of cast iron throughout, each having the field magnet core circular in section and the area of the cast iron core two and one-half times that of wrought.

Since the ampere turns required on each magnet are equal, also the watts expended in winding, there will be the same number of turns of wire on the cast iron as on the wrought iron field.

As the two field cores are circular in section and one two and a half times the area of the other, the length of wire required around the cast iron will be to that around the wrought iron core as $\sqrt{2\frac{1}{2}} : 1$.

Since the weight of copper required to transmit a given amount of electric energy at a given pressure and loss varies as the square of the distance, the weight of copper on the cast iron will be to the weight of copper on the wrought iron core as $(\sqrt{2\frac{1}{2}})^2 : 1^2 = 2\frac{1}{2} : 1$.

The general practice among American manufacturers of bi-polar dynamos and motors is to use either cast iron entirely or cast iron yokes and pole pieces and wrought iron cores.

In the latter case the sections of the cast iron parts are usually made only about one and a half times that of the wrought iron.

With these proportions between the wrought and cast iron either an excessive amount of magnetizing force must be expended to drive the magnetism through the pole pieces and yokes, or else the wrought iron core must be only saturated to a very low degree.

The amount of copper or field current must be in either case considerably increased above that required when the cast and wrought iron parts have their correct relative proportions.

Magnetic leakage is considerably increased by the use of cast iron, as compared with wrought iron, by reason of the greater surface of the cast iron, also the much higher relative degree of saturation at which it is frequently used.

It is evident from the above that the weight of iron and of copper for the field magnet and winding in a machine of given capacity are both more than twice as great when cast as when wrought iron is used entirely.

When the field magnet is made partly of cast and partly of wrought iron, the increase of iron and copper is not so great and varies with the relative section of the cast and wrought iron parts.

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* Read before the National Electric Light Association, St. Louis, Mo., February 28 and March 1, 2, 1893.

The advantages of wrought iron over cast for the field magnets of bi-polar dynamos seem to be more generally appreciated in England than with us, as nearly all the leading makers of such machines there use forged wrought iron entirely for field magnet frames.

As the relative magnetic value of wrought and cast iron becomes more generally appreciated by dynamo builders in this country, the former will, no doubt, be much more generally adopted.

The following data of a two horse-power, 110 volt motor, designed by the writer, and having a forged wrought iron field magnet throughout, may be of interest as illustrating some of the above points:

Type of motor, bi-polar.

Type of armature, smooth core, Gramme.

Weight of motor, 250 pounds.

Speed of armature without load, 1,700 revolutions per minute.

Turns of wire on the armature, 360.

Size of wire on the armature, No. 15 B. & S. gauge.

Weight of armature wire, $3\frac{7}{10}$ pounds.

Resistance of armature, cold, $\frac{32}{100}$ ohms.

Resistance of field coil, cold, 140 ohms.

Current in field coil, $\frac{78}{100}$ ampere.

Wire in field coil, 26 pounds No. 21 B. & S. gauge.

Particular attention is called to the number of indicators on the armature of this machine, namely 360, which is very small when its weight and the moderate speed at which it runs are taken into consideration.

It is very evident that these results could not have been obtained had cast iron been used, either wholly or in part, for the field magnet.

It may be pointed out that the weight of wire and the energy required for field excitation might have been considerably reduced had it been thought best to reduce the length of the air gap, but it was desired that the field exciting force should practically overcome the tendency of the armature to distort the magnetic field in the air gap, which result has been obtained by the above construction, so that no change of lead, with the brushes, is necessary when the load of motor is varied from nothing to its full capacity.

Relation of Insurance to Electric Lighting and Power.

BY. WM. BROPHY.†

Is has been my good fortune to be in a position to witness the early attempts to introduce the electric light, and the attitude of the insurance companies and their agents as well as State and local boards.

To say that they received this new form of illuminant with unmistakable manifestations of welcome would not be in exact accordance with the truth.

Insurance companies have paid dearly in the past for the mistakes of those engaged in the introduction of all modern forms of artificial illumination and many forms of heating.

But in spite of their evident hostility, the electric light made slow but steady progress in the good graces of the public, and while looked upon as being capable of doing more than its share to reduce dividends on insurance stocks, yet it has gained somewhat in favor with them.

The insurance inspector instead of assuming a knowledge which he did not possess, for the sake of increasing his own importance in the eyes of those who employed him, kept in touch with those whose daily experience enabled them to detect any inherent weakness in the devices and systems of transmission, and enabled him to assist in perfecting the same by advocating all improvements that increased the safety and did not impair the efficiency of the system. In this way the standard of safety has been raised to a degree that approaches perfection.

In this way fire losses caused by electric current decreased, notwithstanding the enormous increase of electric light, power and railway business, and the fears of the insurance companies were in a great measure allayed. In marked contrast with this mode of procedure is that of certain insurance inspectors and others who are now engaged in an attempt to undo all that has been done to bring about an era of good feeling between these two great interests and enable them to work together harmoniously.

This attempt at mischief-making is all the more reprehensible owing to the progress that has been made toward harmonious relations at a meeting of your representatives and those high in the councils of insurance associations. With the exception of one or two of those present at that meeting, all expressed themselves in the most friendly terms toward those engaged in the electric business, and desired to cultivate this feeling of friendship.

The real fact in the case is that millions of insurance has been placed by the agents and brokers on property that is far more hazardous than the very poorest electric light plant in the business portion of the city, and in view of the fact that it is now proposed to add a small charge to the rate of insurance where electric lights "are installed in compliance with board rules and specifications," and a charge of 25 cents where they do not meet with the approval of the insurance inspector, I would advise you to proceed with as much care as though the building in which you are installing wires and fixtures was your own and you had no insurance on it. Do not rely on the uncertain movements of the insurance inspector. You are the one whose business will suffer from the bad effects of fires caused by defective wiring.

Do not place a station in some old abandoned building, as an increase of rates will follow. Do not set your machinery down on the ground and build a tinder box around it, for besides assuring high rates of insurance it does not speak well for the business sagacity of the owner.

Proceed as though you proposed to do a legitimate business and for all time. Build your station on solid foundation, the walls of brick or stone, not over two stories high.

Take every possible precaution known, and you need have no fears of acts of unneighborly conduct or apparent neglect of your property by the ever active insurance agents. Instead of waiting for you to seek them out and beseech them to insure it, they will be as attentive to you as the most ardent young suitor ever was to his lady-love. Remember that so-called tariff rates and agreements, that hold insurance associations together for the purpose of maintaining high rates, are but ropes of sand, and that keen weapon, active and oftentimes bitter competition, is continually cutting it up in little pieces and letting this craft, that should be rightly named "Trust," drift on the hostile shore of independent action.

Some Experiences with the Alternating System.

BY R. H. STERLING.*

To those who adopted the alternating system in the early days I need not recall the feelings with which we looked on this long-distance transmission of energy for incandescent lighting. It was such a gigantic stride—such a radical departure from previous methods of incandescent lighting—that many who had experimented for the benefit of parent companies before were a little cautious about nursing this new infant up to the state of practical manhood. Especially were we so when so much was said and written by the opposition side and by others who claimed to be non-partisan. However, our company, among the first, did install a large alternating plant—the largest, I believe, at the time in the United States. How wise we were in doing so I will answer by pointing to the enormous growth and success from the start of alternating current lighting, and its finally being fostered by those who were at first its bitterest enemies.

A few minor details in apparatus did not just meet the requirements for practical use; but our parent company has always been willing to adopt the suggestions of its users and remedy defects discovered by them—a plan, by the way, which should be followed by all who manufacture apparatus—for the central station men are those who are best able to judge its merits and criticise it from all sides.

I will begin with the switchboard. A circuit board is eminently better made of marble, as a matter of both safety, durability and appearance, and should have plenty of space between it and the wall. The dynamo bus wires should run in horizontal rows on the back, with plug holes extending through to the front, to connect to either side of the changing switch. There is a changing switch, of course, for each feeder or circuit, and all bus wires can be connected to any particular feeder. The front of the board should be divided into perpendicular panels, each panel representing a feeder.

On the back there will be the converter for voltmeter, compensating devices, etc., and the fuse blocks. These are preferably placed on the back, as it is an unpleasant thing to have a fuse blow in a man's face, and they should not be so high on the board that they cannot be reached standing on the floor. Many of you, undoubtedly, have had trouble with a fuse arcing, and finally melting the fuse block into a conglomerate mass, or setting fire to the switchboard. There are two simple remedies for overcoming this: one is to have all fuses covered with a piece of asbestos paper rolled around the fuse wire or link in the form of a tube, a little larger on the inside diameter than the wire, to allow for radiation of heat, so that the fuse will not melt under its rated capacity. These asbestos tubes are very easily made, and can be pasted either with shellac or silicate of soda, which is preferable, the idea being that when a fuse is blown the pent-up gases in the tube are forced out at either end so violently that the resulting arc is dissipated immediately.

Another simple plan to prevent arcing is to have all fuse blocks placed on a narrow shelf, with their faces up, as there is always a tendency in an arc to take an upward direction owing to the current of heated air resulting from it, and in taking this direction there is a natural pulling away of the arc from the two metallic portions of the fuse block, whereas were it in a perpendicular position with the current usually coming in at the bottom of the block, this upward tendency of the arc only completes the path across the gap, and so continues arcing. Fuse wire as now made is quite reliable as to its carrying capacity, but, like many other good things, is not trustworthy if abused. A lead fuse, either wire or flat link, should never be screwed down under a screw head and washer, no matter how small the carrying capacity it is intended for. This may do for a short time, but the soft metal soon loosens up, a poor contact is formed and the fuse melts from the heat thus generated, causing no end of annoyance. This applies to fuses, no matter where they are used, all over the circuit. The one way out of this is a small flat copper terminal, slotted to slide under the screw head, and soldered to each end of the fuse wire. We now compel all wiring contractors to use a copper terminal fuse, and we ourselves replace all blown-out ones with this style; but with seventy-five thousand lights connected up, we do not see our way clear to weeding out the old fuses just at present; so let this be a warning to those young in the business.

On the front of the switchboard we have for each section or panel a volt and ampere meter for every feeder, one over the other, and surmounting these a pilot lamp run from the converter supplying the voltmeter, whose primary should be tapped on the feeder wire above the fuse block, so that should a fuse go out quietly, as is generally the case when fuses are arranged in the manner I have mentioned, the attendant's attention will be called to the fact by the extinguishing of the pilot lamp. The changing switch, generally placed on the front of the board for each feeder, should be about breast high, so as to be easily reached to make a quick throw. I say usually placed on the front of the board, as it is only recently that a new switch has come out that has its jaws and contacts so arranged that it can be placed on the rear of the panel, with the lever extending through a slot to the front of the board. Placing the switches horizontally will lessen greatly the continuance of this arc on the same principle that I have mentioned the placing of fuse blocks on the switchboard with their faces up, and a fibre or slate partition between the jaws will prevent the arc short-circuiting the dynamo. It is due to inductive discharge from converters and line, and is similar to the extra current or field discharge of a dynamo. Its occurrence depends largely upon the period in the wave phase at which the circuit is opened, and is proportional to the length of the circuit and the number of converters connected on the line. I have found this discharge to occur more frequently on circuits whose converters were partially loaded. This would naturally seem to be the result when the secondary coils of the converters were exerting no action on the primary, but I have had the most severe arcing on circuits with heavy loads. The damaging result of these arcs, however, has been entirely diminished since placing the switches horizontally, as I have described. I have spoken only of the feeder ammeters. There should, of course, be an ampere meter for each dynamo. These are preferably placed together in a group at one end of the board, so that at a glance the attendant can see what load he is carrying, or on what dynamo there remains room for more feeders as the load comes on or goes off. The regulators and rheostats can be placed at the base of the switchboard, or much better, if there is room, in a compact row out in front of the board about four feet on a strong framing of wood or iron, so that all the voltmeters can be watched at the same time that the adjusting of the pressure is taking place. This saves the annoyance of the attendant jumping from the rheostat out to the front to catch a glimpse of the voltmeters to see how near he has come to guessing at the right amount of resistance he should have thrown in or out. The result will be far better service if the rheostats are thus arranged.

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† Abstract of paper read before the National Electric Light Association held at St. Louis, Mo., February 28 and March 1, 2, 1893.

* Abstract of Paper read before the National Electric Light Association at its Sixteenth Convention, St. Louis, Mo., February 28 and March 1, 2, 1893.

This now brings us up to the remaining feature of the switchboard—the lightning arrester. There may, however, be a lightning arrester on each side of every feeder, placed in a row at the top of the board or on the wall back of it, and a heavy copper wire running along past this row and connected to each arrester with a tap wire, and the main wire leading to a good ground in as straight a path and with as few crooks and turns as possible, as every bend offers a source of self-induction detrimental to the flow of the lightning discharge. The source of ground cannot be too perfect; have several of them radiating off to different points, so should one fail the other may be relied upon. The lightning arrester itself should be an instrument devoid of fuses, be capable of rupturing instantly the arc formed, and still remain set for a second discharge; should be free from all moving parts, not absorb energy, and should be so reliable and substantial that they could be set up anywhere on the line and forgotten and still perform their duty. A very convenient method I have found to make a reliable earth connection for arresters out on the lines, is to dig a hole at the foot of the pole about two feet in diameter, three feet deep and driving down through it a twelve foot length of one and a quarter inch galvanized iron pipe, having on the lower end a driven-well point to allow it to be driven easily, and a cap screwed on the upper end to prevent the sledge hammer splitting the pipe. The No. 6 wire can be more thoroughly soldered to the pipe before it is sunk. The upper end should be driven to about one foot below the surface, and the hole filled in with finely broken coke, which increases the conducting surface at that part of the earth that is the dryest, and the lower end of a twelve foot pipe will usually be in moist earth, and can be relied on to furnish a good connection at all times

As alternating stations increase in size and larger units of dynamos are adopted—which is certainly a wise step towards economy—another class of appliances are required at the switchboard; namely, devices for independently regulating the state of pressure on any particular feeder, the dynamo pressure remaining the same. The necessity of this can readily be seen, for we will have, say, on the same dynamo, when it is of large capacity, several feeders of different loads; those carrying the greatest number of amperes requiring a higher electromotive force to overcome the drop on line, so that if this required pressure all came from one source these feeders of lighter load would be receiving too much potential, and a large lamp breakage would be the result. Therefore, the potential of the dynamo is regulated for the lighter feeders, and pressure raisers or "boosters" used to bring up the potential still higher for the remaining feeders. The principle of these regulators is this: If we take a converter whose capacity equals the maximum load of the circuit and connect the secondary in series with one side of the feeder, and the primary across the two sides, we are then adding the fifty volts of the secondary of the converter to the 1,000 volts of the line, raising its initial pressure five per cent. Adding a number of these in series in like manner and having a suitable switch to throw them in or out in succession, makes a very convenient means of raising the voltage.

Reactive or choking coils may be employed instead of "boosters," with the same end in view —i. e., the proper adjustment of pressure on feeders of unequal drop supplied from one source —only in their use they will be placed on the lighter feeders and the dynamo be made to raise the electromotive force for those having the heavier load.

A serious annoyance is often met with on the line from the inductive effect of two parallel circuits upon each other, causing the lights to waver or "pump," which better expresses it.

We seldom find this effect in small stations unless the feeders are parallel to each other for a considerable distance. It is most marked in circuits that are parallel and one of them carrying a heavy load, which exerts this inductive influence on neighboring lines on the same principle as the primary coil of a converter inducing currents in the secondary parallel to it; only in the case of this action on the lines where each line is fed from a separate dynamo, their phases, of course, not corresponding, we have in this cross-induction a very unsteady action in the current. Annoying as this trouble is, it is one of the easiest to remedy. First, see if some combination on the switchboard will not bring about a change in affairs. Ascertain if the several lines on which this trouble is noticed cannot be all run on the same dynamo; but if this should cause this induction to appear on other circuits formerly free from it, the then remaining way is to transpose the circuits midway between the starting point and where they cease to run parallel, by inserting a break arm in each side of the line, and joining in the shape of a cross the four ends thus formed. This will neutralize and break up the trouble completely.

These topics I have touched on in my paper have been chosen as those most interesting and worthy of discussion, and with the hope that they will be of benefit to some of you, and call to mind other experiences I have not mentioned, which, if given freely before a body of this nature, will help bring about the results we are all striving for—good service and dividends.

Thermal Storage for Central Stations.

BY PROF. GEO. FORBES.†

When asked to give you a paper on some electric lighting subject, it seemed to me that I could not choose a better one than Thermal Storage for Central Stations, which has had so much attention directed to it lately in England. It has long been evident that storage of some kind might lead to great economy in central station work. The reason of this is that the demand for light has in most cities a maximum for only two or three hours of the day. Not only do we require to have plant lying idle all the rest of the day, but the expense of working for those few hours is increased by its temporary character. This loss of economy has occurred both in engines and boilers. Underloaded engines are very inefficient and use up a lot of coal. This defect is, however, got over in all important central stations by having at least a few engines of small power to carry the day load. We are thus able to have engines in use always working their most economical load, that is near full load. The other loss in economy comes from the boilers which have to be fired up and heated only for a few hours' work, and then banked or else allowed to cool down. This loss cannot be overcome by working the ordinary plant in any special manner. At the Kensington Station in London, where the engines are always working at an economical load, 5 lbs. of coal are used per electrical horse-power per hour, whereas in tests of twenty six hours' duration, made on the same plant with all the boilers doing full work, only 3½ lbs. of coal were required for the same duty. If, then, we could have storage of any kind by which power is absorbed at times of light load and given off at times of heavy load, we should save 1½ lbs. of coal per horse-power per hour.

Some have thought that the use of storage batteries would overcome this trouble. It does so, but at an enormous capital expenditure in storage batteries, with a loss of 20 per cent. in the energy given to the batteries and with a depreciation account which no one would put at a less figure than 12 per cent. per annum.

I have previously proposed that in a hilly country the boilers and engines should be working all the twenty-four hours at the rate of the average demand, and that they should be used to pump water through a pipe to a high reservoir at least 500 feet above the pumping station. At the lower end of the pipe turbines are placed driving dynamos. During the daytime the reservoir is being filled, and in the evening it is being emptied. This procures a saving in boilers and the substitution of cheap turbines and a small number of efficient pumping engines for a large number of less efficient engines to drive dynamos. It also reduces the coal consumption from 5 lbs. to 3 lbs. per horse power per hour. In a paper read last year before the British Association for the Advancement of Science, I showed that this plan could easily be adopted at Edinburgh, in Scotland, the saving in capital and annual expenses being both very large.

But it is not every city that has these advantages, and I wish now to introduce to your notice the excellent scheme which has been invented by Mr. Dewitt Halpin, of England.

He proposes to put up boilers only of the average capacity and to work them day and night. At times of light load the steam is carried through pipes into large iron reservoirs of cheap construction, and is used to heat up the water in these reservoirs to a high temperature and pressure. When the heavy demand comes on in the evening, steam is drawn from these reservoirs. The losses of heat from radiation from the reservoirs can be made very small indeed with proper lagging, in fact quite imperceptible.

This is the general scheme of Mr. Halpin's plan. But it has two advantages which are not so apparent at first sight. One is the purity of water supplied to the boilers. Mr. Halpin's pumps feed water into the hot reservoirs when impurities are precipitated in a place where they can do no harm. The boilers, on the other hand, are fed from this pure water in the reservoirs.

The other incidental advantage of the system is that priming in the boiler does not cause any inconvenience, as the steam is all supplied to the engines from the reservoirs. Now it has been found from the experience with the water-tube boilers which are so much used in this country, that only three pounds of coal per hour can be burned per square foot of heating surface, on account of excessive priming, instead of the six pounds per square foot which we can use with the Cornish or Lancashire boilers, and which might be used with water tube boilers if priming were no objection. Thus it appears that the adoption of Mr. Halpin's system not only reduces the number of boilers that we require, but also doubles the capacity of each boiler.

Mr. Halpin has worked out the relative cost of supplying machinery to the central stations of Berlin (1) without any storage, (2) with storage batteries and (3) with thermal storage. He first selected this station because the output at each hour of the day all through the year was published before any other central station had published similar data. In this system there are four central stations, giving off about ten thousand electrical horse-power.

The load at different times of the day is such as to lead to the following data:

Maximum load	7,500 kilowatts.
Mean load	2,030 "
Excess of max. above mean	3,080 "
Duration of ditto	7.5 hours.

Now Mr. Halpin claims that he can replace 22 boilers for working in the ordinary way by 5 boilers and 92 of his storage cylinders, which are cheap to construct and have necessarily a small depreciation. His claims, which I must admit seem to be quite well founded, are that while laying out somewhat more capital on his plan he gets a very large return from the extra capital spent.

I consider that in these days, when we are learning to realize the importance of cutting down working expenses in central stations, this system must necessarily occupy an important place. But it is of peculiar interest to me, owing to its applicability to a kind of work to which I have devoted a large part of my time in the last seven or eight years. I refer to the burning of the house refuse and garbage in our cities.

Taking the ordinary house refuse consisting of ashes, coal, wood, paper, old boots, vegetables, bones and scraps, crockery, tin-cans, iron pots, bottles, and adding thereto occasionally dead cats and dogs, infected mattresses and condemned meat, I can throw the whole of these without sorting upon the furnaces, and without producing any offensive odor or dust I can raise the temperature of the gases where they reach the boilers to over 2,000 degrees Fahrenheit. From my data as to the amount collected in different houses in England per head of the population, I find that from the house refuse of any town I can supply enough steam to generate electric light at the rate of one 16 candle power lamp per head of the population for two hours every night of the year. By doing this I am saving the municipality from $10.000 to $20,000 per annum per 100,000 inhabitants for the cost of removal of house refuse. I am preventing these objectionable materials from being dumped in the outskirts of the city, where building operations will soon commence, or in the neighboring harbors or lakes, either of which plans is a nuisance and unhealthy. The only resulting material is a clinker, which can be broken up and which when mixed with cement makes admirable concrete or artificial stone for paving, while by itself it makes excellent foundations for roads.

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† Abstract of paper read before the National Electric Light Association held at St. Louis, Mo., February 28 and March 1, 2, 1893.

Now these enormous advantages, of the truth of which we have ample proof from a practice extending over nearly twenty years in England, can be worked at full economy only when the burning of refuse is quite continuous and uniform. To do this we must have storage of some kind. In hilly countries the plan I have advocated of water storage is generally available and is very economical. In all other cases thermal storage is far and away the most economical mode of working, and in this line alone, if in no other. I have always said from the first moment I knew of Mr. Halpin's invention that we have here the last item which was wanting in order to do away with the barbarous methods generally adopted for getting rid of house refuse, and at the same time utilizing the refuse in a manner that will confer material benefits on all the inhabitants of a great town, and pecuniary advantages on those who undertake the work.

DISCUSSION.

Dr. Bell—I think we are fully alive to the importance of testing this kind of storage work to which Prof. Forbes has called our attention. In our country it seems to me that his plan of storing water power is one that can be worked successfully, quite aside from the matter of thermal storage. There are certain parts of our country where coal is very dear, and where everything in the way of power that can be saved should be saved. There are places that are so situated as regards topography that the water storage scheme could, I believe, be successfully worked.

As to the thermal storage itself, I hardly feel competent to speak in extenso. I will simply say that it seems to present a very important possibility; and I can heartily add that I most cordially agree with Prof. Forbes in the great value of working out a commercial system for the destruction of garbage.

Mr. De Camp—Up to what temperature does the water in these reservoirs rise ?

Prof. Forbes—The highest temperature is about 407 degrees; it runs from about 350 to 407. I think that corresponds to the variation between 120 pounds pressure and 250.

Mr. De Camp—When the time of maximum use of power arrives, does Mr. Halpin put the hot water that is in these reservoirs back into his boiler for generating steam of sufficient pressure to run his engines?

Prof. Forbes—No, sir; the steam in the reservoir under normal conditions, we will say, is under 250 pounds pressure, and as he gradually takes off the steam in the reservoir to reduce the pressure, the water, of course, begins to boil, and gives off still more steam, so that he always has a supply of steam until the pressure in the reservoir has been reduced down to the working pressure of the engines. When he gets below that, of course, he has exhausted his steam, and has to put in more power from his boilers.

Mr. Haines—I would like to ask Prof. Forbes to give us a comparison of the efficiency of storage of water—raising water to a height—and the efficiency of the storage of steam in his cylinders, which would be of interest to many of us.

Prof. Forbes—The gentleman has asked me for a comparison of the relative efficiency or cost of the system of the storage of water which I had myself proposed, and that of thermal storage which Mr. Halpin has proposed. The running expense is almost the same in the two; but the economy of capital, if your reservoir is anywhere near your pumping station, is very much in favor of the water storage. The water storage takes off about 20 per cent. from the cost of a central station built upon the ordinary lines.

Mr. Hammer—I heard a lecture that Prof. Forbes delivered in London, on the subject of the "Utilization of Rubbish in Producing Power." I would like to know what were the results of the experiments in London. Also, will he please state if a central station will use five pounds of coal per horse power hour, what the amount of rubbish is compared with coal to produce the same power ?

Prof. Forbes—We have reduced the quantity down to about five or six pounds of refuse to be equivalent to one pound of coal; therefore, in answer to Mr. Hammer's question it would take about thirty pounds of house refuse to equal five pounds of coal.

Mr. T. C. Smith—I would say to the members of the Association that a very common and familiar example of much the same process that Prof. Forbes has outlined can be seen in the boiler and engines commonly used for hoisting purposes. Take a small five horse power boiler, with pretty large storage capacity, and they will use that and drive an engine which will develop from twenty to thirty horse power. The fire is kept going at the same steady rate all day long, and in the intervals of the hoisting, when the load is being lowered, the pressure will rise to one hundred and twenty pounds. When the hoisting is being actually done the pressure will drop back to one hundred or down to eighty pounds. Then the engine is at rest for a while, but the boiler keeps on making steam and storing it. In this way we are enabled to do with a small boiler work that is far beyond its capacity.

Prof. Forbes—I am obliged to Mr. Smith for his excellent remarks on this point. They are most appropriate. He has spoken about the hoists being practically worked on the same lines. I may mention that water storage, which I have also advocated, has been used similarly for hoists and for hydraulic accumulators by Lord Armstrong, very largely indeed.

Mr. Wirt—The fireless steam locomotive is also another example in point. We had these engines in service in Chicago for many years, during which they did good service, and were finally replaced by the cable line. These locomotives were of the ordinary type, but had larger steam boilers than usual. The boilers had no furnaces and were charged at one end with hot water under high pressure from an ordinary stationary steam boiler. The locomotive ran a round trip of six or eight miles perhaps, and pulled very heavy cars and heavy loads, giving regular and satisfactory service, winter and summer.

Mr. Stillwell—I want to say a few words in regard to the saving being effected at an early or late step in the process of transforming the potential energy of coal into light or power for sale. It seems to me that we should bring out the fact that a great deal depends upon the relative length of these steps. The central station man who is paying for energy in the form of coal and selling it in the form of light is losing various amounts at each step of the process, but up to the present time he is losing far more before it gets to the dynamo than he is after it leaves the dynamo.

Mr. Smith—We have come to the conclusion that it would not pay to have storage batteries in a large building for the purpose of getting rid of night running. We have come to the conclusion that it will cost you as much to get your light from your battery, and you will burn the same amount of coal, for the reason that you at once lose twenty per cent. of your energy in the battery.

The Incandescent Lamp from a Commercial Standpoint.

BY CALVERT TOWNLEY.†

All modern commercial forms of electric incandescent lemps in this country are similar in that each produces light by heating to incandescence a hard carbon burner of comparatively high resistance, enclosed in a glass receiver from which the oxygen has been largely exhausted. We know that after a time a burner so heated gradually depreciates, either by disintegration, oxidation, or some other cause, and is finally destroyed. We know that of two similar burners that raised to the higher temperature will require less energy per unit of light produced, but that its depreciation will also be more rapid and its destruction take place sooner. Consequently, in determining the temperature at which a carbon should be burned to secure the best economy, we are influenced to use a high temperature on account of the first condition, and a low temperature on account of the second condition.

There may be said to be other causes, due to differences in the design and construction of various lamps, which will affect the length of the lives of their burners, but it seems fair to assume that, by the employment of proper methods, these causes may be eliminated in so far as they hasten depreciation in one carbon more than in another, and therefore, in discussing the relation between the life and efficiency of different lamps, we may consider simply the characteristics of their burners.

For convenience in discussion, we may divide the commercial lamp burners into three classes, viz.:

1st. The untreated or natural burners used in the Edison lamps.

2d. The treated or flashed burners used in the Sawyer-Man, Thomson-Houston, Beacon, and a number of other lamps.

3d. What we may call the super-treated burners used in the new Westinghouse stopper lamps.

In all published tests of the life of burners there is shown to be a definite relation existing between the life of a carbon and the temperature at which it is burned, this relation remaining fixed for carbons of the same kind and varying only for carbons of different kinds. If we formulate this relation, it will assist us to determine what temperature of any kind of carbon may be expected to yield the best commercial results; that is to say, how much money it is desirable to spend on the maintenance of the carbon, and how much on the energy to heat it. The temperature of a burner is difficult of measurement. It will, therefore, be simpler, and quite as satisfactory, if we consider the relation between life and energy consumed, expressing the latter in watts.

By a series of experiments extending over several years and covering tests of many thousand lamps, Mr. Frank Stuart Smith has found the relation between the life and efficiency of the Sawyer-Man carbons, and through his courtesy I am permitted to give you the results. The relation is expressed by the curve A, illustrated herewith in Plate I, where the axis of Y represents hours life, and the axis of X watts per each candle of light produced. As this relation is confirmed by so many tests made at different times, upon lamps of different efficiencies, and under the care of different assistants, there can be no reasonable doubt as to its correctness. From a limited number of experiments made on many other lamps having treated carbons, it is indicated, as might be expected, that the relation between the lives and efficiencies of their burrers follow the same general law. Therefore, if we assume that these lamps are constructed with the same detailed attention to design and manufacture, we may then also assume that their curves will not vary materially from that of the Sawyer-Man carbon.

The exact mathematical expression corresponding to this curve is somewhat complicated, but as we are considering the question from a purely commercial standpoint, we may consider the curve between commercial limits, in which case we can express the relation within one-half of one per cent. by the formula—

$$L_{,}=3.742\,E_{,}^{5.78} \qquad (1)$$

where L represents hours life and E watts per candle.

During the past year many tests have been made by Mr. Smith with the super-treated carbons of the Westinghouse stopper lamps, and the relation between life and efficiency thereby found to exist is illustrated by another curve shown B, Plate I. With the same degree of accuracy as above, we may represent this curve between commercial limits by the equation—

$$L_{,,}=5\ 44\,E_{,,}^{5.684} \qquad (2)$$

We note that this curve corresponds very closely in its general form to the curve of the treated burners, except that for a given efficiency the life of the super-treated burner is always longer. This is as it should be inasmuch as the super-treated burner is, in fact, a treated burner which has been subjected to an additional process to render it more stable.

(*Continued on page* 101.)

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† Paper read before the National Electric Light Association, St. Louis, Mo., February 28 and March 1, 2, 1893.

ELECTRICITY.

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Gas vs. Electricity for Lighting. A suggestive article is contributed in this number by Mr. Hesse, concerning the relative efficiencies of conversion into light energy of gas and electricity, which points to a possible economy in the production of illumination, a subject that has hitherto received but little attention in this country. The figures submitted in this article show that while 14 per cent. of the total energy of gas may be obtained in producing mechanical power, the same amount of gas will give a much lower efficiency when transformed into light energy.

On the other hand we find the conversion of electric energy into light involves but a small loss of energy, from which it follows that the production of light from gas may be accomplished with greater economy by the use of a gas engine and dynamo than by burning the gas direct.

There is no doubt that the slow progress that until lately has marked the development of the gas engine in this country has been a potent cause for the neglect of this branch of the lighting question, and the inefficiency of this class of engines has doubtless been sufficient to discourage experiments in this direction. But recently the gas engine has attained an efficiency and reliability that warrant a trial of this method, he economy of which is too apparent to be gnored.

OUR Table of Contents will be found on the last page of this issue.

"Electricity," under its present ownership, has never solicited the advertising patronage of the General Electric Company.

THE ELECTRIC TRUST COULD NOT SURVIVE AN IMPARTIAL AND FAITHFUL INVESTIGATION BY A CONGRESSIONAL COMMITTEE. WHAT CAN YOU DO TO BRING THIS INVESTIGATION ABOUT?

* * *

"You may dam up the waters of agitation, but if their source remains, you are but preparing in the future for a great disaster."

* * *

The St. Louis Convention. The Sixteenth Convention of the National Electric Light Association, held during the past week at St. Louis, was a notable one as regards the number and importance of papers read and discussed, and more than kept pace with the steady improvement which has marked the progress of its career. The report of the proceedings, presented in this issue as fully as space will permit, shows the practical character of the subjects discussed, and the large attendance and increase of membership point to the benefits derived from these meetings by central station men. A number of changes were found necessary in the programme as originally planned, owing to the general interest taken in the papers, which manifested itself in the extent of the discussions which followed.

The supply men were well represented, but, with few exceptions, attended the regular sessions while omitting the exhibition of electrical goods which in former years constituted a feature of these conventions. The papers read excited discussion to such an extent that the time allotted to the sessions was found to be too brief to transact some of the routine business which has usually been brought before the meeting, and the consideration of such was necessarily relegated to various committees for adjustment.

The lecture, with experiments, given by Mr. Nikola Tesla on Wednesday evening, proved a most welcome innovation judging from the extent of the audience which it attracted. These experiments, which corresponded closely to those performed at his celebrated London lecture on "Alternate Currents of High Potential and High Frequency," were generally novel to his audience and elicited their closest attention and hearty applause.

The association is to be congratulated upon the success of its latest meeting and its growing usefulness to the central station industry.

* * *

Central Station Power Transmission. The growing importance of this branch of central station work and the increasing demand for power services called forth several papers and considerable discussion at the St. Louis Convention of the National Electric Light Association. To the central station manager the production of an alternating current motor of any desired capacity capable of operating on the ordinary incandescent light circuit would prove a means of providing a day load for the stations, thus enabling them to run at or near the full capacity of their machinery during the greater part of the twenty-four hours' run. Besides the added income from such a source, there would result an additional saving due to the increased efficiency of the plant in operating under a practically constant load.

The experience of those who have attempted to build this class of motors, however, is far from encouraging, and to-day the prospect of transmission of any considerable power by means of the ordinary alternate current generator of the usual frequency appears highly improbable of immediate solution.

Of course there are plants in successful operation employing synchronous motors, but these are adapted only to a comparatively constant load, and being non-starting require special devices to bring the armature up to a speed at which it will fall in step with the generator. Before attaining this speed no torque is developed by these motors, which involves starting them without load, but after coming into synchronism with the generators they will run satisfactorily within certain limits of change of load.

The direct current system, which at high potentials offers some advantages over the alternating system in the matter of regulation, has been advocated by many of the leading men in the profession, and several instances of its use at as high as 5,000 and 6,000 volts have been cited. The practicability of this plan where but a small current is transmitted is unquestioned, but conservative engineers are not yet ready to endorse the plan when a large amount of current is to be carried, and no one has been radical enough to introduce such a system on any extensive scale.

The most promising solution of this question in its present stage is the multiphase system, which, while adding some complications to the machinery and the construction of the lines, permits the use of a motor which will start under full load, regulate with tolerable accuracy and does not require expert attendance. This system comes nearest to fulfilling the requirement of general distribution of power over long distances to various distributing points. Although either of these systems may be efficiently employed in the case of transmission between two points of a small power, the opinions expressed at the Convention seemed practically unanimous that an alternating current motor for use on existing circuits is not a present probability.

* * *

Power Storage. One of the most interesting papers read at the St. Louis Convention was that on Thermal Storage by Prof. Geo. Forbes, printed elsewhere, describing a simple though apparently efficient method by means of which the boilers can be run constantly at a stated capacity, and the excess of power generated during the periods of light load stored in the form of water at high temperature and pressure. Incidental to this, the question of utilizing the refuse of a city for fuel was also treated in the paper.

The lack of suitable provision for the storage of power in central stations during the time of light load has the effect of reducing the efficiency of the plants at these periods, as well as necessitating the installation of considerably more machinery than would be necessary if the total daily output of the station were distributed evenly throughout the day. This fact has long been recognized by central station engineers, and the demand for some means of power storage has been constantly increasing.

In Europe the storage battery has been quite extensively employed for this purpose, and were it not for certain difficulties which its use presents would prove the most direct method of power storage.

The testimony of the station managers who have operated with storage batteries as to the saving in operating expenses is often very contradictory, some claiming their use to be a marked economy while others have found it an additional expense. The type of batteries used in different cases will no doubt account to some extent for this difference of opinion.

In the United States practically nothing has been done with storage batteries in this capacity owing largely to the patent complications which have resulted in continuous litigation since the introduction of accumulators here. At present however, the tendency is in the direction of the Planté type of grids which aside from the patent question, in which they are not involved, have been found the most serviceable type. The limited use for these cells of a capacity necessary for station work has not called forth efforts on the part of the American manufacturers to produce them, and for this reason we are considerably behind European manufacturers in this line of work.

The necessity for storage in some manner is too thoroughly felt by central station men to allow the subject to drop, and the invention of Mr. Halpin, as outlined by Prof. Forbes, opens a new line for experiment in this direction. It is specially applicable to the plan for utilizing refuse, and the economy of these schemes taken together if successful should warrant the expense of a trial.

* * *

The Papers. The papers read at the St. Louis Convention this year, while not of a technical character, were of an exceedingly practical nature and treated of topics which will be of practical interest to all central station men.

Wishing to give our readers the text of these papers as complete as possible, we have given those published this week at considerable length, which makes it impossible to include the entire programme in this issue. The papers of Dr. Bell, Mr. Stillwell and Mr. Bradley on the Transmission of Power, and Mr. Brown's sketch of the subway work in New York City, and those of Mr. Armstrong and Mr. Myers, which complete the entire list, will appear in next week's issue.

* * *

THE staff of ELECTRICITY at St. Louis included scores of friends who are not on our salary list.

"THE object of this Association shall be to foster and protect the interests of those engaged in the commercial production of electricity for conversion into light, heat or power."—*Constitution of the National Electric Light Association, Article 2.*

* * *

THIS is the slogan. No man should buy one dollar's worth of supplies from the Trust which can be purchased elsewhere. Independent concerns should be aided in every practical way, and there is no more practical way than this.

* * *

ARGUMENTS as to the intentions of the General Electric Company should be left to babes and sucklings. Business men should rather consider the most efficient method of thwarting these intentions.

* * *

ELECTRICITY is eminently satisfied with its reception at St. Louis. Modesty forbids further comment.

* * *

THE demoralization or lack of organization of the representatives of the Westinghouse interest at the Convention was conspicuous. This, of course, might be construed as highly creditable to the Westinghouse management. But we hold that as long as the General Electric Company see fit to send a delegation of lobbyists to these Conventions, all independent interests should get together and work in entire harmony.

* * *

WHEN the war is over and peace is finally declared, ELECTRICITY will be the most urbane paper in the field. It will continue to be, as it is now, the best read paper.

* * *

MR. B. E. SUNNY spent only one day at the Convention, and in that day he made more of an impression on the course of events than many of the gentlemen who were in town three days.

* * *

WE extend to the lobby of the General Electric Company assurances of caustic consideration. Their efforts shall not pass into oblivion.

* * *

IT would have been more creditable to the General Electric Company if its delegation at St. Louis had included more men of brains and standing like Dr. Louis Bell and C. S. Bradley, and fewer lobbyists and wirepullers.

* * *

IT is perhaps cruel, though pertinent, to remind Mr. James Reliable Keene and Mr. Stephen Vehement White that General Electric has not yet touched 150.

The Trient Five-Wire System.

The City of Trient has a municipal station which is operated on the five-wire system, and in which the dynamos are driven by turbine water wheels. The station was started in April, 1890, since when it has been in successful operation. The dynamos are inside pole, direct current Siemens & Halske machines, which have a capacity of 140 amperes at 540 volts. The armature shafts are coupled direct to the turbine wheels which run at 265 revolutions per minute. The nominal capacity of the six dynamos is sufficient to supply 5,500 incandescent lamps of 16 candle power.

The machines are connected to two outside lines only and the lamps are four in series, giving 110 volts between any two adjacent wires of the system. The two lines from the station are carried to the center of distribution, at which point they connect with an automatic regulating machine and the five distributing mains are run from this regulator, whose object is to balance the loads on the four sides of the system.

The Incandescent Lamp from a Commercial Standpoint.

In 1888, Mr. John W. Howell presented a paper before this Association, in which he exhibited a curve stated to have been constructed from the results of a large number of tests made with the Edison or untreated burners. I have taken the liberty of reproducing a part of this curve in this paper, shown C, Plate I, but using a different scale of measurement. It will be noted that this curve is very similar to the curve of the treated and super-treated burners, and, considered between the same commercial limits, we can express it with equal accuracy by the formula—

$$L_{,,,} = 1.052\ E_{,,,}^{6 \cdot 453} \qquad (3)$$

$L_{,,,}$ and $E_{,,,}$ having the same significance as before. For a given efficiency, we find the corresponding life of any class of carbon by tracing a perpendicular line until it intersects the proper curve, the corresponding life being found directly opposite the point of intersection horizontally. Thus for an efficiency of 2.5 watts we find the life of the untreated burner to be 400 hours, of the treated burner 713 hours, and of the super-treated burner 962 hours.

It is important to remember that these curves represent the results of laboratory tests, in which the electromotive force is kept more nearly constant than is ordinarily possible under the conditions of central station lighting. Therefore, in order to obtain an expression which will represent commercial conditions, we must introduce the element of a variable electromotive force. In Plate II, I illustrate a curve verified by numerous and exhaustive tests by Mr. Frank Stuart Smith, showing the relation between total energy consumed and the light emitted. This relation is such that a line drawn from any point of the curve O (as AO) equals the tangent of the angle made by such line with the axis of *X*. It is represented by the equation—

$$I = \frac{W^2}{\sqrt{R^2 - W^2}} \qquad (4)$$

where I equals the total illuminating power expressed in candles and W equals watts, R being a constant, which depends for its value on the size and efficiency of the lamp. R is, in fact, the radius of the circle to which our tangent is referred. While the position of this curve varies with different lamps, the relation between the watts consumed and the light emitted remains unchanged through all tests. We know that the resistance of a heated filament will remain practically constant through the comparatively small variations in voltage to which a commercial lamp is subjected. Therefore, if we let p equal the per cent. variations in electromotive force, we may write from our fundamental electrical equation $(1 + p)\,C = (1 + p)\frac{e}{r}$, whence

$$W_{,} = W(+ p)^2$$

By a combination of this equation with formula (4) we get the expression $\left(\text{since } \frac{W}{I} = E\right)$

$$E_{,} = \frac{\sqrt{E^2 + 1 - (1 + p)^4}}{(1 + p)^2}$$

where p equals per cent. variation in electromotive force due to commercial conditions. Substituting this value of E, therefore, in equation (1), we get the expression for the commercial curve of the treated filament

$$L_{,} = 3.742\ \frac{[E_{,}^2 + 1 - (1 + p)^4]^{2 \cdot 865}}{(1 + p)^{11 \cdot 46}}$$

By substituting the same value in equation (2) we get the expression for the commercial curve of the super-treated filament

$$L_{,,} = 5.44\ \frac{[E_{,,}^2 + 1 - (1 + p)^4]^{2 \cdot 842}}{(1 + p)^{11 \cdot 368}}$$

Again, by substituting in equation (3) we get the expression for the commercial curve of the untreated filament

$$L_{,,,} = 1.052\ \frac{[E_{,,,}^2 + 1 - (1 + p)^4]^{3 \cdot 226}}{(1 + p)^{12 \cdot 906}}$$

It is, of course, impossible within the limits of this paper to attempt to express all conditions; but by a comparison of laboratory and central station records a fair average assumption seems to be that, with proper attention to regulation, the commercial variation is equivalent to a constant excess voltage of 3 per cent. I have taken this as a basis, and constructed commercial curves for the treated, the super-treated and untreated filaments, which are shown as dotted lines in Plate I, and designated as A, B and C, respectively. It now becomes possible to calculate accurately the efficiency at which any class of lamps should be burned in order that they may yield the best economy.

It is important to note the great effect that a comparatively small rise in electromotive force has on the life of a lamp. Any neglect to maintain the best possible regulation, therefore, will result in an increased bill for lamp renewals entirely out of proportion to the variation in voltage itself.

The condition of the incandescent lighting business throughout the country is undeniably prosperous. Everywhere central station companies are wiring additional lights or preparing to increase the capacity of their machinery. We will not be far wrong, therefore, if we assume, in the consideration of our subject, that the central station company has a market for all lamp hours it can furnish during a certain portion of the day's run. With this assumption, let us formulate an expression for the profit in incandescent lighting, then we may determine what conditions will give this profit a maximum value. In the consideration of this matter I have taken as the unit of value one 16 candle lamp hour, assuming that what the public want is light, and that, other things being equal, they do not care whether much or little energy be expended to produce it. Therefore, whenever we can increase the efficiency of our lamp, we not only reduce the cost of the energy required to burn it, but also increase the lamp capacity of our station, lines, converters, etc., by a proportional amount. Owing to the fact that the various meters in use measure, not light, but energy in one form or another, when we make our unit the lamp hour and afterwards increase the efficiency of our lamp, we must also increase our charge per unit of energy in order to maintain the same standard of price. Were any unit of energy to be taken as the unit of value, the receipts from a given output would become fixed, and the best lamp at once the most inefficient and longest lived. Political economy is clear, however, that to reduce the price of any commodity increases the demand for it, and in competition with other illuminants the only proper standard can be that of illuminating power. It is nearly always possible to change existing rates whenever it is proper to do so.

With our unit of value illuminating power, therefore, our profit will obviously be the difference between the cost and selling price of a lamp hour multiplied by the number of lamp hours sold. We may, therefore, write the expression—

$$P=(v-c)\frac{S}{W}$$

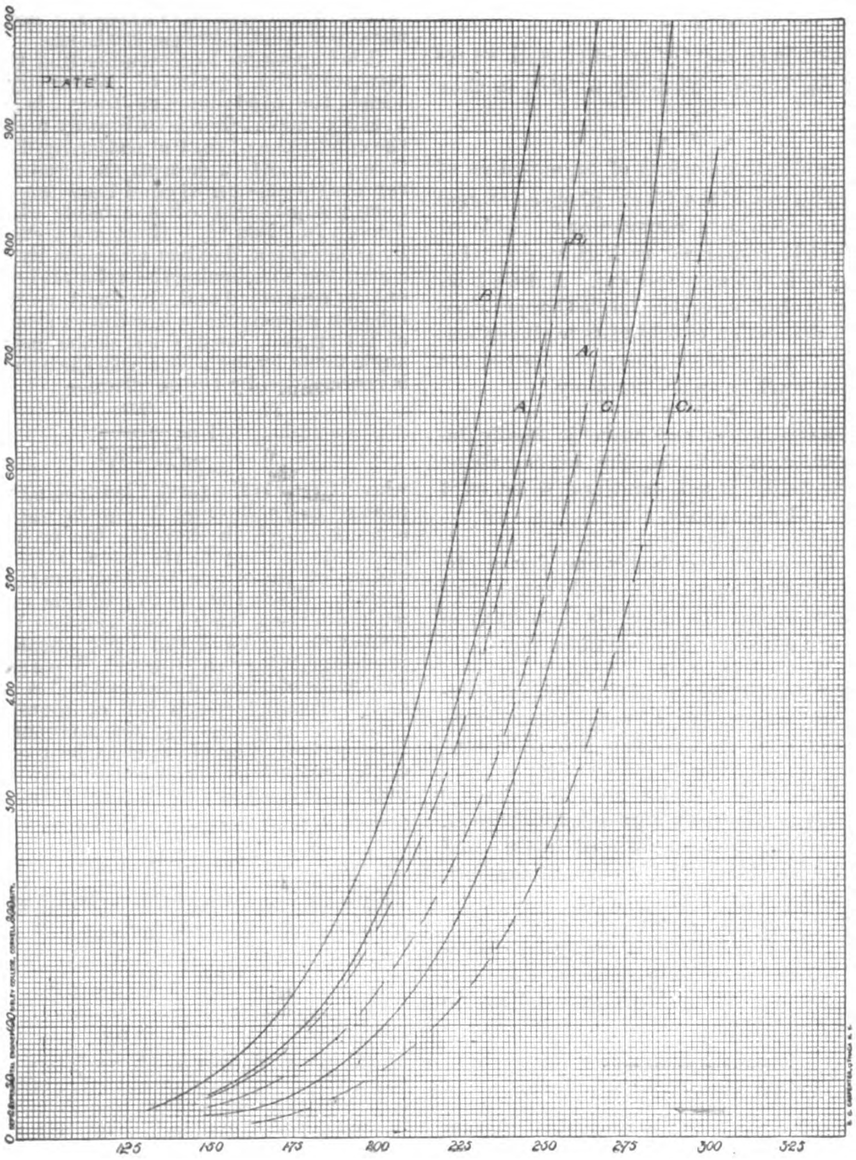
where P equals profit, V selling price, c cost of lamp hour, S output of station in watt hours for the time for which our profit is estimated, and W watts required per lamp. Again, the cost of producing one lamp hour is clearly the proportionate cost of the lamp itself plus the cost of the energy consumed by it. We may, therefore, write—

$$c=\frac{1}{L}+\frac{g}{1000}W$$

where 1 equals cost of a lamp in cents, L its life in hours, and g cost of producing one kilowatt hour of energy. Substituting in this expression, from the formula of our commercial curves, the value of lamp life in terms of efficiency (bearing in mind that for a 16 candle power lamp $E=\frac{W}{16}$), and putting our expression for the value of c in place of c in the formula representing our profit, we have the equation—

$$P=\frac{VS}{W}-\frac{S1\,(1-p)^{2b}}{Wa\left[\frac{W^2-256-256(1+p)^4}{256}\right]^{\frac{b}{2}}}-\frac{Sg}{1000}$$

where a and b stand, respectively, for the coefficients and exponents of the second terms formulæ (1), (2) and (3).



The Incandescent Lamp from a Commercial Standpoint.

	A	B	C	D	E	F	G	H	K
v	.005			.0075			.01		
g	5	3	2	5	3	2	8	6	2

Curves similarly lettered are constructed with similar values of g and v, the differences in their position and form being caused partially by the different costs of the lamps and partially by the differing relations between the lives and efficiencies of the several classes of carbons.

I illustrate in Plate III a number of curves constructed for the untreated, the treated and the super-treated filaments, using this formula. I have taken the original cost of the lamps at, respectively, 35, 50 and 20 cents, the selling price of a lamp hour at, respectively, .5, .75 and 1 cent, and the cost of producing current at, respectively, 2, 3, 5 and 8 cents per kilowatt hour. By the courtesy of a considerable number of central station managers, who have furnished data concerning their respective plants, the average cost of this energy appears to vary between 3 and 7 cents. The only cases where 7 cents is exceeded are those in which fuel is a very expensive commodity and the station output is small. Where 3 cents is too high a very cheap fuel is used and a very large station operated. In assuming these values, I believe that we have covered as nearly as possible the conditions which actually exist, but it is quite easy to adapt our expression to any set of local conditions.

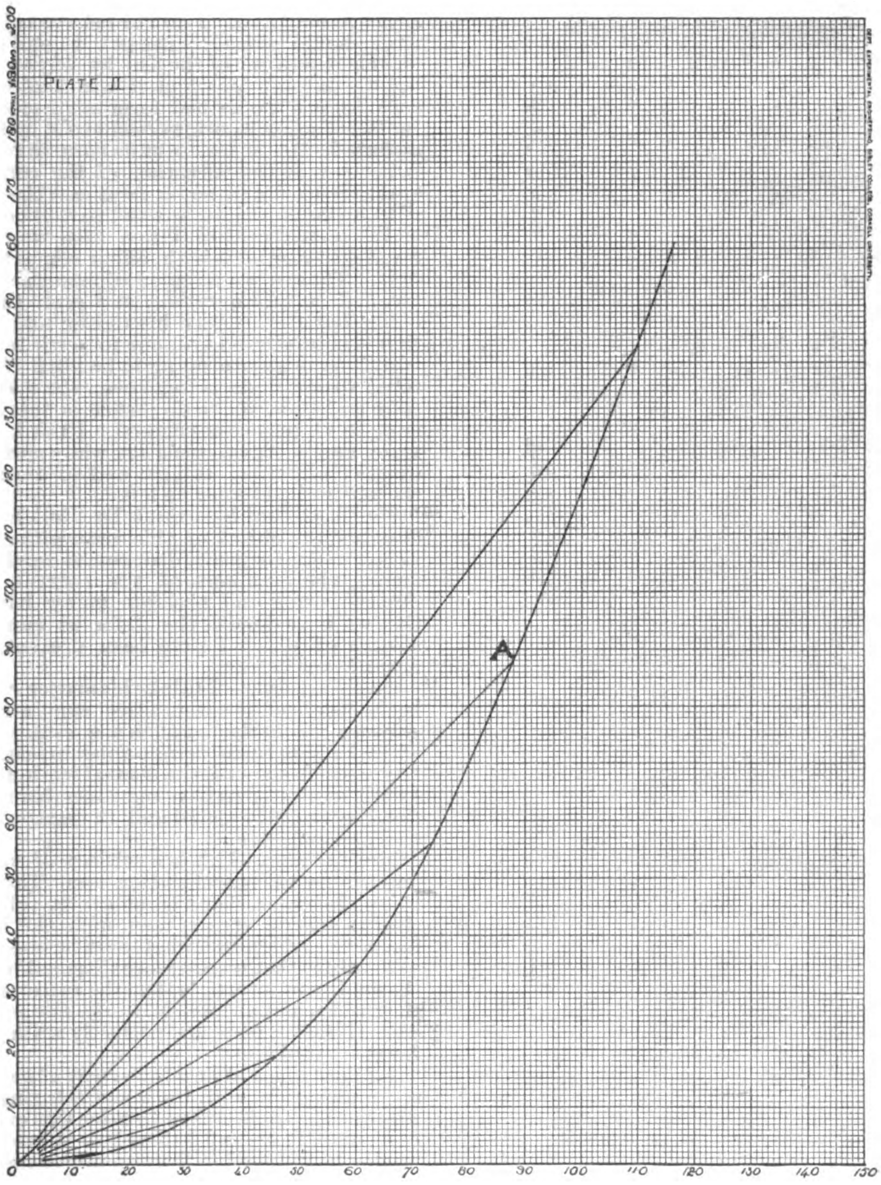
In Plate III you will note that the (Y) axis represents cents and the (X) axis watts per lamp; the station output estimated upon being the unit of one kilowatt hour. The highest points of our several curves represent the conditions under which our profits are a maximum, and the vertical distances between these highest points and any other points on the same curves show the loss in profit due to the use of a lamp of other efficiency than the most economical. The vertical distances between the highest point of any curve of one class of lamp and the highest point of a corresponding curve of another class of lamp show the profit or loss resulting from the use of different classes of lamps at their respective best efficiencies. Other combinations will be readily noted by observation. For example, with the price of a lamp hour at one cent and the cost of generating current six cents per kilowatt hour, the best result we may expect from the treated filament lamp at 50 cents each is, with a 38 watt lamp, *i. e.*, 2.37 watts per candle, when our profit should be (see curve H) 16.6 cents per kilowatt hour. With the super-treated lamp at 20 cents, other conditions remaining the same, the best results are obtained with a 30 watt lamp and our profit should be (see curve H) 22 cents per kilowatt hour.

Considering all these curves together, two facts are especially prominent, namely: first, that although we have assumed strictly commercial conditions, the profits obtained are in excess of those actually made in practice, and, second, that the most economical lamp efficiencies are considerably higher than those of any commercial lamps now in use. It is interesting and very remarkable to note that in every case the profits fell off very rapidly for lamps of either too low or too high efficiency, the variation being more marked where current is dear and running expenses high. By putting these facts together, it is apparently clear that the long lived inefficient lamp is a very expensive article, and that too much weight has been given to the cost of lamp renewals, which shows prominently on the expense side of our ledger, while we have not paid enough attention to the great waste of energy due to low lamp efficiency. By a reference to Plate I we note that the most economical conditions call for, in the case of the untreated filaments, a life of between 250 and 525 hours; in the case of the treated filaments, a life of between 286 and 620 hours, and in the case of the super-treated filaments, a life of between 138 and 260 hours; the shorter life being in each case where both the cost and selling price of the lamp hour are high. I submit these figures for your consideration.

You will note from Plate III that with a charge of three-quarters of a cent per lamp hour and five cents for the expense of generating one kilowatt hour, the use of a 50 watt lamp loses the operating company 1.05 cents for every kilowatt hour sold when using the 35 cent lamp with the untreated burner; 1.4 cents when using the 50 cent lamp with the treated burner, and 5.2 cents when using the 20 cent lamp with the super-treated burner, as compared with the profits which might be made if these various lamps were used at their respective best efficiencies.

It is gratifying to find that the possibility of increased profits carries with it the implied possibility of reduced prices to the public, and therefore a great demand for light, and greater success to the companies furnishing same, in competition with other illuminants.

I have said nothing in this paper in regard to fall in candle power, for the reason that, in both the treated and super-treated filaments this fall is roughly proportional to the time the lamp has been burning as compared to its total life; that is to say, if a filament has a life of 1,000 hours at a given efficiency, and during that time its fall in candle power is *A* per cent., if this filament is burned at an efficiency which will make its life 500 hours, its fall in candle power will still be approximately *A* per cent., so that our commercial results are not appreciably affected. For the untreated filament the fall in candle power is proportionately larger than in the other two filaments. Therefore, if we are making a comparison of total illuminating power per energy consumed, we must put the untreated filament on a somewhat lower scale than shown in the comparisons I have drawn.



THE INCANDESCENT LAMP FROM A COMMERCIAL STANDPOINT.

DISCUSSION.

Mr. Burleigh, of Camden—To those of our members who were able to follow the formulæ of Mr. Townley's paper it must have been interesting. To me a great deal of it was lost. Of course I am not able to follow out the mathematical part of it. My only excuse in rising to speak to so formidable a paper is that I am in great difficulty just now. It is not as to which kind of carbon lamps, treated, untreated, or super-treated, but as to how I am to get any at all. To my last order the reply was: Your valued order received; owing to the shutting down of our factory we will not be able to fill it. If Mr. Townley or any other gentleman could tell me whether I should be justified in entering into a long time contract for lamps, or whether I am to hope to get a lamp to obtain which I shall not have to enter into such a contract, I should be obliged. Mr. Townley refers in his paper to a certain lamp. I would like to ask him if we may expect such a lamp soon, and if it will be generally supplied to those wanting to use it, or if there will be such contracts as are imposed by the other people who manufacture lamps?

Mr. Townley—I suppose the gentleman refers to the stopper lamp. If so, I can say that they are being made and supplied every day.

Mr. T. C. Smith—I have been identified with the association for a long while, and I think there are members here who know that I have been one of those who have always declared for the central station man as against every other element in the Association. I was one of the first to urge that supply houses should only be made associate members; but I was also one of those who always strenuously urged that their representatives should have the right of the floor in the discussion, and every other privilege except voting on the official action of the Association. I did this because at the time there were a good many papers, such as Mr. Townley's, of the utmost value to the central station men. It has been urged against such papers that they are to a very large extent means of advertising. We are willing to let them go at that. They create discussion on subjects of great importance to us all.

If, as it would appear at present, there are only two companies that are going to supply lamps to central station men, we are in very poor shape. I have no axe to grind in this matter, our station being in the fortunate position of having been in business prior to July 14, 1891 (?) The General Electric Company must supply us lamps. They have been very nice about it, with this unfortunate distinction, that because we are in a town in which there is a local Edison Company we are compelled to buy Edison lamps. I do not want to tread on anybody's toes. I am only giving my own experience, and that is, that the Edison lamp for a central station man is the poorest lamp on the market to-day. (Applause) We have gone to the General Electric Company, and said; Gentlemen, we do not use many lamps; we are in the fortunate position of not supplying many renewals to our customers; we have discouraged that, and want to get in the position of the gas companies and supply current through meter. We do, however, supply renewals to a few customers, and we do not care particularly about the price of the lamp. You tell us the Edison lamp is 35 cents. If you will furnish us Thomson-Houston lamps at 45 cents we would rather have them; or if you will furnish us Sawyer-Man, Perkins or Beacon lamps at 50 cents, we would rather have them. They answer, You cannot have these; the Edison Company has the right to sell lamps in this town, and you have got to take that lamp. That is the condition of affairs, but it does not affect us very much; but more than half the central stations have to supply their customers with lamps. They are compelled to take a lamp they do not want. The price has not been raised to any excessive point, however.

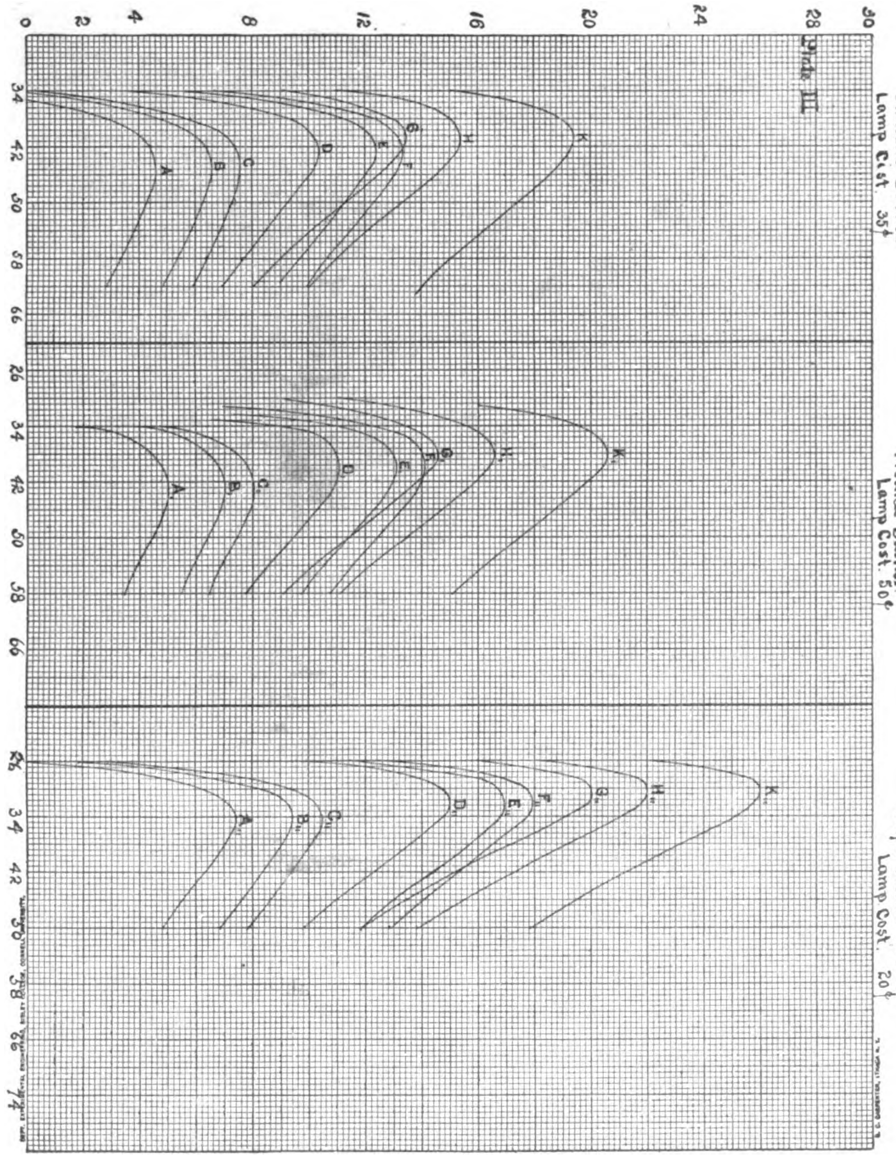
I think this Association ought certainly take some steps, either as a body or bring its members to some concert of action, to break up this state of affairs. The result of competition in any line of trade is improving. I do not think I can take any better example than the transformer. Leaving out of account the rights of the case—who was the inventor, or who had the best claim—I think no one will deny that the converters at present are not only cheaper, but are 50 per cent. better than the converters we used four or five years ago. This has come from the fact that one company would make an improvement and another company would try to beat them.

The method of dealing with the question before us is a difficult one to outline. I would say, however, that in any discussion that takes place, I hope it will be moderate in tone. There is absolutely nothing to be gained by abusing the fellows on top. They are there. The law has given them the right, no matter what are the equities of the case. What the judges thought of the equities of the case their decision shows; but, unfortunately, the parties in question have the legal right to do this thing. The statement has been made that the company having absolute control will not raise prices, and will not make any arbitrary distinctions. They do make these distinctions, in the fact that they compel you to take a particular form of lamp. The idea that any individual or corporation with absolute power in its hands will not abuse that power is too ridiculous to give consideration for a moment. You will remember that the statement was made in court by the counsel that there was no intention to shut these factories up; that they only wanted their rights to get royalties, etc. I made the inquiry of an authorized official of the General Electric Company whether other lamp manufacturers would be licensed. He told me in so many words: We propose to have this business, and we are going to get it, and you fellows will have to pay the price. Immediately after that came out the question of the Goebel lamp. The change in policy was apparent at once. The minute they get hold of that, they will be there again as strong as ever. I do not want to go into the equities case, or go over the history of it. I want to get right down to the root of the question, which is, How are the central station men going to fight this? I do not think there is a central station man who wants to swindle the General Electric Company or the Edison Company out of anything that the law gives them. They have spent a great deal of money to get this monopoly, and there is no reason why they should not be sustained in it; but I do not think that they should tie us down to using something we do not want. It seems to me that the whole equity of the case would be met if the General Electric Company did as they very plainly hinted they meant to do and as they wished the impression to go abroad, and that is, that they would license the various lamp manufacturing companies, and charge a royalty. If they do that, I will have no objection. The Edison lamp is made at 40 cents, we will say, the Thomson-Houston at 50 cents. I am perfectly willing to pay ten cents a lamp more for a lamp of any of about ten different makes. It seems to me if we could bring that state of things about we would all be satisfied. Let them decide what is a fair royalty to charge. Let them give us a chance to get what we want. Give the lamp manufacturers a chance; the moment the price is at a level that moment they will have to get the trade by improving their product instead of lowering the price. We want the best lamp and the best lamp will, of course, in the end be the cheapest.

I do not know that I can say very much as to the policy to be pursued on this question. I know what mine shall be; that I will never buy one cent's worth of material from the General Electric Company until they do that thing. (Applause.) I shall never buy one cent's worth of supplies from that company that I can possibly buy from an independent concern; and I shall do all in my power to advance the sale of any lamp which is put on the market which can be manufactured without coming under the law of infringement.

President Ayer—This topic is very interesting and properly should be discussed; but the hour is getting late, and we have considerable business to transact. I do not wish to convey the idea that I want to limit or restrict discussion. I desire, however, that gentlemen will speak briefly and to the point.

In relation to this matter I will state that we have a standing Committee on Relation of Manufacturing to Central Station Companies. That committee and our Executive Committee, I can assure the Convention, will take such steps as are necessary to bring about the results desired by the Association. These gentlemen will look after the matter, and this thing will naturally be followed up. These committees are composed of central station men only, and they are the men best calculated to carry out the objects of their appointment.



The Incandescent Lamp from a Commercial Standpoint.

Mr. Howell, of Newark—I was not surprised at all to hear the applause that greeted the statement concerning the Edison lamp. I do not wonder at all at some of the experiences with the Edison lamp, especially on stations where the regulation is anywhere from three to eighteen volts more than the normal pressure at which the lamp should be operated. I have made a specialty for the last few years of meeting complaints against the life and performances of Edison lamps. I could bring here a vast amount of data to show the reasons why people had poor results with lamps, why lamps had performed badly on their circuits; but to get down to the pith of the matter, a lamp should be operated at the voltage and candle power marked on the lamp. A 16 candle power lamp should be operated at 16 candle power; not 24. A lamp intended for 110 or 114 volts should be operated there. A lamp of 3 1-10 watts should be operated more closely than a lamp of 4 2-10 watts, for obvious reasons. It is a well established law, and one I have found to be familiar to many, that there is a great decrease of life with increase of voltage; and that law is this: three per cent. increase of pressure halves the life of lamps. That is good for all lamps. Three per cent. on a 50 volt lamp means 1 1-2 volts excess. That 1 1-2 volts excess will halve the life of the lamp. If it be a 3 1-10 watt lamp, and the average life of the lamp under proper conditions be 1,000 hours, that 3 volts excess will halve the life, or bring it down to 500 hours average life. If you are using a 3 6 10 watt lamp, whose average life may be about 1,800 or 2,000 hours at normal candle power, that 3 volts excess pressure will reduce the lamp 1,000 hours. In the case of a 4 watt lamp the average life of an Edison lamp will be about 3,000 or more hours at normal candle power. You may abuse that lamp very much. Your 3 volts excess pressure will halve the life. Increasing the pressure another 3 volts, or another 3 per cent., will bring it down again to half of that, or one-quarter the life—750 hours. That is the reason why the Beacon, Sunbeam, Perkins and some other lamps are better than the Edison lamp. They are a 4 watt or 3 6-10 watt lamp, and they will stand all kinds of abuse and give you a fair commercial life. In buying lamps you should buy lamps to suit your conditions of pressure. If you can maintain on your circuits a constant pressure with a variation of only 1 1-2 or 2 per cent. above or below normal, which is very good, you can operate a 3 1-10 watt lamp with very excellent life—about 800 hours. If you cannot maintain your regulation, or do not care to maintain your regulation, you will buy a lamp of lower economy, 3 6-10 watts. If you have commercial reasons, or reasons based on competition, and wish to run your lamps high—if you wish to buy a lamp of 16 candle power and run it at 24—if your reasons are good for doing so, and you are satisfied with the ledger balance, buy a 4 watt lamp and run it there; but remember that the life of the lamp is always halved by 3 volts excess of pressure; another 3 volts will bring it to one-quarter of what it would be if operated at the candle power for which it was intended. I have for the past year or eighteen months investigated a very limited number of complaints from Edison central station men, and in not one case have I found a fault to exist with the Edison lamps; in every case I have found the pressure too high. In every case when short life of lamps was proven, the pressure has made the life of the lamp short. In no case have I found a shipment of poor lamps from our factory in 18 months. The Edison lamp is not a poor lamp; but it is not as tough at 3 1-10 watts as it is at 3 6-10 or 4 watts. You pay your money and you take your choice.

Dr. Louis Bell—I am very loath to enter into this discussion, and it is with great hesitation that I take any hand in it whatever. Although I happen to be with a particular company, about which some remarks have been made, I first of all want to be of service to the National Electric Light Association. I do not believe this Association should be made a catspaw to pull commercial chestnuts out of the fire by anybody. It is not the purpose for which it was founded, and I consider it not only bad form but discourtesy to the Association to bring commercial matters into dispute before it, unless at its specific request. I believe it is the intention of the company in question to do, in so far as it is in the power of any corporation, justice to all parties concerned, and to protect central station men who have entered into contracts with either component part of it. There are a number of manufacturers interested in this question, and each thinks the other has transcended his rights; and the question is naturally a hard one to settle, and somebody's feelings are going to be hurt. The only thing to be done is to go over the matter carefully and endeavor to do justice as nearly as possible to all parties concerned. I think there are many men in this Association who appreciate the exact condition of things; and to them I think the matter had better be left.

Mr. T. C. Smith—I think Dr. Bell has misunderstood the object of this Association when he says it was not organized for commercial purposes among the members of the central stations. Such an utter and absolute going back on all that we have done at the different conventions, at each of which I have been present, I have never heard before.

President Ayer—I think this matter can be left in the hands of the committee appointed for the purpose of considering such a question, and who will take into consideration the grievances, the wants, or desires of the central station interest. I shall be pleased to have some member move that the discussion be closed and the matter referred to that committee.

Mr. DeCamp—This is a subject of very great importance to central station men. There is one thing, however, that I think can be relied upon, that we central station men wish the manufacturers to understand, whether it be one company or another, that we are more disposed to criticise the quality of an article than the price, and that if they will make an article worth the money the central station men are perfectly willing to pay for it. (Applause.)

I do not know of any better way of getting into communication with the manufacturing companies on this subject than to refer this question to our committee; and I therefore move that the matter be referred to the Committee on Relation of Manufacturing to Central Station Companies.

The motion was put and carried.

The New York Special.

The sun shone brightly on the morning of Sunday, February 26, as a jolly party of gentlemen, accompanied by a few ladies, crossed the North River, New York, and took their seats in the "Electric Special," consisting of baggage, dining and three drawing-room cars, that was to convey them, and those who were to augment the party, for certain 'Phillies' had promised to "join the procession" and faithfully kept their promise, as did those at Pittsburg, Altoona, Indianapolis and other points, until the augmented party had passed the century mark by just one soul. Of course, on so long a trip the creature comforts of the party were not neglected, and the capacious recesses or larders of the dining-car freely gave up some of their savoury contents to appease the appetites of those aboard; for though it was the Sabbath day, the boys did not mope away their time, but spent it in pleasant and friendly intercourse, making new acquaintances and renewing old ones.

As the shades of evening deepened into the darkness of night dinner was announced, and though all had partaken of a hearty lunch at mid-day, they were ready to do justice to the more substantial repast, which proved to be "a free dinner," tendered to the large traveling company by Mr. C. O. Baker, Jr., master of transportation, whose experience and ability as an excursion agent had enabled him to provide a luxuriantly appointed train, including even a barber's shop with a real live tonsorial artist in attendance to scrape the chins and fix the bangs and switches, at a greatly reduced rate, but enabled Mr. Baker to tender his guests a first class dinner, "all complimentary" as it was said; even the gentlemen of color who waited at table politely declining the accustomed *douceur*, their services being "all complimentary" for the nonce.

With quip and joke and many a long drawn-out yawn the time was whiled away until Vandalia was reached on Monday evening; the special's approach being announced, or rather flashed, from afar by a powerful electric headlight, which made the surrounding darkness more hideous beyond the range of its divergent rays, while within its limits every passing object and the track itself for a mile or two ahead were illuminated and stood out in weird contrast with their surroundings.

At Vandalia the reception committee of sixteen gentlemen boarded the train to welcome the Easterners to the city of St. Louis. From their arrival to the end of the journey pandemonium reigned in the "Smoker," for the most hilarious gave full vent to their pent up feelings and East and West vied one with the other in trying to kill time in the most improved fashion.

About 7:15 the "Electric" steamed into the Union Depot, St. Louis, where Mr. James I. Ayer, President of the Association, was in waiting accompanied by several members, all alike anxious to extend a hearty welcome to the visitors from afar.

A very few minutes sufficed to convey all the party to the Southern Hotel, which was the rendezvous, and in double quick time all were comfortably quartered for the week.

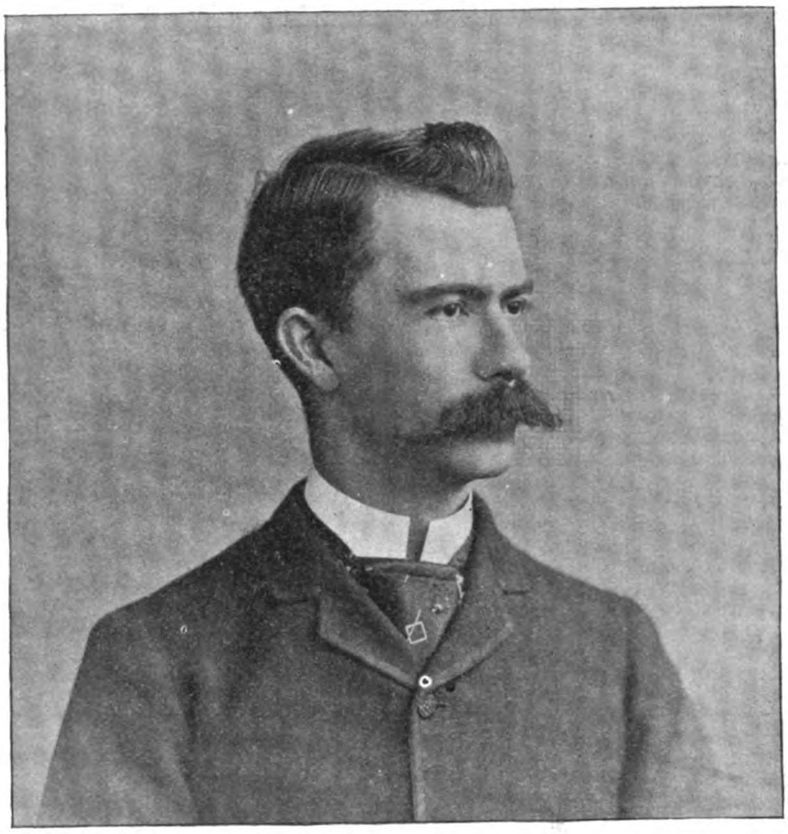
The New President.

The newly appointed President of the National Electric Light Association, whose portrait we have pleasure in presenting to our readers, is the Hon. E. A. Armstrong—Judge Armstrong—President of the Camden Lighting and Heating Company, Camden, N. J., a gentleman who has done yeoman service for the organization over which he will preside for the coming year. Judge Armstrong is so widely known and respected that we deem it unnecessary to write at length about him or in a biographical way; but he is fully entitled to have it said of him that ever since he became interested in things electrical he has evinced a growing desire to render every possible aid in the development of this great industry.

For several years past he has attended the Conventions, and by his weighty counsel in the debates as well as through the medium of the contributions he has made in the form of papers or addresses, he has convinced all of his great ability and wide learning. He has made a study of the legal aspects of the business, is well versed in the bibliolatry of the science and art, and is entitled to rank as one of the most solid and weighty men engaged in the business. He has long served on the executive council of the Association, and the members have done a gracious thing in recognizing his value by appointing him President for the coming year, a year which is expected to be fraught with interest and importance, and must of necessity mark an epoch in the history of the electrical business. During the World's Fair there will be so many responsible duties for the President to discharge that it would have been difficult, if not actually impossible, to select one in every way so splendidly equipped for so high an office as the one upon whom the honor has fallen—Hon. E. A. Armstrong.

Notes.

The brief and well presented one act drama that was performed in the chief parlors of the Southern Hotel on Thursday afternoon was, without doubt, the most pleasing, gracious and well merited act done during the entire Convention. It proved a great surprise party to the chief actor, the genial and popular favorite, Mr. C. O. Baker, Jr., who for several years has been unremitting in the discharge of his onerous duties as Master of Transportation for the National Electric Light Association. Recognizing the value of his services, always so freely and successfully given, Mr. Baker's hosts of friends determined that he should return to his beautiful home and estimable wife in Newark with a substantial token of their esteem, "chipped in" and purchased a massive and elegant silver punch bowl and ladle, having the same appropriately engraved with an inscription. About half past four on Thursday afternoon Mr. Baker was unwarily "steered" into the parlor, where were assembled a large circle of both ladies and gentlemen, who gathered round a stand on which rested a handsome case in blue plush. By a preconcerted arrangement Mr. T. C. Martin mounted a chair and in a few choice sentences presented the case and its contents to Mr. Baker, who fairly staggered under the unexpected shock it gave him, thus to be made, so unwittingly, the recipient of this handsome present. In his usual modest and blushing manner, Mr. Baker acknowledged his indebtedness to the donors; expressed the pleasure he always felt in making every one comfortable on their trips to each succeeding convention, and having received the congratulations of the crowd, an adjournment was at once made for the christening ceremony, which was performed—not with the usual liquid-water, but champagne—all alike standing in as sponsors. One of the boys remarked: "Baker, had your estimable, good lady been on hand you wouldn't have got that present." "Why?" was the reply. "Because it would have been presented to Mrs. Baker herself." Chorus: "For he's a jolly good fellow, and so say all of us."



Hon. E. A. Armstrong.

The 5,000 ladies and gentlemen who crowded the Exposition building on Wednesday evening to hear Mr. Tesla lecture, probably did not hear all he had to say; but his weird, brilliant and startling experiments more than compensated for the disappointment they all felt at being unable to hear his lucid remarks on the topic of which he is *par excellence* the acknowledged exponent and discoverer.

Mr. Tesla well deserved the plaudits of the multitude so generously accorded him, and which, in his charming manner, he so promptly acknowledged. Those who had the pleasure of grasping his hand at the reception subsequent to the lecture will long appreciate the honor of meeting with so famous a man and genius.

That was indeed a representative group of electrical genius which occupied seats on the platform during the Tesla lecture. It included some of the foremost men in the field of electrical science, there being present men of light and leading both English and American. This distinguished group consisted of Professor George Forbes, London, England, Dr. Edward Weston, Dr. Louis Bell, Messrs. John A. Seely, T. C, Martin, T. Carpenter Smith, F. A. Nichols, W. J. Hammer, James I. Ayer, C. S. Bradley, C. H. Wilmerding and G. H. Blaxter.

The Executive Committee of the Association must feel more than gratified with the present strength and staturs of the important organization they have the honor to control. Numerically and financially the Association was never so flourishing as it is to-day, and its power, influence and usefulness are destined to be greater than ever

The indefatigable secretary, Mr. George F. Porter, had a hard task in discharging all and every one of the onerous duties pertaining to his office. But he got through them just the same; and in being able to submit a financial statement showing several thousands of dollars of assets and the enrolling of no less than 31 new active members during the convention was an achievement he may well be proud of. May such good results continue to increase!

The tour of the various electric light and power stations, which was made in carriages provided by the Entertainment Committee on Tuesday evening was very much enjoyed by everyone who joined the procession and they were many. They were astonished at the splendid order everything was in and more than astonished when they had gone over the immense buildings of the Municipal Electric Lighting and Power Company, which now ranks as the foremost and largest central station in the country. Mr. James I. Ayer, the general manager, received many compliments from his visitors.

When Mr. James W. Godfrey returned from church to his room at the Auditorium on Sunday evening last, he first thought a Montana cyclone had been getting in its work on his furniture and traps. It was finally proved, however, that Mr. Dan Spruance had simply been fixing up a little object lesson, showing what the boys are going to do with the Trust before they finish with it.

Much has been written of late about the masked highwayman who rides on horseback in the streets of Chicago, holding up its citizens with impunity. In comparison with Mr. I. N. Took who pulled the leg of Brother Stump, a thoroughbred New Yorker and a newspaper man at that, the masked highwayman is a bungler in the business.

Those Present.

Ackerman, P. C., New York Agent American Electrical Works, Providence, R. I.
Adams, H. C., Phillips Insulated Wire Co., New York.
Atkinson, E. P., Chas. A., Schieren & Co., New York.
Adams, Wellington. Dr., St. Louis, Mo.
Ambler, T. N., St. Louis, Mo.
Ayer, James I., St. Louis, Mo.
Armstrong, Judge E. A., and Mrs. and Miss, Camden, N. J.
Adams, A. D., Indianapolis, Ind.
Ashton, W. H., Dayton, Ohio.
Austin, W. B. and wife, Water, Light, and Power Co. Rensselaer, Ind.
Atwater Chas., Pres. Stanley Elec. Mfg. Co., Pittsfield, Mass.
Baker, C. O., Jr., Newark, N. J.
Bauer, A. H., New York.
Babcock, C. A., Cuyahoga Falls, Ohio.
Burns, P. C., St. Louis, Mo.
Booker, S. G., St. Louis, Mo.
Bailey, G. C., St. Louis, Mo.
Ball, W. D., Consolidated Elec. Eng. Co., Chicago, Ill.
Beetle, Col. G. L., Chicago, Ill.
Brown, C. E., Chicago, Ill.
Bulkley, M. I., Chicago, Ill.
Buss, F. W., Chapman Valve Co., Chicago., Ill.
Bragg, C. A., Bristol Electric Light and Power Co., Philadelphia.
Bell, Dr. Louis, General Electric Co., Boston, Mass.
Bibber, Charles E., Gen'l Mgr. Consolidated Elec. Mf'g Co., Boston, Mass.
Blaxter, G. H., Alleghany Electric Light and Power Co., Pittsburg, Pa.
Burleigh, J. J., and Mrs. and Miss, Camden, N. J.
Bryant, W. C., Gen'l Man. Bryant Electric Co., Bridgeport, Conn.
Bailey, Wm. J., Chanute, Kan.
Bradley, C. S., Fort Wayne, Ind.
Bishop, Harry Weston, agent "Insullac," Chicago, Ill.
Butler, C. J., Jonesboro, Ind.
Boardman, I. S., Kenosha, Wis.
Bishop, R. S., Lockport, N. Y.
Berkey, John A., St. Paul, Minn.
Bran, W. W., St. Joseph, Mich.
Bernard, E. G., Troy, N. Y.
Brophy, Capt. W., Boston, Mass.
Brooks, H. H., American Circular Loom Co., Boston, Mass.
Baird, M. E., Eddy Electric Co., Windsor, Conn.
Cassier, Louis, and Mrs., *Cassier's Magazine*, New York.
Churchill, F. A., Jr., St. Louis, Mo.
Clark, Ernest L., Chicago, Ill.
Corey, R. B., New York.
Colvin, F. H., *Electrical Engineer*, New York.
Coffman, John R., Chicago.
Conover, A. B., Roebling's Sons Co., Chicago, Ill.
Collins, L. W., Chicago.
Collins, W. F., Manager *Western Electrician*, Chicago.
Cummings, E. A., Chicago.
Cutter, George, Chicago.
Cummings, Miss, Philadelphia.
Cutter, H. B., Philadelphia.
Clisdell, A. A., General Electric Co., Cincinnati, O.
Crider, J. S., Washington Carbon Co., Pittsburg, Pa.
Crossman, T. E., Stenographer, Brooklyn, N. Y.
Cleveland, W. B., Cleveland, O.
Clohassey, Thos. F., Kansas City, Mo.
Carpenter, C. E., Bridgeport, Conn.
Clover, D. M., Dallas, Texas.
Culver, F. S., Eau Claire, Wis.
Carnes, W. W., Memphis, Tenn.
Coleman, S. G., Milwaukee, Mo.
Conegill, M. J., Omaha, Neb.
Crane, J. O., Waterbury, Conn.
Clark, D. M., Vandalia, Ill.
Campbell, S. S., Denver, Col.
Campbell, Scott, Southern Electric Co., Louisville, Ky.
Clayton, G. C., Kearney City, Neb.
Degenhardt, F. E., Chicago.
De Land, Fred., *World's Fair Engineering*, Chicago.
Dickerson, J. W., *Street Railway Journal*, Chicago.
Drake, F. E., Standard Elec. Co., Chicago.
Dutton, A. W., St. Louis, Mo.
De Camp, A. J., Mrs. and Miss, Philadelphia, Pa.
Dee, J. R., Houghton, Mich.
Douglas, S. A., Brush Electric Co., Chicago.
Dyer, T. F., St. Joseph, Mo.
Elliott, H., Jr., St. Louis, Mo.
Ferguson, J. O., St. Louis, Mo.
Fairbanks, H. H., Electric Light Co., Worcester, Mass.
Flower, W. I., St. Louis, Mo.
Flintham, J. W., Denver, Col.
Fortemer, A. E., Miss, Chicago.
Foust, C. J., Cincinnati, O.
Ferguson, James, Brooklyn, N. Y.
Foote, J. B., Battle Creek, Mich.
Foote, W. A., Jackson, Mich.
Forbes, Prof. George, London, Eng.
Francisco, M. J., Manager Elec. Light Co., Rutland, Vt.
Francisco, Mrs., Rutland, Vt.
Francisco, Miss, Rutland, Vt.
Friend, H. W., Vincennes, Ind.
Grant, C. W., and Mrs. Grant, Davenport, Ia.
Gerleman, J. F., St. Louis, Mo.
Getz, R. J., Lancaster Carbon Co., Buffalo, N. Y.
Greene, B. E., ELECTRICITY, New York.
Goe, D. E., "Electric Spark," Chicago,
Godfrey, James W., New York.
Gregory, G. E., Chicago.
Grier, T. M., Chicago.
Greene, M. T., Mrs., Chicago.
Goodhue, Wells, Taylor, Goodhue & Ames, Chicago.
Gamp, Leo. H., Kansas City, Mo.
Gorke, H. J., Electric Engineering Co., Syracuse, N. Y.
Greene, W. J., Cedar Rapids, Ia.
Gwynne, J. G., Steubenville, O.
Harney, A. W., Chicago, Ill.
Haines, H. M., New York.
Hammer, W. J., New York.
Hatch, E. B., H. W. Johns Mfg. Co., Hartford, Conn.
Hayden, M. M., New York.
Hall, E. J., Jr., New York.
Hopkins, J. H., St. Louis, Mo.
Hooner, P. H., Chicago, Ill.
Hadaway, H. I., Chicago, Ill.
Haley, C. S., General Electric Co., Boston, Mass.
Hills, C. I., Boston, Mass.
Heinrich, E. S., Westinghouse Elec. Co., Pittsburg, Pa.
Hill, Henry, Pittsfield, Mass.
Howell, Wilson S., Newark, N. J.
Hoover, John, Pittsfield, Mass.
Hine, Henry, General Manager Stanley Electric Mfg. Co., Pittsfield, Mass.
Hunt, W. T., *Electrical Age*, New York.
Hunter, D., Jr., Allegheny, Pa.
Hawkon Ninian, London, England.
Hose, J., Peru, Ind.
Higbee, E. H., Jr., Roodhouse, Ill.
Issertel, Henry I., New York.
Jenney, C. D., Jenney Electric Co., Indianapolis, Ind.
Jackson, G. J., Waterbury, Conn.
Jackson, ——, New York.
Johnston, W. J., *Electrical World*, New York.
Jones, C. E., Cincinnati, O.
Jones, A. J., New Brunswick, N. J.
Kester, J. F., Chicago, Ill.
Key, W. S., ELECTRICITY, Boston, Mass.
Kilbourne, Dr. E. C., Seattle, Wash.
Korst, P. H., Badger Electric Co., Racine, Wis.
Knight, J. C., New York.
Lane, F. A., Cleveland, O.
Laurence, A. B., Sultz Belting Co., New York.
Little, E. W., Interior Conduit Co., New York.
Little, E. W., Pittsburg, Pa.
Le Vake, L. B., Cleveland, O.
Little, F. P., Buffalo, N. Y.
Larkin, E. L., Galesburg, Ill.
Mace, Romaine, Interior Conduit Co., New York.
Manson, G. T., Okonite Co., New York.
Manson, Mrs., New York.
Mager, F. A., E. S. Greeley Co., New York.
Martin, T. C., *Electrical Engineer*, New York.
Matthews, W. N., St. Louis, Mo.
Miller, J. D., New York.
Mitchell, P. W., New York.
Martin, A. J., Philadelphia, Pa.
Myers, W. C., New York.
McQuaide, J. P., New York.
Martin, J. N., Philadelphia, Pa.
Moore, J. J., New York.
Manning, H. S., Chicago, Ill.
Manwaring, A. H., Philadelphia, Pa.
Manwaring, Mrs., Philadelphia, Pa.
McKinlock, W. C., Chicago.
McKinlock, W. H., Chicago.
Morse, S. F. B., Day's Kerite Wires, Chicago.
Mosher, J. A., Chicago.
Mackie, Robb, Cincinnate, O.
Mason, J. H., General Manager Simplex Electric Co., Boston, Mass.
Merritt, M. M., Boston Incandescent Lamp Co., Boston, Mass.
McDuffie, H. H., Pittsburg, Pa.
Mead, Morris W., Pittsburg, Pa.
McGonnigle, ——, Allegheny County Light Co., Pittsburg, Pa.
Marsh, J. V., Underground Cable Co., Pittsburg, Pa.
Moore, F., Pittsburg, Pa.
Mason, F. C., Brooklyn, N. Y.
McFarland, G. E., Davenport, Ia.
Myers, G. M., Mo. Water and Light Co., Kansas City, Mo.
Myers, Mrs., Kansas City, Mo.
McIntire, C. O., Newark, N. J.
Morrison, W. J., Fort Wayne Electric Co., Syracuse, N. Y.
Mead, C. K., Des Moines, Ia.
Mead, Mrs., Des Moines, Ia.
Markland, W. H., Street R. R. Co., Altoona, Pa.
Mayo, Geo., Rockford, Ill.
Miller, J. H., Springfield, O.
Moore, J. J., Toledo, O.
Nahm, Louis, St. Louis, Mo.
Newton, C. E., Jewell Belting Co., Hartford, Conn.
Nipher, Prof., St. Louis, Mo.
Noll, Augustus, General Incandescent Arc Light Co., New York.
Norcross, P., Janesville, Wis.
Norcross, Mrs., Janesville, Wis.
Nichols, Frederic, Toronto, Can.
Newton, A. D., Eddy Electric Co., Windsor, Conn.
Osborne, W. F., New York.
Ogden, D. H., *Electrical World*, Chicago.
O'Hara, J. B., *Western Electrician*, Chicago.
Oswold, W., New Orleans, La.
Packard, W. D., Warren, O.
Partridge, A., St. Louis, Mo.
Perry, Nelson W., *Electrical World*, New York.
Porter, Geo. F., Secretary N. E. L. A., New York.
Price, C. W., *Electrical Review*, New York.
Perry, D. P., Standard Electric Co., Chicago.
Page, C. T., Chicago.
Powers, E. L., *Electrical Industries*, Chicago.
Paiste, H. T., Philadelphia.
Pentz, Jas. A., Philadelphia, Pa.
Peck, E. F., Brooklyn, N. Y.
Pyle, G. C., National Elec. Headlight Co., Indianapolis, Ind.
Pardee, E. T., Syracuse, N. Y.
Pearson, F. J., Consulting Elec. Eng. Omaha Canal and Power Co., Omaha, Neb.
Farker, J. H., St. Joseph, Mo.
Penn, Jerome, Washington Court House, O.
Quire, J. N., Mrs., Rochester, N. Y.
Quinlan, J. H., Ball Electric Light Co., Toronto, Can.
Reiman, G. L., Mosher Electric Co., Chicago.
Richards, H. T., "Electrical Review," New York.
Rose, P. N., St. Louis, Mo,
Randolph, R. J., Cincinnati, O.
Ryan, T. J., General Electric Co., Cincinnati, O.
Ross, C. A., Kansas City, Mo.
Redman, G. A., Gas and Electric Light Co., Rochester, N. Y.
Redman, Mrs., Rochester, N. Y.
Rollins, E. W., Denver, Col.
Roberts, W. B., Elec. Mfg. Co., Rockford, Ill.
Royce, F. W., Washington, D. C.
Seely, John A., New York.
Seymour, E. W., Westinghouse Electric Co., New York.
Scudder, R. V., St. Louis, Mo.
Shain, C. D., New York.
Smith, H. J., Edison Electric Light Co., New York.
Stump, C. E., "Street Railway Journal," New York.
Swetland, H. M., "Power," New York.
Schlosser, F., St. Louis, Mo.
Stedman, G. C., St. Louis, Mo.
Seixas, E. F., Chicago and St. Louis Elec. R. R., Chicago.
Searing, G. S., Chicago.
Searles, A. M., General Electric Co., Chicago.
Scribner, J., Chicago.
Small, H. H., Chicago.
Stacey, T. S., Chicago.
Stockwell, Edward, Washburn, Moen Mfg. Co., Chicago.
Sullivan, M, J., "Street Railway Gazette," Chicago.
Smith, T. Carpenter, Philadelphia, Pa.
Stearnes, R. S., Cincinnati, O.
Sargent, A. G., Boston, Mass.
Stillwell, L. B., Pittsburg, Pa.
Scheffler, Fred. A., Brush Electric Company, Cleveland, O.
Sexton, Howard W., Gas Light Co., Anniston, Ala.
Slater, H. B., Canyon City, Col.
Sterling, P. H., Denver, Col.
Scott, Campbell, Louisville, Ky.
Shultz, J. A. J., Shultz Belting Co., St. Louis, Mo.
Sunny, B. E., Chicago.
Taltavall, J. B., *Electrical Age*, New York.
Tesla, Nikola, New York.
Talmage, C. H., St. Louis, Mo.
Terry, F. S., Ansonia Elec. Co., Chicago.
Turner, John, Edison Electric Company, Cincinnati, O.
Taber, R. B., Gen'l Elec. Co., Boston, Mass.
Taft, Benj., Boston, Mass.
Taylor, A., Stanley Electric Mfg. Co., Pittsfield, Mass.
Talcott, G. F., Campbell Electric Supply Company, Boston, Mass.
Tudor, H. C., Baltimore, Md.
Tice, E. S., Minneapolis, Minn.
Urquhart, D. F., T.-H. Carbon Co., Boston, Mass.
Wade, E. E., Colorado Springs, Col.
Webb, Herbert Laws, Electric Selector Co., New York.
Western, B. R., Mfrs. Advertising Bureau, New York.
Wilson, Fremont, New York.
Wood, E. E., "Electrical Industries," New York.
Woods, A. G., St. Louis, Mo.
Wilson, C. E., C. & C. Motor Co., Chicago.
Wilson, C. H., Chicago.
Wirt, Chas., Ansonia Electrical Co., New York.
Wood, M. M., New York.
Wunder, F. A., and Mrs., New York.
Wilkins, E. Ward, Partrick & Carter Co., Philadelphia.
Wilshire, J. W., Card Motor Co., Cincinnati, O.
Willard, R. S., Cuyahoga, Falls, O.
Wyant, R. E., Birmingham, Conn.
Whitehead, S. E., Carthage, Mo.
Whitney, L. C., New Britain, Conn.
Young, E. P., Electric Light Co., Semickley, Pa.

Gas and Electricity.

BY G. EMIL HESSE.

Electricity is a successful competitor with gas, especially with regard to power and light. Gas engines are not very extensively used in this country, but they are found almost everywhere in Sweden, Germany and England wherever power up to 100 H. P. is required. The increased efficiency of the modern gas engine is best illustrated by the fact that the first practical engine consumed 3 cubic meters gas per I. H. P. per hour, while those of modern construction only consume about 0.75 cubic meters for the same power. We find in practice that it takes about 0.85 cubic meters per actual H. P. One kilogram of gas is equal to 8,500 thermal units. The theoretical energy is therefore :

$$\frac{0.85 \times 1.251 \times 0.5 \times 8{,}500 \times 424}{75 \times 60 \times 60} = 7.095 \text{ H. P.}$$

The efficiency is consequently :

$$\frac{1}{7.095} = 0.141,$$

or a little over 14 per cent., which is very high indeed when we consider that the very best triple expansion steam engine does not give more under the most favorable conditions. Experiments with gas engines have even shown as high as 18 per cent., a figure never reached by the steam engine.

An ordinary good burner will consume 0.12 meters per 16 C. P. per hour. Utilizing the result in the equation above, we find that this is equal to :

$$\frac{7.095 \times 0.12}{0.85} = 1.001$$

theoretical horse-power hour. This gives per actual horse-power hour as consumed by the gas engine seven 16 C. P. lights, or 112 C. P.

The above figures show very clearly that there is a great loss when the energy stored in gas is changed to light, which latter is only another form of energy. This is due to the heat that is produced, which is a total loss, but there would naturally not be any light at all if not for the high temperature by which the carbon is made incandescent.

Electricity for power does not stand on an equal basis with gas, inasmuch as when used it is transmitted to some more or less distant place. The loss depends therefore on that distance, and a comparison is consequently out of the question.

Electricity for lighting, on the other hand, stands on the same ground as gas. One 16 C. P. lamp requires 50 watts. This is equal to :

$$\frac{50}{746} = 0.067 \text{ H. P.}$$

One actual horse-power will therefore give :

$$\frac{1}{0.067} = 14.92$$

sixteen candle-power lights, or 238 C. P. The difference is too great to pass over lightly. It appears from the above that one actual electric horse-power produces 238 C. P., and that gas equivalent to one actual horse-power produces 112 C. P. Allowing 90 per cent. as the efficiency of the dynamo and a 10 per cent. loss in transmission from the gas engine to the dynamo, we find that 1 H. P. as developed by the present gas engine will produce :

$$14.92 \times 0.81 = 12.08$$

sixteen candle-power lights. It is therefore evident that it is more economical to use the gas as motive power in a gas engine and driving a dynamo than to use it direct for light. The actual gain is :

$$\frac{5 \times 100}{7} = 71.42 \text{ per cent.},$$

which is really enough to set our city officials and gas companies thinking.

The Business End.

Electrical Exhibits at the Convention.

Although the exhibits at the Convention held in St. Louis last week were limited in number, in comparison with former meetings of the National Electric Light Association, they were sufficiently numerous to attract the attention of all the members present, between the intervals of the daily session. The goods on exhibition were of a character to interest not only the central station and supply men, but also the visitors not directly connected with the electrical business. Everything was arranged to attract the delegates' attention and every article was examined carefully.

The General Arc Incandescent Light Company, New York, had the most extensive and attractive exhibit of lamps at the Convention. It included nearly a score of different types of their artistic and efficient specialties. The introduction of these rare goods has created quite a demand, and many words of commendation were heard from the interested crowd which surrounded the stand the days of the Convention. Every lamp shown was a real work of art, the "Bijou," for hall lighting, being, without doubt, a petite gem, and must speedily grow into popular favor wherever good taste and artistic judgment are engaged in securing effectively brilliant results. It was nothing less than a rank injustice to this company and its fine display that through the neglect of some one sufficient current could not be secured to run the lamps in such manner as would have shown them off to the best advantage, besides attracting that full measure of attention they abundantly deserve. Mr. Augustus Noll, who had charge of this exhibit, did his best and succeeded admirably, notwithstanding the untoward incident that prevented him having all the electric current he required and had previously arranged for.

The Eureka Tempered Copper Company, North East, Pa., had an elaborate display of its specialties, including trolley wheels, commutators, dynamos, brakes, gear wheels, etc., all made of tempered copper. This display attracted a large share of attention, the goods being very popular wherever used.

The Okonite Company of New York, while not making any exhibit of their goods were as usual represented by Mr. George T. Manson, who, as every one knows, is a whole host in himself, and never fails to carry away with him from these conventions substantial and profitable evidence of the high reputation gained by the goods he handles.

The Central Electric Company, Chicago, had two able representatives in Messrs. W. H. McKi lock and C. E. Brown, who had charge of a few well-known specialties.

The Electrical Engineering and Supply Company, Syracuse, N. Y., with Mr. H. J. Gorke in charge, showed some handsome samples of switches, cut-outs, voltmeters, ammeters, etc. Two enormous central station switches attracted universal attention.

The Consolidated Electric Manufacturing Company, Boston, Mass., represented by Mr. C. E. Bibber, the live general manager, had a number of its well-known jackknife switches, push buttons, cut-outs, etc., on exhibit. Mr. Bibber also displayed diagrams of the new 60-light arc dynamo with Elkins' automatic regulator.

The Bryant Electric Company, Bridgeport, Conn., represented by Mr. W. C. Bryant, treasurer and manager, and Mr. Thos. G. Grier, Western agent, Chicago, exhibited a large, varied and most attractive display of their well-known and efficient devices. A handsome switchboard was filled with sockets, switches, cut-outs, carbon holders etc., etc. These varied devices are too well known to need any words of commendation from us ; suffice it to say that the display received close attention from all present. The handy little memo. and St. Louis guide book distributed by the Bryant Company was fully appreciated.

George Cutter, the ubiquitous one from Chicago, failed not in his efforts to have as usual an attractive display, which didn't fail to attract, for there were many novelties shown, such as shadeholders, sockets, switches, voltmeters, ammeters, snap knife switches and many other devices that are always in demand in both central stations and isolated plants. George Cutter himself was on deck as usual to welcome his innumerable old friends and to show them some fresh novelties, in which all were interested, the new type of lightning arrester in particular. Mr. Frank McMaster proved a valuable aid-de-camp to Mr. Cutter, and was unremitting in his endeavors to adorn every visitor by affixing a diminutive monkey built of chenille and supporting a Chinese lantern at the end of a fishing pole in its right hand.

The Fibrone Terreloid Company, Newark, N. J., distributed among their friends some very handy paper weights, made of highly finished fibrone, a substance which this company is manufacturing into nearly every conceivable electrical device which hitherto has been made of hard rubber, which fibrone closely resembles. The unique paper weights will find a place on many a desk, and fibrone goods will grow in demand in the electrical field.

The Chapman Valve Company, Boston, was represented by Mr. Buss, their Chicago manager, who had on exhibit three samples of their high grade valves, which are in use all over the world. For electric light and power stations these valves are in ever increasing demand and the company's factory at Indian Orchard, Mass., which is the largest valve factory in the world, is kept running night and day to fill orders.

The Ansonia Electric Company, of Chicago, had quite a display of its special lines of goods, including the Wirt Meter, which had many careful and curious examiners.

The Eddy Electric Company, Windsor, Conn., represented as always by the Messrs. M. E. Baird and A. D. Newton, had a complete working equipment consisting of a dynamo and 15 H. P. four pole motor of their well-known and efficient type which were kept running for the benefit of visitors. In connection with this installation a number of rheostats of a special type were shown in operation.

Chas. A. Schieren & Company, New York, exhibited an unusually large perforated leather belt, the largest of its kind ever made. It was 117 feet long, 72 inches wide, three-ply, and weighing 2 458 pounds. It was made to order for driving a Westinghouse dynamo of 1,000 H. P. at the World's Fair. As may be imagined, such a belt excited the attention of all the central station men present.

The Standard Electric Company had a number of their direct current arc lamps on exhibition in the main hall of the Southern Hotel.

The Washburn & Moen Manufacturing Company, Worcester, Mass., had samples of the famous Salamander wire on exhibition.

The Falconer Manufacturing Company, of Boston, placed their porcelain sockets and switches on exhibition in the main rotunda of the hotel. The display also included a full line of incandescent light supplies.

The Ward Arc Lamp Company hung several of their arc lamps in an exhibit room to the left of the hall ; connection was made with the incandescent circuit which showed the lamps in practical operation.

The Electric Appliance Company, of Chicago, presented a very neat advertising novelty in the shape of a celluloid toothpick of various colors with their name and business stamped in gold.

The Cutter Electric Manufacturing Company, Philadelphia, represented by Mr. H. B. Cutter, made an attractive display which included a large variety of handsome electric switches, cutouts, push buttons and electric locks. These latter devices are attracting unusual attention and rapidly coming into general demand. They are attachable to house, office, store and closet doors of every kind, the act of opening the doors, shutting off the lights in building or room, and turning on light or lights on opening any door. As a burglar alarm it is quite unique, for on being attached to a window the slightest attempt at opening said window turns on the light and so spoils the attempt. By a special contrivance and the aid of two keys light can be turned on and off at will by the one who carries both keys, while no one can tamper with either lock or electric switch. This company is meeting with splendid success with its many useful and ingenious devices. The Cutter electric locks are to be placed on every closet door in the new Netherlands Hotel, New York ; Insane Asylum, King's Park, N. J., and other public buildings, including the Metropolitan Life Building, corner of Twenty-third street and Madison avenue, New York.

The Weston Electrical Instrument Company, Newark, N. J., had a handsome display of its high grade standard measuring and other instruments, including station meters, voltmeters, ammeters and separate parts of instruments, arranged on a handsome showboard. During the Convention there was a constant stream of visitors to Room 70, where this attractive exhibit was shown. Mr. R. C. Heinrich making every visitor welcome to examine the brilliant exhibit.

The Carpenter Enamel Rheostat Company, Bridgeport, Conn., showed several samples of its now well-known instrument, which is meeting with well-deserved recognition.

The Fort Wayne Electric Company, Fort Wayne, Ind., had several arc lamps of the Woods type on exhibit, the improved features in which were carefully noted by and duly explained to those interested in arc lighting.

The Falls Rivet and Machine Company, Cuyahoga Falls, Ohio, showed a model of a friction clutch of their well-known type. These clutches are deservedly popular, being in use in most of the central stations throughout the country, and being of the simplest, most approved and efficient type.

The Electric Selector and Signal Company, of New York, had one of the most extensive and complete exhibits at the Convention. It embraced a complete working installation of their unique system of controlling arc and incandescent lights whether singly or in groups along the same single circuit. By the use of this apparatus any lamp or lamps can be started up or shut off at any pre-arranged moment, from the central station, thus securing for the company supplying current, or the users of same, the most punctual and reliable service, and ensuring the strictest economy in the consumption of current. Disputes as to quantity of current, or hours used, become impossible, and the same efficient service is secured on motor circuits as on lighting circuits. This system recommends itself to every user of electricity and is destined to play an important part in the future of the electrical business everywhere.

James J. Murray & Company, Philadelphia, had a full line of their well-known specialties, including glass globes, shades, reflectors, etc., etc., for use in electric service, wrought into many quaint and artistic forms. The arc and incandescent globes made by this firm are well known, their rich tints and artistic forms being known everywhere, hence the big demand that always prevails.

The Interior Conduit and Insulation Company exhibited several Lindell motors operating fans and driving miniature incandescent dynamos which were supplying current to a group of eight lamps.

Mr. James A. Pentz, of Philadelphia, showed one of the Pentz-Reckenzaun electric meters about which the electrical fraternity is soon likely to hear something that will be decidedly interesting and profitable. Arrangements were made to have this apparatus in actual operation, but through some misunderstanding connection with the only available line circuit could not be made until the close of the Convention. Suffice it to say that this instrument is so delicately adjusted that it will correctly measure current to the 1-40th of an ampere, and is in every detail a useful adjunct where electricity is used. It has been subjected to the most trying tests, and the Board of Trade in London, Eng., is so satisfied with its performance that it is to be adopted for general use by that important corporation.

Alexander, Barney & Chapin, of New York, represented by Mr. H. G. Issertel, displayed lamp sockets, push buttons and a general line of lamps and fixtures.

The Gould Packing Company, East Cambridge, Mass., makers of the only "original ring" steam and water packing, showed a pyramid of various sizes in its well-known specialty which is in universal demand throughout the electrical field as well as the engineering trades. This packing has proved itself superior to anything else of its kind on the market, hence the big demand which keeps the company shipping it to all parts of the world. Its wearing capacity is such that where it has once been used no other kind ever gets a show.

The W.S. Hill Electric Company, of Boston, Mass., had an extensive and attractive display which came in for no small amount of attention, and from which much fun and amusement were derived. These consisted of single and double pole switches, three pole single throw and double throw station switches with fuse—one being a massive 200 ampere double pole double throw station switch—all handsomely finished and on slate bases. There were also shown three of the wonderfully powerful and handsomely finished "Columbian" generators, which created quite a cyclone of fun among both the ladies, gentlemen and young folk who visited the ladies' parlors where the exhibit was shown. These diminutive machines are without doubt the greatest electrical novelties recently put on the market, which fact accounts for the phenomenal demand which has sprung up both among the juvenile part of the community and the medical profession by which it is now largely used in the treatment of rheumatism, sciatica, lumbago, neuralgia and other nervous complaints.

Mr. C. C. Lewis, Boston, Mass., showed a sample of his new "Acme" rubber shield for protecting motormen on electric cars from receiving shocks through the handle by means of which they turn the current on and off, as well as being a preventive of blood poisoning through the hands being in constant contact with the brass handles, which has and is playing havoc among street-car men. The shield fits the handles very tightly and is a sure and certain safeguard. Costing but a few cents each, the demand is becoming enormous, and ere long every car in the country will be equipped with this handy and efficient safeguard.

The Shultz Belting Company, St. Louis, which does such a phenomenal business with the electrical fraternity throughout the country, and indeed in Europe as well, did not show any specialty, but was well represented by Mr. J. A. J. Shultz, the general president of the company, and Mr. A. B. Laurence, Eastern agent, who was one of the party that travelled from New York per electrical special train. They assisted in making everyone enjoy the visit to St. Louis, and booked some good orders.

The Jewell Belting Company, Hartford, Conn., without having a single foot of leather belting on exhibit, were most ably represented by jolly C. E. Newton, who made everybody feel good by presenting them with a handsome and useful morocco portmonnaie in which to carry greenbacks, each of these little auxiliaries actually enclosing as a gift a spic and span flim-flam fac-simile of a $100 bill—"green goods." They were as welcome and useful as if genuine—that is, the portmonnaie.

The De Mott Motor Company, New York, showed samples of its efficient fan motor, which were run by bluestone batteries, both motors and batteries being of the most compact and neat design possible. These motors have proved their high efficiency and popularity, and are sure to secure a large sale for ventilating purposes when the hot weather gets around. Being highly finished in every detail, most compactly built and possessing the following salient features—noiseless, efficient and economical—they promptly recommend themselves. They are made in four sizes to meet the requirements of varied service, and combining the highest workmanship with cheapness in price, they are sure to become general favorites. The display at the Convention was carefully examined and approved by all who saw it.

The Blakeslee Manufacturing Company, of Da Quoin, Ill., was represented by Mr. A. H. Blakeslee, who has charge of the St. Louis branch. He distributed some beautifully designed cards and circulars.

Wm. Jessup & Sons, the great steel manufacturers of Sheffield, England, whose goods are employed largely in the manufacture of fine tools, were well represented by Mr. Ezra H. Lundley, a gentleman well known in St. Louis and to many of the delegates to the Convention.

C. W. Hunt Company, of New York, the well-known manufacturers of the Hunt system of Industrial Railways, distributed circulars which clearly demonstrated that coal and other materials can be more economically and quickly handled by their system than in any other manner.

The Ahendroth & Root Manufacturing Company, of New York, had a representative on hand, and some elegantly prepared catalogues which were eagerly sought after by the central station delegates present. Incidentally it may be stated that the Root boiler has been adopted by many electric light and power stations East and West.

James Leffel & Company of Springfield, Ohio, distributed a souvenir of worth and value, on the subject of water wheels for electric light and power stations. The popularity of the Leffel Wheel has long been an assured fact.

Messrs A. Wyckoff & Sons of Elmira, New York, were usefully represented at the Convention by catalogues and circulars, setting forth the merits of the Wood Water Pipe and Patent Steam Pipe Casing, the latter being an excellent non-conductor of heat, and the former being known for its economy in first cost, durability and other important features for the purpose designed.

The Manufacturers' Advertising Bureau and Press Agency, through its proprietor, Mr. Benjamin R. Western, a veteran in newspaper work and advertising, did most efficient work on behalf of its clients in furnishing information to the members of the press for publication.

There were some very novel advertising schemes sprung on the visitors to the Convention, several of them being particularly attractive and useful. Mr. Louis Cassier, of *Cassier's Magazine*, reminded his many friends that he was around by presenting them with a series of epigrammatic advertising truisms, which were enclosed under a cover consisting of a genuine new $1 bill, with a huge red seal at one corner securing the leaves of this artistic *billet*; said dollar bill being good for 100 cents purchase at any place in Uncle Sam's domain.

Mr. C. E. Newton, the enterprising secretary of the Jewell Belting Company, Hartford, Conn., endeared himself to all by presenting them each with a handsome morocco portmonnaie in which to carry their wads of current bills when they have any to carry.

The Electric Appliance Company of Chicago and Mr. B. R. Western, of the Manufacturers' Advertising Bureau, New York, anxious to have their names in everybody's mouth, distributed variegated quill toothpicks on which the names and addresses of their respective firms were inscribed.

Mr. C. E. Bibber of the Consolidated Electric Manufacturing Company, Boston, distributed ivory counters or markers for keeping the score in playing whist and other games, and of course some electrical men do play whist occasionally.

Mr. James W. Godfrey gave out large numbers of pocket memorandum books, containing a handsomely engraved portrait of James himself, looking as happy as though he had just made a sale of 1000 miles of Grimshaw wire.

Samples of Sperry fuse wire were shown by Mr. George S. Searing of New York.

The Norwich Insulated Wire Company, New York, represented by Mr. G. J. Jackson, had a most effective display of its wires and cables, which were arranged in a handsome case that contained no less than 100 different samples.

The Boston Incandescent Lamp Company showed a new series lamp which they are pushing.

A C. & C. motor and generator was exhibited in operation, furnishing current for the apparatus shown by the Electric Selector and Signal Company.

The Helios Arc Lamp was shown in successful operation at various places during the Convention, and Mr. D. Spruance must have felt abundantly satisfied with the flattering comments.

The Mosher Arc Lamp, for both direct and alternating circuits, were examined by many visitors, these lamps being in operation in the hall of the St. Louis Electric Club and other buildings.

The elegant, efficient and popular Ward Arc Lamps, which have become all the rage of late, were splendidly represented by Mr. Corey, who knows just how to handle such high-grade goods.

The Wagner Electric Manufacturing Company, St. Louis, showed a handsome 2 H. P. alternating motor, which was placed in the private office of the Missouri Electric Light Company.

A New Factory for the Crocker-Wheeler Electric Company at Newark.

The Crocker-Wheeler Electric Company, New York City, have bought the large plant of the Spiral Weld Tube Company at Newark, and are preparing to move in. A feature of the new factory will be the conspicuous absence of belting and shafting throughout the entire works. The plan to be adopted is to transmit the power to each machine by wires which will connect to a motor on the machine and drive it direct. This method will be followed in the case of every machine where it is found possible, and will result in a considerable saving of power which would be otherwise required to constantly run lines of shafting and countershafts to each machine, as well as a large saving in the cost and maintenance of belts, countershafts, pulleys, oiling, etc. It is expected that the new establishment will give employment to 1,000 hands, many of whom will go to Newark with the company.

INCORPORATIONS.

The Knox Gas and Electric Company, Rockland, Me. Capital stock, $200,000. President, G. E. Macomber; treasurer, A. D. Bird; directors: George E. Macomber, J. Manchester Haynes, H. L. Shepherd, E. K. O'Brien, W. S. White, W. T. Cobb and S. M. Bird. The corporation is a consolidation of the Rockland and Thomaston Gas Light Company, the Camden and Rockport Electric Light Company and the Thomaston and Warren Electric Light and Power Company, and its purpose is to supply light, heat and power by the manufacture and distribution of gas and electricity in the city or Rockland and in the towns of Thomaston, Warren, Camden and Rockport.

The Wichita (Kan.) Electric Railway Company and the Citizens' Electric Light Company have been consolidated under the name of the Wichita Electric Railway and Light Company, with a capital stock of $500.000, paid up. Officers were elected as follows: Charles E. Dustin, president of the Schuyler Electric Company of Hartford, Conn., president; A. L. Batchelder, president of the Cheshire bank of Keene, N. H., vice-president; J. W. O'Neil, of Wichita, secretary and general manager; George A. Litchfield, of Keene, N. H., treasurer, and Arthur Faulkner, of Wichita, assistant treasurer.

The Lancaster and Downington Street Railway Company, Harrisburg, Pa. Capital stock, $1,000,000. President, H. B. Piper, Tyrone; directors: John A. Clark, Lancaster; George W. Melly, S. A. Hench, A. E. Melly, Jesse Wingert, Harrisburg. The road to be built by the company will be operated by electricity and will be thirty miles long. It will run from the intersection of the Bridgetown and Horseshoe turnpike road and the Philadelphia and Lancaster turnpike road through the towns of Smoketown, Bird-in-Hand, Intercourse and Earl and Leacock townships over the public road leading past Smoker's coach works and Centreville school house to the limits of the town of New Holland, thence returning by same route through Leacock and Salisbury township, the two towns of Spring Garden, West Caln township, thence to the Borough of Downington.

The name of the Asbury Park Electric Light Company has been changed to "Neptune Electric Company," and the capital stock has been increased from $60,000 to $200,000.

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ELECTRICITY.

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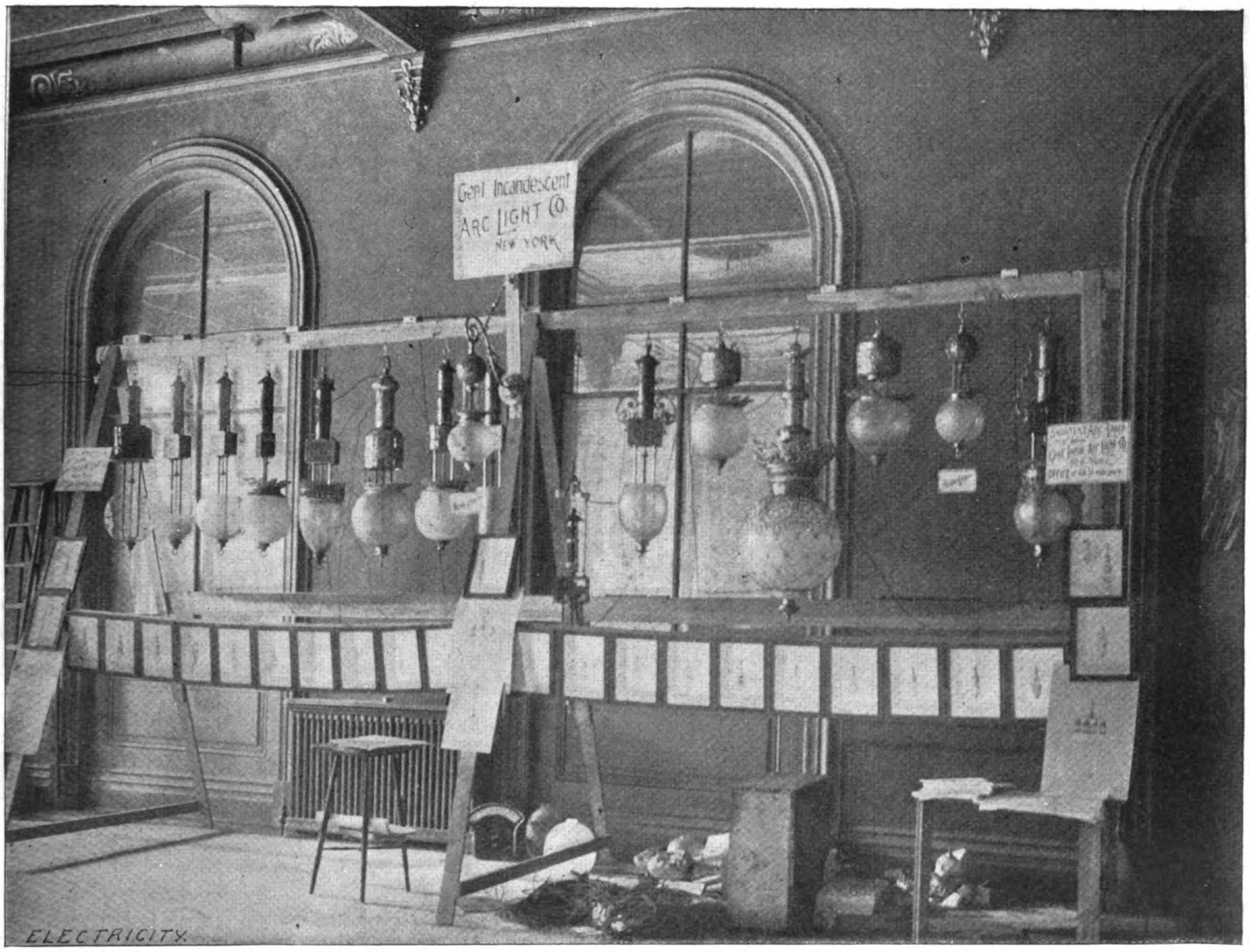


EXHIBIT OF THE GENERAL INCANDESCENT ARC LIGHT CO.—ST. LOUIS CONVENTION. (SEE PAGE 121.)

The New Kelvin Wattmeter.

A new engine-room wattmeter, the invention of Lord Kelvin, shown in the following illustrations, was recently exhibited by Dr. Fleming in his Cantor lectures. Fig. 1 gives a general view of the instrument with the case removed, which is described by our London contemporary, the *Electrician*, as having a main circuit formed of a double rectangle of copper rod of sufficient area to carry 200 amperes, and a shunt circuit with two fine wire coils astatically arranged. The main coil is mounted on a slate back so that the rectangles are horizontal. The shunt coils are mounted on a light but strong aluminum frame in the manner shown in Fig. 2. One end of this frame has a circular knife-edged hole fixed to it, and the other end has a straight knife-edge. These two knife edges rest on two phosphor-bronze hooks attached by insulating supports to the outside ends of the double rectangle. By this method of suspension complete freedom from friction is obtained, while the movable system is kept in a definite position without end guides. Each fine wire coil has about 1,000 turns of insulated wire, and its resistance is about 100 ohms. The current is conducted in and out from the movable system by two flat palladium spiral springs which also supply the restoring force for governing the sensibility of the instrument.

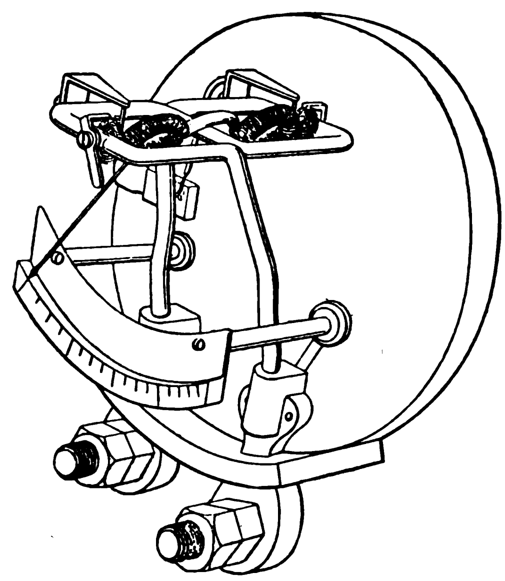


Fig. 1.

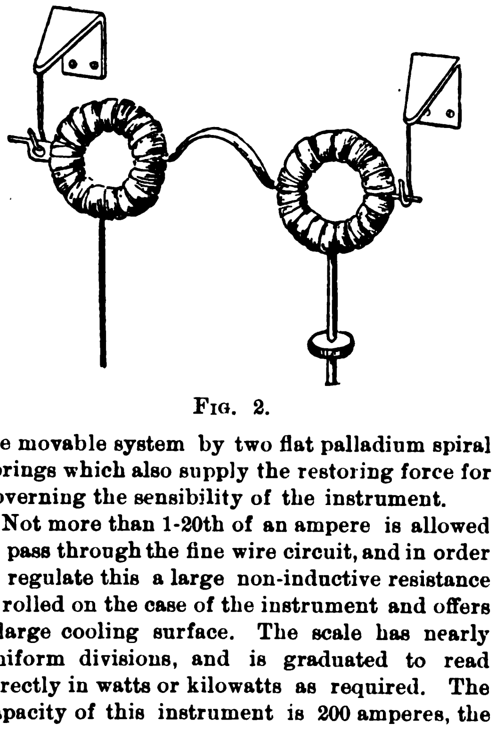


Fig. 2.

Not more than 1-20th of an ampere is allowed to pass through the fine wire circuit, and in order to regulate this a large non-inductive resistance is rolled on the case of the instrument and offers a large cooling surface. The scale has nearly uniform divisions, and is graduated to read directly in watts or kilowatts as required. The capacity of this instrument is 200 amperes, the volts being immaterial.

Mr. James W. Godfrey, of the New York Insulated Wire Company, left Chicago last week for a flying business trip to the Pacific coast.

Electrical Quackery.

A most important judgment was delivered in the London Law Courts (Queen's Bench) on Friday, February 17. The case was one for libel taken by a certain Dr. Tibbitts against the proprietors of the London *Electrical Review*. Our contemporary has always waged war against every description of electrical quackery, but more especially during late years has it condemned the electropathic appliances sold at a London establishment—so-called electric belts, which are declared by the vendors to cure almost every imaginable disease or complaint. In September last the *Electrical Review* received a pamphlet for review which proved to be nothing other than a testimonial written by Dr. Tibbitts, who it appears had been retained by the Electropathic and Zander Institute to report on these belts for a fee of 100 guineas. This pamphlet was in due course reviewed by our contemporary under the heading "Electricity and the Medical Profession," (September 23, 1892). In this review the qualifications of this doctor were seriously questioned and yet another attack was made on the Harness belts. Dr. Tibbitts accordingly filed action against the *Electrical Review*, as did also Mr. Harness. The former was the case which last week aroused much interest among the English public, crowds of whom assembled at the Courts while the action was proceeding. The case lasted for the greater part of three days, there appearing on the side of the defendants such witnesses as Lord Kelvin, Prof. Sylvanus Thompson, Mr. James Swinburne, Mr. H. R. Kempe and Mr. T. E. Gatchouse and a large number of eminent electrical and medical men. All of these witnesses testified more or less to the inefficiency of the appliance and to the fact that "the dear old doctor didn't know what he was writing about," to quote the words of Prof. Thompson when in the witness box. In the course of the evidence it was stated that Dr. Tibbitts was an undischarged bankrupt and the necessary funds for the present proceedings were being provided by Mr. C. B. Harness.

The verdict was given by Mr. Justice Mathew and the jury in favor of the defendants with costs.

This decision was received by the public in the court with much applause and there was even cheering, which as a rule is not permissible. There was, however, no attempt made on the part of the judge to stop this uproar.

Hon. E. A. Armstrong.

A contributor has furnished us with the following information in regard to the new President of the National Electric Light Association:

E. A. Armstrong was born in Salem County, New Jersey, December 28th, 1858. He studied law in Camden, and was admitted to the bar in 1880. He was four times elected to the House of Assembly, twice its Speaker, and he was Judge of the Camden District Court for four years. He is the President of the Camden Lighting and Heating Company, the Atlantic Electric Light and Power Company, the Electric Light Company of Atlantic City, and the West Jersey Construction Company.

He is the legal officer of several corporations, some of which are the New Jersey Trust and Safe Deposit Company, the Camden Horse Railroad Company, the Cape May, Delaware Bay and Sewell's Point Railroad Company.

Indeed there are very few enterprises in Southern New Jersey that he is not in some way connected with. He is a Republican, and in politics has always taken a very active part, being in great demand as a speaker.

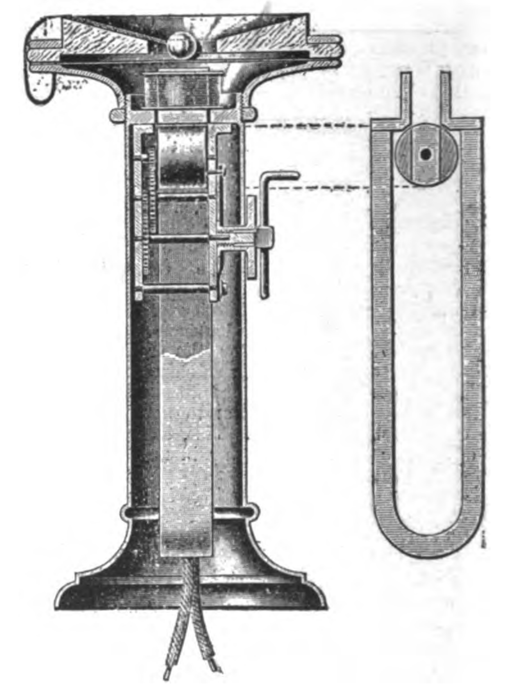
The Perkins Lamp Company.

Advices from Manchester, Conn., state that there is no prospect of the company being able to resume business. The managers of the Perkins Company have decided that they can no longer do business and they are now trying to dispose of their plant. The company employed about 100 hands and paid out wages amounting to $1,000 a week. The business was of great benefit to the town and its loss will be severely felt.

Siemens' Siren-Call for Telephones.

A special arrangement for a telephone call has been used with the Siemens bipolar telephone instead of the usual magneto call bell. This device, known as a siren-call, contains a brass cylinder of which two soft iron segments diametrically opposed form a part. This cylinder is rapidly revolved by means of a crank and train of gears connected to the armature. The *Electrical Engineer*, of London, describes the action of the instrument as follows: "This rotation causes a rapid introduction and removal of the armature from the magnetic field below the soft iron pole pieces, and a corresponding magnetic change in their cores which affects the home as well as the distant telephone diaphragms, setting them both into vibration. In general the siren-like sound emitted by the telephone alone is quite sufficient for the purpose of a telephone call; but the small bullet which is attached to the cord may be kept resting on the diaphragm; it is brought into violent movement by the vibration of the latter, and acts as an intensifier of the telephonic sound emitted.

"The armature if left to itself would take up a position across the field below the poles, and weaken the magnetic field through the diaphragm. In order to avoid this, when the telephone is used for conversation it is necessary that the armature be always brought into its neutral position and locked there. This is done by a special spring-catch dropping a pin into a pinhole, which arrests the armature in the proper position. When a call is given, this pin is first drawn out of action by a cam with a milled head, which, together with the crank-handle for rotating the armature, projects outside the telephone casing."



Siemens' Siren-Call for Telephones.

A New Electric Club.

The Elgin Electric Club, of Elgin, Ill., has completed its organization by the election of the following officers:

President—Frederick Purdy.
Vice-President—Dr. G. L. Marion.
Secretary—J. Frank North.
Treasurer—Henry Klinder.
Librarian—R. W. Pikerton.

The club begins its career with forty-eight members and was formed for the interchange of ideas, the promotion of scientific investigation and for social intercourse. It meets every Saturday evening.

The New Western Union President.

General Thomas T. Eckert has been chosen to fill the vacancy caused by the death of Dr. Norvin Green, President of the Western Union Telegraph Company. Gen. Eckert was previously vice-president and general manager of the company. He is a native of Ohio, and made his first appearance at St. Clairsville, in that State, on the 23d of April, 1825. His services to the Government during the Civil War, as Superintendent of the Military Telegraph, Department of the Potomac, were of a character to attract the attention of the Administration and he was placed in charged of the military telegraph headquarters in the War Department, in which position he was brought into close confidential relations with President Lincoln. Entering the service with the rank of captain he rose through the grades of major and lieut.-colonel, and was brevetted brigadier-general. He was one of the party who met the Commissioners of the Southern Confederacy in January, 1865. In 1866 he left the public service, being then Assistant-Secretary of War, and became superintendent of the Eastern Division of the Western Union Telegraph Company. When the Atlantic and Pacific Telegraph Company was formed he was chosen its president and as such entered with his customary spirit into the aggressive war which arose between that company and the one he left. The strife between the two companies ended in the sale of the Atlantic and Pacific to the Western Union, although the former company still retained its corporate existence and its president. In 1880 Gen. Eckert became president of the American Union Telegraph Company, a creation of Jay Gould. A rate war between this company and the Western Union prevailed from the first, and this engaged his active attention until in January, 1881, the rivalry was terminated by an agreement to consolidate the two companies, and Gen. Eckert then became the executive officer of the Western Union.

Gen. Eckert is held in high esteem by every one connected with the company, and being possessed of commanding ability and a thorough knowledge of all the details of telegraphy, he will doubtless prove fully equal to the requirements of the great office which his predecessor so ably filled.

D. Herbert Jeffery.

It is with sorrow we record the death of D. Herbert Jeffery, secretary of the Crocker-Wheeler Electric Company, which occurred on the 2d instant, from pneumonia, after an illness of only ten days.

Though Mr. Jeffery was but forty-one years of age at the time of his demise, his business career had been a wide and varied one. He was born at Corning, N. Y., and in the early years of the sewing machine business became connected with the Remington and Wheeler & Wilson companies. Foreseeing the great future of the electrical business he accepted the secretaryship of the Crocker-Wheeler Electric Company two years ago. His brief association with this company proved him possessed of great executive ability and a first class salesman, and had endeared him to all of his business associates and to the electrical fraternity with whom he constantly came in contact, doing the major part of the buying and selling for the concern.

He was well known in musical circles in New York, sang in several of the churches of the city, and was connected with a number of its choral societies. His numerous friends always found him of an extremely loyal and generous disposition, and his fine musical talent was always freely and cheerfully exerted in the cause of charity.

Aaron F. Perry.

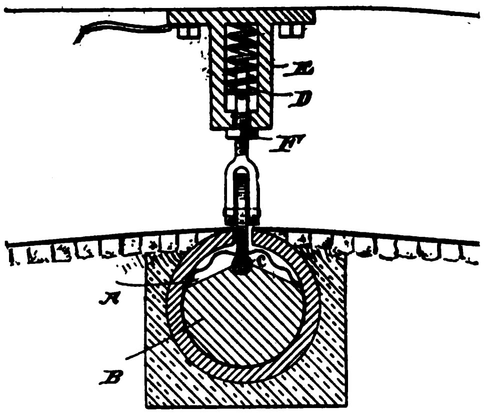
Hon. Aaron F. Perry, who died on Saturday last at his home in Cincinnati, was for thirty years a leading member of the Ohio bar. He was an ardent anti-slavery man, and sustained close relations to President Lincoln during the early days of the war. He was a life-long friend of the late Chief Justice Waite, and had represented his district in Congress. He retired from practice two years ago, at the age of seventy.

An Electric Railway Conduit.

A patent has recently issued to Mr. F. C. Perkins for an inclosed conductor for electric railways to take the place of the uninsulated trolley wire as ordinarily used. The invention contemplates the use of a supply conductor which is insulated throughout its entire length yet from which a continuous supply of current may be obtained by a moving contact or trolley. The cut shown below is a diagram of this arrangement in which A represents a metallic tube of any suitable material having the requisite elasticity for the purpose and being proof against the effects of the weather and at the same time a good conductor of electricity. This tube is formed in lengths which may be jointed and contains an insulating support B within it, which may be of wood impregnated with oil or otherwise treated to render it a good insulator, upon which is mounted a bare supply conductor C. This conductor C is referred to herein as a supply conductor, by which is meant either the outgoing or return conductor of a system of electric supply.

In its normal position the tube is maintained by its own elasticity out of contact with the conductor C and may be held at any suitable distance therefrom.

Upon the car is mounted a presser-foot which is preferably shod with a wheel at the point where it enters the conduit or comes in contact with the metallic tube, which may be arranged so that the degree of pressure may be controlled by the motorman. An elastic spring D surrounds a stem which enters a box E, the tension of which may be varied by adjusting the nut F. The pressure of the spring should be sufficient to force the top of the metallic tube A into contact with the conductor C. Under these circumstances as the car proceeds a shifting contact is maintained by the wheel between the tube and the conductor and the current is led from the conductor to the motor on the car by suitable connections, the tube rising away from the conductor as the car passes any given point and opening the connection at that point.



Personal.

Mr. W. S. Andrews has resigned his position of General Superintendent of the Works of the Canadian General Electric Company, Limited, at Peterborough, to assume the management of several large electric light and power concerns in Pennsylvania. His experience in this business dates from 1883, when, in connection with Mr. Frank J. Sprague, he put in the first Edison three-wire central station plant at Sunbury, Pa. Mr. Andrews began his electrical career with Mr. Edison at Menlo Park in 1879, and ever since that date he has been intimately and constantly connected with the manufacture, setting up and running of electric light and power machinery. His long training in these fields of work should be of especial value to the plants placed under his charge.

Mr. Nelson W. Perry, editor of the *Electrical World*, left New York on Saturday last to attend the funeral of his father at Cincinnati.

Long Distance Transmission of Power.

BY CHARLES S. BRADLEY.*

It now lies within our means to build an electric transmission of power plant from coal mine to city which shall cost $300,000 and will transmit 5,000 horse power. This plant will do the work of 30,000 men steadily day and night, year in and year out, and once placed will last a lifetime. The $300,000 represents the work of the 30,000 men for about four days, or an outlay of ten dollars each; thus these men can build a plant in four days that will do more work during their whole lives than they can. Can anything appeal to the imagination of man with more force? The energy of 5,000 horses transmitted noiselessly over a small wire; the coal from the mine placed by one act immediately beneath the boilers; the energy thence running to its destination without any labor from man; the air to supply combustion taken in the country, thus not robbing the human being gasping for breath in the city; the smoke and foul gases being thrown off where they will do no harm. Think of a city free from smoke, its cars, elevators, shops, run and lighted by electricity which shall be generated miles away. I have not said houses heated, but I hope that before 1900 we may say this also. The present obstacle to heating by electricity is the inefficiency of the steam engine. Many are looking for the direct conversion of the energy of coal into electricity. There is no doubt that it can be done, but I fear it will never be economical, for we must depend upon the combustion of the coal in the oxygen of the air.

For the electrical transmission of power we have two general systems—the alternating and direct. The multiphase alternating was advertised extensively by the Lauffen-Frankfort plant in 1891. This pioneer plant was built by much sacrifice of time and money, and we owe gratitude and honor to those men whose indefatigable efforts accomplished the beginning of an art which is destined to revolutionize the social status of mankind. This plant proved conclusively that very high voltages could be successfully used and the insulation maintained. This is the whole thing in a nut-shell; the choice of this or that particular way of generating and using the energy is of secondary importance, and will vary with each situation. Surprising as it may seem, the maintenance of the insulation was the least trouble in the operation of this plant. One of the greatest, the interference with the telegraph, which belongs to the German Government, and when the German Government says "stop" it means stop (in Germany). The next difficulty in importance is the static induction; each wire, being so long and exposing so much surface, becomes a reservoir to hold electricity, and the generator must fill this reservoir on each impulse before it can deliver energy at the distant end. When the generator reverses the direction of current, as it does some 100 times per second in the alternating, this reservoir must be discharged and filled with electricity of opposite sign; that is, if the first impulse to a given wire was positive and fills its capacity with the positive electricity, the reverse impulse must discharge the positive and then fill the reservoir with negative electricity. This operation consumes but little power; it is an ebb and flow, as it were. The trouble, however, is that this idle current swinging back and forth occupies the carrying capacity of the generating apparatus; so much so, that I saw the fuses blown at Lauffen with no load of consequence at the Frankfort end. In damp weather the insulators become wet on the external surfaces, and this largely increases the capacity, which is more serious than the increased leakage. These difficulties vary with the length of the line and the amount of power transmitted, the surfaces being proportional to the length of line. The carrying capacity is proportional to the square of the diameter of the wire, while the static capacity is proportional to the surface, which is equivalent to being proportional to the diameter, so that the larger the amount of current transmitted the less proportional influence the static capacity has. These things must be determined by the engineer in each case. The multiphase alternating is the most pliable, adjustable system that has ever been conceived. It is capable of transformation in voltage; will supply motors of either synchronous or non-synchronous type; will readily convert in motor transformer to direct current for electric railroad or direct current distribution, and thus supply direct current motors. A patent was issued to me October 2, 1888, which covers this ground, and it is surprising and gratifying to read the original specification filed April 23, 1887, now nearly six years ago, and note there the complete provision for the transformation for these varied uses. At the factory of the Fort Wayne Electric Company I have had exceptional facilities for experimentation on the multiphase systems, some 270 different tests having been made on motors, dynamos and transformers, the record of which fills a respectable volume. If this could be given to the world, that the engineers might know what not to do, undoubtedly the wings of many a genius would be clipped. Where the power is to be delivered in compact form the direct current offers some important advantages. We can get very high voltages by a battery of machines placed in series for the generator and motor stations. The placing of machines in series for power transmission was proposed by Mr. Edison in 1880 and Prof. Thomson in 1883. Each contributed some essential improvement, but it is evident that the enormously high voltages now contemplated were not then thought of. For the generator station I prefer compound wound machines; first, that the system may be self-regulating; second, that the series coil when a machine is thrown into action shall magnetize the field in the right direction; this also requires that the switch shall close the series coil first. The shunt coil would tend to reverse until the machine has attained electromotive force enough to overcome the resistance of its own armature. In order that each machine shall be as far as possible independent of its neighbors, I prefer that it shall be short shunt, or in other words, the shunt coil be charged direct from the brushes of each machine. I would use the 500 volt machines, and of such ampere capacity as the size of the plant demanded, and belt them all from one shaft. The 500 volts have been found safe to life and the commutator works well. Now, we must protect the insulation of the windings; the end machines where the terminal voltage, say, reaches 20,000 volts may, in case of grounds, be subjected to the piercing strain of the entire electrical pressure. It is impracticable to insulate the windings of each machine to stand any such potential; therefore, we connect the windings of the machine at some point with the frame so that it may never be subjected to a strain greater than its own voltage; next, each machine foundation is thoroughly insulated from earth, and in case this insulation fails for any reason, the fuses of the line will be blown, thus protecting the whole structure. It is easy, however, to make this foundation insulation so perfect that no derangement will take place. For this I have struck upon a cheap plan, which was not apparent at first. Having now provided for the insulation, we must next consider the safe handling of the machines. A moment's consideration of the electrical potential of each successive machine in the series will make it evident that the whole of each machine will attain the potential of its individual position; or, beginning on one end, each successive machine will be 500 volts above the preceding one. We can use a wooden platform around and attached to the base of the machine, so that the man must cross it before he lays his hand on the metal part. Here, again, I want to point out how essential it is that the windings be in metallic connection with the frame for the safety of the man. It secures that no part of a machine shall exceed its own voltage, and in case of a leakage in the foundation insulation, immediate detection. If this metallic connection were not provided and a leakage occurred in the foundation, you will readily see that it might be undetected, and a man touching the brushes and the frame would take a current through him of uncertain high voltage. At the motor station we use simple 500 volt shunt machines with the same precautions as at the generator station. Our power having been transmitted can now be converted into whatever may be demanded. If it is an electric system of distribution, we shall have the advantage of its being impossible for the high tension current to get into the system of distribution. If it is a large plant, the motor station may be subdivided into two or three parts, preferably in multiple arc, with the same potential on each. On very long lines I think the transmission must be done by direct current.

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*Abstract of paper read before the National Electric Light Association at St. Louis, Mo., February 28 and March 1, 2, 1893.

Remarks Concerning Power Transmission from the Economic Standpoint.

BY L. B. STILLWELL.[†]

At the Buffalo Convention of the National Electric Light Association in February, 1892, in the general discussion of the subject of "Electric Transmission of Power," a great deal was said about different systems of electric apparatus which might be employed for this purpose. But the writer carried away from that Convention the impression that after all the manager or owner of a central station, or the business man desirous of securing information as to the practicability of profitable investment, must have failed to derive any great amount of information of the kind which he desired to obtain. The first question of such a man is "Does it pay?" and it is a question which an engineer who has become so involved in the consideration of technical points as to lose sight of the question of practicability from a business standpoint has great difficulty in answering. But the business man is right. "Does it pay?" strikes direct at the root of the whole matter. The practicability of all systems and of all projects of this description must be measured in monetary units, and electric transmission of power, as well as every other form of engineering undertaking, must find its ultimate reason for existence in considerations of economy. Any engineering project which cannot live when measured by this standard should never be undertaken.

At the present time we find in actual operation a large number of central stations utilizing the energy of coal by means of steam plants, and distributing power and light through the medium of various types of electrical apparatus. The number of central station plants operated by water power is, on the other hand, extremely limited. The best way to arrive at results of some tangible value is obviously to compare a hydraulic and electric transmission plant with a central station using steam engines to drive dynamos.

In the former we have the steam plant, consisting of boilers, engines, pumps, heaters, etc.; the electric generating plant comprising dynamos, exciters and all electrical apparatus located in the central station; and the distributing plant, comprising motors, lamps, transformers, and the conductors connecting these with the central station. In the latter case it is usually convenient to locate a sub-station at a point adjacent to the market, for example, on the spot where the central station would be located were we to obtain power from coal. In such a plant we have the hydraulic apparatus, comprising dam, flumes, draft tubes, turbines, regulators, etc.; the electric generating plant, consisting of generators, exciters, and all electrical apparatus located in the generating station; the transmission circuits between generating station and sub-station; electrical apparatus in the sub-station, which usually consists of transformers employed to reduce potential, together with switching and regulating apparatus; the motors, lamps and other translating devices, and the local distributing circuits connecting these with the sub-station. We may assume that the two installations from the point where the local distributing circuits leave the generating station on the one hand and the sub-station on the other to the premises of the consumer are precisely similar. There is no reason why they may not be so, and since the whole installation, no matter which of the two plans is adopted, must be designed to supply such service as the customer wants and will pay for, the assumption is perfectly fair. It follows that if the two contrasted plants are capable of delivering the same amount of power to the local distributing circuits they are alike as regards revenue. We may, therefore, at this point make our comparison still more direct by further narrowing the problem, disregarding the revenue side of the question and comparing simply annual charges. In other words, that phase of the general problem which I have selected as perhaps the most interesting may be stated as follows:

"What are the total annual charges against a hydraulic and electric installation utilizing cheap power at 'A' and transmitting it to 'B' as compared with the annual charges against a steam and electric plant located at 'B' and capable of supplying the same amount of energy in equivalent form to the local distributing circuits?"

We may conveniently construct an algebraic skeleton or framework of the annual charges against each of these typical installations. When we come to translate algebra into arithmetic by substituting numerical figures for the algebraic symbols, opinions will differ widely as to the actual values of the different factors, but I think that the skeleton will be useful, as by discussing, and, if possible, fixing one factor at a time, we shall be better able to arrive at some approximation to a definite and tangible result. It is in the power of this Association to compare, analyze and arrange this information in such a way as to make its application to a new project direct and reasonably conclusive. If there be any means by which failure in ventures of the kind in which you are and will be interested may be avoided we should certainly put ourselves in possession of these means as early as possible, and I would, therefore, respectfully urge the advisability of concerted action looking to the collection and proper analysis of information concerning each of the various items of expense and the various sources of revenue of your central stations. The problem is somewhat complex, and unless we have some definite and progressive method of analysis it is practically impossible for an association which may be considering the subject, or even for a select committee of engineers who may be called upon to advise with reference to a specific case, to arrive at an agreement in which all will concur.

In calculating the annual charges against the steam and electric plant we must consider the following:

Fb—First cost of real estate and buildings.
Pb—Percentage covering interest upon and maintenance of real estate and buildings.
Cb—Constant expenses, taxes, insurance, etc., on real estate and buildings.
Fs—First cost of complete steam plant, including engines, boilers, steam pipes, pumps, heaters, etc., installed.
Ps—Percentage covering interest upon and maintenance of steam plant.
A—Cost of fuel to produce one pound of steam.
S—Pounds of steam used per indicated horse power per hour.
N—Number of indicated horse power hours used per year.
Ws—Cost of water (if any) per annum.
Os—Cost of oil and waste per annum for steam plant.
Fe—Cost of electric generating plant, including exciters, regulators and complete station equipment.
Pe—Percentage covering interest upon and maintenance of electric generating plant.
Oe—Cost of oil and waste per annum for an electric plant.
Cse—Constant expenses, including superintendence, wages, taxes, insurance, etc., steam and electric plant.

Then $PbFb + Cb + PsFs + ASN + Ws + PeFe + Os + Cse + Oe =$ annual charges.

For the hydraulic and electric plant we have the following:

Fb—First cost of real estate and buildings.
Pb—Percentage covering interest upon and maintenance of real estate and buildings.
Cb—Constant expenses, taxes, insurance, etc., on real estate and buildings
Fh—First cost of hydraulic plant, including turbines, dams, flumes, etc.
Ph—Percentage covering interest upon and maintenance of hydraulic plant.
Oh—Cost of oil and waste per annum for hydraulic plant.
Ch—Constant expenses, including superintendence, wages, taxes and insurance on hydraulic plant.
A—Cost of water per horse power hour (where water rate is paid).
N—Number of horse power hours at turbine used per year.
Fe—First cost of electric apparatus between turbines and local distributing circuits exclusive of line.
Pe—Percentage covering interest upon and maintenance of electric plant exclusive of line.
Oe—Cost of oil and waste per electric horse power from generators for electric plant.
Ce—Constant expenses, including superintendence, wages, taxes, insurance, etc., on electric plant.
Fl—First cost of pole line, insulators and conductors.
Pl—Percentage covering interest upon and maintenance of pole line, insulators and conductors.
Cl—Constant line expenses (supervision and repairs).

Then $PbFb + Cb + PhFh + Oh + Ch + AN + PeFe + Oe + Ce + PlFl + Cl =$ annual charges.

And now, what have we accomplished? We certainly have not arrived at a definite solution of the problem of comparative annual charges, and the more carefully one looks at the statements, the more evident does it become that there are many factors the value of which can only be fixed by actual experience. It appears, however, that were we in possession of accurate and detailed data as to the cost, operating expenses and income of a steam and electric plant, we might form a pretty accurate idea of the practicability of an alternative project involving electric transmission of power. We should also need some information as to the cost of installing and operating hydraulic plants under various conditions, but this can be obtained with sufficient accuracy and with no great difficulty. The evolution of apparatus adapted to the efficient and reliable transmission of energy, and hence to the utilization of vast amounts of power in the form of falling water now wasted has reached such a stage as makes this question a most vital one, and the importance of information relating to the cost of steam and electric plants now in operation is manifest.

[†] Abstract of paper read before the National Electric Light Association at St. Louis, Mo., February 28 and March 1, 2, 1893.

This paper is offered simply in the way of suggestion and for the purpose of inviting criticism and comparison of opinions. The skeleton statements of annual charges have been hastily prepared and may doubtless be revised and amended with good results. It is intended simply for classifying purposes, to facilitate the accumulation of much needed data and to avoid confusion of ideas in discussion of the problem which I have attempted to analyze.

Power Transmission for Central Stations.

BY DR. LOUIS BELL.†

This paper makes no pretense at being an exposition of the theory and practice of long distance transmission of power, nor in it shall I attempt to go into lengthy discussion as to the relative merits of various methods and diverse apparatus none of which has been in use long enough to permit a ripe judgment of its relative qualities. I shall confine myself to discussing the question of power transmission as it appeals to the man who runs a central station, bearing in mind that however much may be learned from theoretical considerations, theory often needs to be chastened by facts.

If the problem arises of transmitting electrical energy from a distant point for use in light or power distribution, we must ask ourselves, before answering the all-important question of "Will it pay?" first, what are the conditions surrounding the transmission as such, and second, what are the conditions of the distribution that is to be accomplished?

If we simply desire to take a given unit of power and transfer it in the form of electrical energy from one point to another, the facts in the case are widely different from what they would be if it is necessary either to sub-divide that power unit at the receiving station or to scatter it along the entire path of the transmission. So far as distribution is concerned, we may then divide electrical power transmission into three classes: first, the transmission of single units; second, the transmission of power to a centre of supply from which point it is to be distributed in various ways; third, supplying the power for lights and motors throughout the length of the transmission line. Each of these classes of work imposes conditions on the possible methods of transmission, and requires special consideration. In new plants, hampered in no wise by existing stations, any one of these classes may exist, perhaps the last two more frequently than the first. Where a single motor is to be employed, the problem is exceedingly straightforward. Where a new centre of distribution is to be organized, some complications are encountered but not serious ones. Where power is to be scattered along the line, however, conditions arise which are not altogether easy of fulfilment and require a good deal of special care and skilful engineering.

In a general investigation of the methods which may be employed, the case stands somewhat as follows so far as the central station man is concerned:

First, if the distance over which he is to transmit power is moderate, he may use the ordinary direct current generator and motor, displace his engine with the motor and go ahead. But unfortunately direct current machines of any considerable capacity are practically limited in voltage by the existence of the commutator. Dynamos and motors of large size cannot, individually, in the present state of the art, be satisfactorily built for more than about 1,200 volts. Machines for greater voltage have very generally broken down in the experimental stage.

Multiphase currents—and by this I mean currents having more than one phase—are subject to the same general laws as any other alternating currents. Their most valuable peculiarity lies in the fact that for alternating currents of more than one phase excellent motors can be built which will run at steady speed, start under heavy load, and in general possess very much the same qualities as a well organized shunt motor of the ordinary kind. Incidentally, certain of the multiphase systems, more especially the three-phase, enjoy the advantage of effecting something of a saving in copper, under favorable circumstances up to 25 per cent. from what would be required by a plain alternating current of the same nominal voltage.

The fundamental difference between single and multiphase systems, then, is mainly the adaptability of the latter for driving motors, and multiphase are better than single phase motors principally in their ability to start under load and somewhat larger output for the same weight.

The multiphase motor can be pulled out of phase, but it can be readily started. We can, where railway currents are necessary, do much better than to drive the dynamos directly by motors of any kind. We can for this use start with the multiphase current, and through the medium of a single machine, scarcely more complicated than an ordinary railway dynamo, transmute this multiphase current into a direct 500 volt current of the ordinary sort. This very valuable result has been brought about through the ingenuity of my friend, Mr. C. S. Bradley, who invented the device a half dozen years ago. It has lain dormant, principally because there has been no special call for power transmission of any kind until recently, but to its thorough practicability I can personally testify, as a 100 kilowatt triphase direct current transformer which I recently tested, operated in the manner described, showed an efficiency of over 95 per cent. at full load, stood sudden variations from no output up to 100 kilowatts and back again without even a wink at the brushes, and bore up under heavy overload without difficulty.

Now, take up the case where a centre of distribution is to be fed, consisting it may be in part of an existing station and in part either of extensions and new circuits from this plant or subsidiary centres of distribution having other districts of the same town. Here the problem becomes more complicated and it is almost impossible to lay down any general procedure.

First, we can feed all existing railway circuits and extensions thereof very effectively and economically by use of the triphase direct current transformer just described.

Second, we can handle all direct current incandescent systems, whether two or three wire, by means of the same type of apparatus, the triphase direct current transformer.

Third, we can successfully operate any existing alternating incandescent circuits or any extensions thereof by feeding alternating current from the distant point directly into them through banks of transformers.

Fourth, if any new centres of distribution are to be made with circuits independent of those already in existence, we can operate these circuits very effectively for both lighting and motor service, if both be necessary, by employing multiphase apparatus; and right here let me say that there is one widely spread error which I desire most emphatically to contradict.

It has been asserted that incandescent lighting cannot be successfully done on multiphase systems especially triphase, since this happens to have been most talked about. This statement is absolutely false, to my own personal experimental knowledge. Lamps can be as successfully operated on systems of two, three or more phases as on an ordinary single phase circuit, provided equal pains be taken with the distribution of copper in the lines and the regulation of the voltage at the machine. If these conditions are observed, a two-phase circuit with separate wires acts substantially as if it were fed from two ordinary alternating dynamos. A triphase circuit gives a similar result, and if more phases were concerned the same would be true. If the condition of constant voltage at the centre of distribution be fulfilled, as it can be and must be for successful operation on any system whatever, two and three phase incandescent lighting systems can and do work admirably. Furthermore, if we combine circuits, for example, if we use three wires instead of six for the three-phase system, there is no exact equality of balance required between the lamps placed in different connections across these circuits. On the three-phase system we would place lamps between each possible pair of the three wires, this arrangement gaining, as I before mentioned, in copper wire enough to compensate for the slight inconvenience in connecting three sets of lamps instead of one or two. Branches can be run from any two wires of the triphase arrangement, and lights placed on them will act exactly as if they were placed on any ordinary alternating circuit. I lay stress upon this matter of incandescent lighting in defense of multiphase systems, because it is the one upon which they have been most often misrepresented, chiefly through foreign experiments, which I do not hesitate to denounce as clumsily conducted.

There has been much discussion as to the relative merits of two and three phase induction motors. In general the more phases the smoother action of the machines in various respects. I have never yet seen a two-phase motor any better than a three-phase motor. I should want a pretty careful series of tests to convince me that I had seen any one as good. The difference between them, with proper design, ought not to be very great, though the three-phase has the advantage in cost of wire. There are two important points in which multiphase motors have been misrepresented, which I should like to mention.

First, it has been stated of them that they take an enormous current when running light, and second, that they introduce a very large and most objectionable lag in the circuit, so that the apparent current on the line is much greater than the energy current. Such facts have doubtless been observed. Broadly speaking, they have been due to faulty design. A multiphase motor will always take a somewhat larger current when running idle than the corresponding direct current, but it takes very little more energy, as the phenomenon of lag then becomes noticeable, so that of the apparent current running light only a portion represents energy.

In case, then, of working a central station from a distant water power where necessity for extensions or new centres of distribution exists, we have plenty of methods available. Triphase direct current transformers for railway and direct current lighting service, alternators to feed into the existing mains or to supply extensions for them and for new centres where light alone is to be employed, ordinary alternating currents, or where both light and power are necessary multiphase apparatus, which, as I have shown, is entirely applicable for such a mixed system.

I may add that there is a possibility that we may have before long practicable motors to run on an ordinary alternating circuit constructed after such methods as were suggested by Prof. Thomson a few years ago. In very small sizes they are already practicable. Brown, abroad, has been making a desperate effort to exploit these very methods on his own responsibility, and has obtained motors which run successfully, but as yet do not start well under load. From what I can learn of them I doubt very much if they are any improvement on the motors of the same type shown by Prof. Thomson at the Paris Exhibition, or on Mr. Tesla's motor for running on a two-wire circuit.

The amount of drop advisable in long distance lines will depend of course principally upon the relative prices for copper and the apparatus necessary. If copper be relatively cheap, it pays to employ a good deal of it. If apparatus is relatively cheap, it is better to use larger generators, and allow more drop on the line—15 to 20 per cent. will hit the large majority of cases on the score of economy and convenience. It should be remembered, however, that for such drops as these good regulation is most essential, but good enough is available with direct, alternating or multiphase machines to make these drops thoroughly practicable.

I think cases would be rare where transmissions, the advisability of which would be dictated by commercial consideration, would encounter serious difficulty from inductants and capacity. I have never personally investigated a proposed transmission of over fifty miles that gave any promise whatever of financial success, but the time may come when such a case will appear, and if it does, the work can be done successfully so far as the electrical part of the matter is concerned. I think the greatest difficulty in surmounting long distances is the difficulty of keeping a long line in proper repair. Eternal vigilance will be the price of success in this respect, otherwise there is little trouble. The apparatus is thoroughly reliable and efficient, and the methods comparatively straightforward and simple.

Throughout this discussion I have taken the position that no one method of procedure is applicable to all cases. Personally, I am decidedly eclectic in my taste, believing that it is better to put in for each individual case such apparatus as on the whole proves to be cheapest and best rather than to advocate on any fine drawn theories methods which might be applied to the perfectly general case of transmission of power.

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† Abstract of paper read before the National Electric Light Association at St. Louis, Mo., February 28 and March 1, 2, 1893.

DISCUSSION.

President Ayer—Gentlemen, you have listened to a series of papers pertinent to a topic that is fraught with interest to almost every central station man. The rapid development of our business brings forcibly to our minds the necessity of transmitting large amounts of power over long distances in large units, or on the other hand of maintaining central stations and smaller units. The proposition is presented to us that in the near future we shall have to add enormously to our station or generating capacity for the manifold uses of electricity.

To-day we are placed in a peculiar position. Our attention is called to the direct system, moderate sized units, covering a large area, which looks to be a very practicable method for many uses, and also to one very large unit, transmitting power to various centres of distribution and there distributing it; and a further suggestion comes to us, especially where we are located near our coal fields, of generating power at the mine and transmitting it to the various points of distribution; so that it may be wise to consider the advisability of one or the other of the multiphase systems that are offered. My experience is that the more we look into it the less we seem to know.

Mr. Hammer—I have a few remarks to make on this subject, which is a pretty large one. Mr. Bell states that it is not practicable to use direct current machines over 1,200 volts. I think there are machines, not very far from this city, running direct currents of 3,000 and more volts. Moreover, the other night Prof. Crocker made the statement that he had been running for some time direct current machines of 5,000 or 6,000 volts without any difficulty whatever. Mr. Bell has stated, in speaking of the three-phase system, that the current at one time was passing through one wire and returning through the other two. I think it is generally expressed the other way; that the one wire is the common return of the other two. I do not think he placed enough importance upon the application of the motor transformer in this country. I think it would be very interesting to all the station men here if Mr. Bradley, Dr. Bell and Mr. Stillwell and others would get up and state just why it is that the alternating motors of large capacity are not in use.

Dr. Bell—I shall be pleased to vouchsafe Mr. Hammer any information on the subject. In the first place as to high voltage. We know we can make an arc machine to work on high voltage. I practically stated in the paper that high voltage could be used requiring the employment of 1,200 volts or thereabouts if the machine is designed to carry large currents. Experience up to date has shown that they will not work satisfactorily for any length of time.

As to why alternating current motors in large sizes have not been used up to the present time, I think the principal reason is that there has been no very large call for long transmissions until quite recently. Apparatus does not spring up like crocuses in the spring; it comes after a demand for it has arisen; it is dragged out of the inventor's brain when commerce demands. And the reason why we have not had more of this long distance business is because we have not had any very large call for it.

Mr. Stillwell—As to Mr. Hammer's question as to why these motors are not used extensively at the present time, I think that Dr. Bell's answer is very true as far as it goes. At the same time the demand for this long range transmission has existed. The development in this country of the multiphase systems was taken up, as you know, by Mr. Tesla, or rather it was taken up on the other side of the water, and he brought it to this country about 1888, and he spent with others a great deal of time in working up the applications of this multiphase system, which opened the door to a type of alternating current motor which would start from rest and work with efficiency. The last or at least one of the recent additions to the system, although the thing had been worked out before a long time ago, is the rotary transformer. The application of that, as Mr. Hammer says, is certainly of the greatest value.

There is one point of a great deal of practical interest in regard to the difference between two-phase and three-phase machinery. Dr. Bell has stated his belief that the triphase has some advantage over the two-phase. There is one advantage of commercial importance, and that must be carefully considered, and that is the slight economy in the investment of copper. The triphase effects a reduction of about 14 per cent. in the amount of copper for the transmission circuits that would be needed by a two-phase system. Now that does not mean that we must increase our potential by any such amount as 14 per cent. in order to come back to even terms on the copper proposition. It is sufficient to go up about seven or eight per cent.; seven per cent. would cover it unless I am mistaken. Seven per cent. increase of potential would bring the two-phase on all fours with the three-phase on this point.

Mr. Adams—It seems to me that the last question that Mr. Hammer asked on the floor was very important. While we may recognize and admit that we have not to-day large alternating systems of transmission because there has not been much demand for machines of that class and transmission of that kind in this country, I do not see that we have an answer to the question "Why we have not to-day, if it is possible to produce such a machine, an alternating current motor, in moderate sizes, which will fill, to use a trite expression, a long felt want?" That is a question I believe an answer to which would be very interesting to all present.

Mr. Hammer—I do not consider that Dr. Bell or Mr. Stillwell has answered the question I asked. For instance, in St. Louis there is a large alternating current station, and I cannot believe that an establishment of that kind would not be very glad to have a large number of fifteen or twenty H. P motors to run elevators and things of that kind. If there is nothing in the way of their being supplied, they ought to get them.

Mr. Bradley—I tried to build those motors and I have not been able to do it. We succeeded in building a one to two H. P. motor to work on a single phase alternating circuit which had an efficiency of fifty-two per cent. We have never been able to construct one without a commutator, and wherever a commutator is used the sparking is something dreadful. If it is not bad when the motor is first started, after a few hours it becomes very bad, and we have not been able to design any brush that will obviate the difficulty.

Dr. Bell—I will simply add to Mr. Bradley's statement of the case what I have been able to get hold of regarding the Brown alternating motor which has been exploited in Europe somewhat. The first efforts in the way of getting a motor to run on an ordinary alternating circuit which would be self starting were made by Zipernowski and his associates; that started well, but as Mr. Bradley stated had a continuous blaze on the commutator during starting.

I have no grudge against the two-phase motor at all. And as far as the transformers go it does not make any difference whether it is a multiple of two or multiple of three. In one case we have the same number of wires as in the other; in the three-phase we would only run three wires; in two-phase we run three or four; I think the usual practice tends more to four wires, so that I think the difference is quite largely constructional difference.

Prof. Weston—I think that Mr. Bradley hit the nail on the head a moment ago when he frankly admitted that he had tried to build an alternating motor of large power but had been unable to do so. There can be no question as to the fact that there has been and still is a large demand for such a system of transmission of power as has been referred to, viz., a simple transmission by means of the ordinary alternating current generator. Therefore I do not think it is exactly fair to dodge the question. There has been a demand. The demand exists to-day The difficulties have been so great that they have not been able to surmount them.

I would like to ask Dr. Bell why he makes the statement that 1,000 volts is the limit of work for the direct current, giving anything up to 100 amperes. I do not think that statement was well founded. I do not know whether Dr. Bell has any particular instance in mind—if so, I do not think the machine could have been designed correctly. I am quite sure of that, for with correctly designed machines I do not think there is any difficulty in running up to 5,000 volts, and with very large currents—very large currents—several hundred amperes. The question of the advantages of the two processes is still an unsettled one, and will not be settled probably for some years to come; it is a question of the survival of the fittest. But it does seem to me that the direct current system has a great many advantages over the alternating and *vice versa* ; just how the matter will terminate we shall have to wait I think to find out.

Mr. Bradley—I think this is a question of current; that is, as you increase the current you will have to decrease the voltage. It is not 1,000 volts, nor is it 1,200 volts, nor anything of that kind. With an arc machine having nine or ten amperes you can readily reach 6,000 or 7,000 volts; with a machine having 20 amperes you can reach perhaps 5,000 or 6,000 volts. I do not mean to say this as a scale; I am merely trying to give an example of what the thing probably is. If it is 50 amperes the voltage has to be reduced. I think that is the explanation.

Mr. Nunn—From experience in the back part of the room I am very much afraid I shall not make myself heard. I suppose my testimony in reference to the alternating plant that we have been operating is what is wanted. I can say that from its first installation to the present time it has been under my care, and I consider it a brilliant success, especially when I compare it with direct current systems which are in use around us. Our greatest trouble has been from lightning and from ground—ground very largely. The lightning has caused many defects and made many of the plants failures. We have to start our motors with a special starting apparatus, and we once in a while have a little trouble with that; that is as far as the operation of starting is concerned very simple. The men who take care of these machines, with two exceptions, are men who never saw an electric apparatus before.

Mr. Hine—My experience is entirely commercial I am not an electrician nor an inventor. I think that there is a demand for a system, whether single-phase or multi-phase, which can be used in cities like St. Louis for supplying power for all sorts of purposes—two horse power here, two horse power there, and ten horse power over there. I think it would be a great advantage if a central station man would be able to run the same generator and same system of circuit in a city like St. Louis. Long distance transmission is one thing; transmission of power for various purposes in a city is another thing.

Mr. Hammer—I would like to have Prof. Forbes give us his experience with the two-phase against the three-phase system.

Prof. Forbes—I can only say this in response to Mr. Hammer's kind invitation, that both the three-phase and the two-phase systems are working very satisfactorily in Europe. I have examined the apparatus and have made tests of the efficiency and I feel confident that we shall get very good results from either of those two systems. Of course there are two problems totally distinct as has been already mentioned—the question of transmission of power and the question of distribution of power. They are two very different problems and are capable of being treated in totally different ways. Of course besides these two systems of transmission and distribution, for these are systems which are very applicable for distribution as well as transmission, we have also the single-phase system, which works remarkably well, and of which we have had considerable experience in this country as well as in Europe.

President Ayer—This discussion has been exceedingly interesting and I think quite profitable to the membership. We have demonstrated one thing here to the central station men, viz., that our American electricians have very little faith in the promise or in the probability of the development of a practical alternating current motor for the single-phase current. We are either turned back to our direct current motors for power, where it is to be utilized in varying units such as are demanded of us for commercial wants to-day, or else we have to look forward to the development and introduction in the near future of the multiphase motor. We all hope that that time will be hastened so that we may be able finally to decide the problem, because long distance transmission of power goes and must go hand in hand with the distribution of power.

Underground Conduits and Conductors.

BY WM. H. BROWNE.*

Those who are intimately acquainted with the histories of the electric lighting companies of New York City may be pardoned if they believe that the experiences undergone by those companies have been unique, and that they afford to companies elsewhere opportunities for beneficial consideration.

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* Abstract of Paper read before the National Electric Light Association at its Sixteenth Convention, St. Louis, Mo., February 28 and March 1, 2, 1893.

In the years 1880 and 1881, but twelve or thirteen years ago, two companies began in New York City the business of distributing electric current from central stations. They were the pioneers, at least in that city, in the business of electric lighting. They were provided with apparatus which, compared with present standards, would be considered totally inadequate to the designed purpose.

Coincident with this imperfect apparatus and other difficulties, the best medium then obtainable for the transmission of current of high potential was bare wire.

The first step from that bare wire towards the underground conductors of to-day was soon found necessary.

That necessity developed the cotton-covered wire, and with that the operatives felt safe from injury by shock.

Soon some protection from the conveyance of fire by the covering became necessary, and then followed the saturation of the cotton covering with lead. This proved so equal to the conditions that the fire underwriters in the interest of insurance companies formulated rules prohibiting the use of any other but that wire, which obtained their own name of "Underwriters."

With the improvement of insulation came improvements in the apparatus, and it became possible to pass through one entire night occasionally without having lights out or a "dead ground."

In the year 1884 manufacturers of apparatus saw in New York City a field of profit and advancement for their machinery. The result was that in that year, 1884, franchises were granted to no less than six other companies, all of them primarily intended for arc lighting. Some of the companies created in that year did not make rapid progress, and the increase of poles and wires for electric lighting was not materially appreciable until 1888.

The wires for telegraph, telephone, messenger service, police and fire alarms, however, increased rapidly and became so numerous that a bill was passed in the Legislature directing that the wires be removed from the streets.

Some approaches were made to the two old companies engaged in electric lighting as to their taking upon themselves the task of building subways for electric lighting purposes; but they, it appears, chose to refuse to entertain the propositions.

After a long contention between the city and the companies, nearly all the wires for all the high tension arc and incandescent service transmitted in the City of New York below the Harlem River were placed underground. Above the Harlem River the Board of Electrical Control allows the construction of aerial lines, no subways having been built in that section of the city. Below the Harlem River no overhead wires are permitted to be erected and few of those that were in existence remain. It is probable that before the end of this year scarcely any will be in existence. The penalties endured by the companies for their opposition to the subways have been severe and drastic. The expenses imposed upon them in their effort to take care of their business and meet the requirements of transferring their systems from overhead to underground have been enormous and burdensome. The expenses continuing for rentals, due in a large measure to the amount of subways constructed and not occupied, continues and seems likely to continue to be an onerous tax. These expenses and burdens have tended and are likely to tend further in the future to confine the operations of the companies to territory contiguous to their generating stations, and may also tend to avoid the fierce competition which existed during the days of aerial transmission, and which lowered prices to below remunerative rates.

Is it not advisable for controllers and managers of companies in such places to recognize that condition, and endeavor to avoid the experiences of New York companies by planning deliberately the procurement of the right to themselves to build and operate their own subways and further to utilize the experiences of New York to avoid the expensive mistakes there made and to place their business on a stable footing and in a position where they may have immunity from injurious and cheap competition and secure service to their customers free from the interruptions belonging to aerial transmission? The telephone companies find it materially to their advantage to use underground conductors and are doing it in many cities.

Underground conduits and conductors for electric lighting and power, provided with due care and deliberation, need not increase the fixed charges of companies doing a reasonable amount of business to such an extent as to be prohibitory.

The transmission of electric current is entirely analogous to that of gas, water or steam and must inevitably, in the not very distant future, be conducted underground as they are. To electric light companies, as to gas, water and steam companies, the Legislatures and law-making bodies should give rights enabling them to meet the conditions in the manner calculated to produce the best results for the companies and the public users.

DISCUSSION.

The President—Gentlemen, you have before you for discussion this paper of Mr. Browne's, which is a very full exposition of the experiences they have had in New York with the underground conduits. The paper perhaps, considered as a whole, is indicative of the solution of the question or the scheme of operating high pressure currents underground. He cautions central station men there to beware of the pitfalls that the New York companies have fallen into. He outlines some of the mistakes made in laying the conduits, and in other ways gives advice and caution. There is a good deal to consider, and the development of the future is not one of the simplest factors to be taken into consideration on planning and laying out underground wires and conduits. The question is peculiarly interesting to the companies in St. Louis, where the subject has been agitated in the last year or two Efforts have been made to pass State laws compelling the companies to go underground in the cities of Missouri. The telephone company has been endeavoring to get a franchise to go underground, but there is a difference between them and our local legislators, and they seem to be unable to get a satisfactory franchise; at the same time the local city government have been endeavoring to procure State legislation compelling them to go underground. No doubt many of you have had similar experiences. I would like the discussion on this matter to be as full as possible, but at the same time I desire to remind you that our time will be very limited to-day for the amount of business we have yet to transact.

Mr. De Camp—I would like to ask, as I am not personally acquainted with the gentleman, who is Mr. Browne who writes the paper.

The President—I am informed that Mr. Browne is the General Manager of the United Electric Light and Power Company of New York, and that he is the gentleman who took charge of the Consolidated Companies several years ago at the time the Westinghouse Company went into New York.

Mr. Moore—I would say, having been through the underground law in New York, that I would like to make a little statement of the state of affairs there. The New York situation was brought about mainly I think through the stupidity of the companies themselves. In New York two companies controlled the arc lighting business. The price for city lighting was 70 cents a night. It was generally understood that it was to be made about 50 cents. My company were very anxious to get into the business. They wanted to bid way down and I said no, "the present price they are going to bid is $182.50 a year." I wanted to bid $181. They gave me my way on every piece of territory there except the Bowery. They said we must get into the Bowery, and we made the price $160. On the opening of the bids one of the old companies made this statement: "If you will throw out all those bids we will light the entire city for 25 cents a night." In response to that statement and in compliance with their duty, they threw out all bids and we were asked to bid again, and our company bid $19\frac{9}{10}$ cents, and we got a very large order, one thousand lights.

Mr. Smith—I do not know how other members of the Convention feel, but I have attended some seven or eight conventions right straight along in which this matter has been thrashed out until all the grain was out of it and nothing left but the straw. You can read over the last five printed reports and find that all this has been gone over time and again. You can read them at home and save a great deal of time here. We do not want to go underground if we can help it, and the best way to stave it off is to do good overhead work.

CORRESPONDENCE.

Multiple Images in Lightning Photographs.

To the Editor of ELECTRICITY.

SIR: In regard to the fine photograph of so-called ribbon lightning by Mr. W. N. Jennings, a reproduction of which appears in your issue of March 1, 1893, I would suggest the following explanation.

It is not unusual with a heavy flash of lightning that the main stream brings the air particles in it to such a high state of incandescence that an appreciable interval exists after the flash during which the path remains more or less luminous, just as a meteor track fades out gradually. This is due to the gradual cooling of the hot stream of particles. If, therefore, such a flash be photographed by a camera which is moving or swinging, as would be the case on the rear platform of a rapidly moving train, the vibratory ramifications of the flash would come out rather sharply, as would also the rails and ties and other objects in the view, illuminated instantly by the main flash and not illuminated sufficiently by the hot streak remaining after the flash. The hot streak itself would, however, be spread out from the main flash like a ribbon, due entirely to the motion of the camera, and the direction of spreading would indicate the motion which the camera had instantly after the flash. In the picture of Mr. Jennings this motion was evidently an upward swing of the camera tube, and a swing a little to the left after the upper limit had nearly been reached. The motion is not directly upward, as shown by the transverse streaks having an inclined direction. The middle portion of the flash does not show the ribbon-like stream, and for the simple reason that it happened that the motion of the camera tube was in the direction of the line of the flash at that part. This, I think, will be found a complete and satisfactory explanation of the picture as obtained. A very slight angular movement of the camera tube would give the ribbon appearance of the stream in the picture.

The pictures showing multiple images are explained not because the lightning flash is of an oscillatory character, because such oscillations would be manifestly more rapid than would permit the change of position of the camera to take superposed pictures with the objects displaced. There are two causes for these multiple images. In the first place, it is well known that the heated gas left after a discharge of lightning acts as a good conductor and provokes the passage of other discharges down the same path. Now, the train by moving the camera will have changed its position between these separate discharges and each one of them illuminates the landscape, but the impression of the objects will be on different portions of the plate so that multiple images will be formed. Again, if there be a high wind blowing, the hot stream left after the discharge is itself displaced somewhat between the times of the flashes, but this displacement would be apt to be so slight that it would only blur the images and not cause them to be separated as they are shown in Mr. Jennings's pictures. I am therefore of the opinion that the multiple images were formed by the movement of the camera tube occurring between the times of the successive flashes down the same path. Yours truly,

ELIHU THOMSON.

Lynn, Mass., March 7, 1893.

New Companies.

The Riverside Park Railway Company and the Sioux City, Iowa, and Leeds Electric Railway Companies have filed articles by which the companies agree to a consolidation of the operating departments of the two roads, a sharing of expenses of operation, etc.

The Beverly and Edgewater Park Electric Light and Power Company, Mount Holly, N. J. Capital stock, $30,000. Incorporators: Louis R. Hibbard, John V. Rice, Jr., Edmund G. Harrison, George M. Lane and William E. Harrison.

ELECTRICITY.
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"Electricity," under its present ownership, has never solicited the advertising patronage of the General Electric Company.

THE ELECTRIC TRUST COULD NOT SURVIVE AN IMPARTIAL AND FAITHFUL INVESTIGATION BY A CONGRESSIONAL COMMITTEE. WHAT CAN YOU DO TO BRING THIS INVESTIGATION ABOUT?

I do not know that I can say very much as to the policy to be pursued on this question. I know what mine shall be; that I will never buy one cent's worth of material from the General Electric Company until they do that thing. (Applause.) I shall never buy one cent's worth of supplies from that company that I can possibly buy from an independent concern; and I shall do all in my power to advance the sale of any lamp which is put on the market which can be manufactured without coming under the law of infringement.—*T. Carpenter Smith, of Philadelphia, before the National Electric Light Association.*

THIS is the slogan: No man should buy one dollar's worth of supplies from the Trust which can be purchased elsewhere. Independent concerns should be aided in every practical way, and there is no more practical way than this.

Lightning Photography. The publication of the remarkable photographs by Mr. Jennings, taken from a moving train, which appeared in our issue of March 1, has given rise to various expressions of opinion as to the explanation of the "ribbon" effect and the multiple images.

We print in another column a communication from Prof. Elihu Thomson, giving an explanation of the lightning's effect on the camera plate. In order to bring out more information on this subject, we invite expressions of opinion from others who have witnessed these phenomena.

* * *

Direct vs. Alternating Currents. One of the questions which came up during the discussions before the National Electric Light Association was the relative efficiencies of the direct and alternating current systems of distribution from central stations. A company about to establish a new station is generally confronted with the difficulty of making a choice between these two systems, and the desirability of either cannot be generally decided to cover every case.

The most important factor in the decision will probably be the distance to which the current is to be transmitted. The low voltage and heavy currents which are employed with direct current distribution make the use of a heavy system of conductors necessary, and practice has shown that beyond a certain distance the interest on the investment in copper conductors becomes great enough to eat up the profits of the lamp rentals. The introduction of the three-wire system enables this distance to be extended with some economy over the two-wire system, and in a few cases in Europe the use of the five-wire system has still further reduced the first cost of the copper used in the distributing system. The limit to which both of the latter systems may be carried is, however, soon reached, and their use introduces to some extent complications in the methods of regulation and additional apparatus which operates to increase the running expenses at the station.

The direct current offers in several respects some advantages over the alternating in a district comparatively compact and where the services are evenly distributed. This is especially the case in regard to the operation of motors, which is a most desirable service for stations, as it helps to overcome the difficulty of a light day load—a condition for which most station men are seeking a remedy. Although alternating current motors of a capacity of one horse power or less are now made to operate successfully and with a fair efficiency on the usual single phase alternating current employed for lighting circuits, there is no motor of this class on the market of large size which can start with a load and be put in the hands of the layman with confidence, nor at present is the prospect of such a machine encouraging. In some cases these large size alternating current motors are employed with success, but where the variations in the load are large the motor is apt to be pulled out of step with the generator or perhaps stopped altogether. Another advantage offered by this system is the possibility of utilizing electrical storage, which, although not yet employed in this country to any extent, is daily becoming more and more recognized as essential to the highest economy of operation.

The charging of batteries for isolated plants is also impossible in the case of alternating currents, although such a service is frequently called for. The regulation of the voltage is less exact with the latter system, and the economy varies to a greater extent with the decrease of load than it does with a direct current. This is due to the loss in efficiency in the transformers as their load decreases, although this factor has been very materially reduced recently on account of the improvements in the design of transformers now on the market.

For a small station supplying current over a limited area and for various kinds of service the direct current offers the greatest flexibility, but on the other hand a good many cases arise where the alternating system is the only possible method, from a commercial standpoint, and in other cases the question of the difference of the cost of installing and operating either of these can only be decided after careful investigation of each particular case. There has lately been a far greater tendency towards the use of alternating currents than formerly. Were it not for a few of the drawbacks mentioned, its economy in almost every case would be unquestioned. To-day it has the field of long distance transmission for lighting almost to itself, and with some modifications will take the same position with long distance power circuits.

Should the future produce a satisfactory motor for this current and some efficient means of electrical storage, the alternating current would no doubt take its place at the head, but now the question between direct and alternating currents must remain to be decided in any particular case according to the distances to be covered and the class of services rendered.

Encouraging Symptoms. When ELECTRICITY, a little over six months ago, began a vigorous and effective attack on the Electric Trust, there were few who believed the attack to be unjust, but there were many who believed it to be premature, if not wholly unnecessary. The intention of the Trust to wipe out by any means, fair or foul, all competition, was not doubted; its ability to carry out its intentions to any disastrous extent was doubted. ELECTRICITY knew what it was talking about, and was content to wait for a wider dissemination of knowledge of the actual condition of affairs. It has not been compelled to wait long.

It was made clear at St. Louis, where were gathered representatives of nearly all the leading manufacturing houses and a large number of Central Station men, that the entire body of independent interests has in a few months come to know that ELECTRICITY was right; that we were not even premature; that the danger was present then, and is still present; that decisive action is necessary to preserve any measure of competition in the trade.

History has been made in the past six months. The Trust has proved not only its intentions, beyond any doubt whatever, but it has also proved its power of injury. Although business as a whole is good, there is not a supply house but has been made aware that the Trust *can* curtail its profits; there is not a builder of dynamos but has learned that the uncertainty as to a supply of lamps has injuriously affected his trade; there is not a Central Station man but knows that the price of Trust supplies has been increased, and that with all competition crushed the prospects for profit in his business are gone.

With this realization of the truth by the independent interest, the battle is, perhaps, half won. But we are not among those who underestimate the strength of the General Electric Company, the effectiveness of its methods, and its many advantages in the fight.

Its primary advantage is that it has no conscience; that it will and does stoop to methods which decent business men are not accustomed to meet. And there is no prospect that, whatever its earnings or losses, it will be without ample funds for a year to come.

We place ourselves on record as asserting that the trouble has only begun with the closing up of the various lamp factories, and that before January 1, 1894, it will be found that the Trust has stronger cards than it has yet played.

A plan of redress must be adopted and carried out with vigor.

We believe that a thorough and impartial investigation by a Congressional Committee would do more to break up the whole Trust machine than any other action which could be taken.

Every man in the trade should do his utmost to bring this about. We shall send out with our next issue blank forms of petitions which we trust will be filled up speedily and forwarded by the hundreds to various Representatives.

Meantime, Central Station men should not buy one dollar's worth of supplies of the Trust which can be purchased elsewhere.

IF YOU have been receiving an occasional complimentary copy of ELECTRICITY, and like the paper, *send in your subscription.*

* * *

IT IS about time for those old sea-dogs, Lieutenant Greene and Midshipman Colvin, to concoct another letter proving that the General Electric Company has no policy.

* * *

QUESTIONS for every independent manufacturer and supply man to consider : Is ELECTRICITY aiding me in my business in any degree? Should it not have my support?

* * *

IF Captain Eugene Griffen is to pose as the President of the General Electric Company after the next annual election, assuming all the odium with none of the power of the office, he is making a sacrifice for friendship's sake which few men are capable of and which few friends would insist on. Mr. Coffin is not going to lay down the reins; and working under a blanket his power for evil will be increased rather than diminished.

* * *

The *Electrical World* in a recent issue saw fit to publish its views as to the proper field of a trade paper. It practically asserts its cowardice, and glories in it. It proclaims itself a poltroon, and is proud of it. This would have been surprising from any journal with an average sense of journalistic proprieties; but coming from the *Electrical World* it is just what was expected. The proprieties of the situation would have demanded an apology, not brazen glorification.

* * *

THE admirable remarks of Dr. Edward Weston on the incandescent lamp question, in discussion of Mr. Townley's paper at the St. Louis Convention, will be presented next week.

Trust Methods.

Notes and Comments from Various Sources.

Even Painful Duties Must Be Performed.

To the Editor of ELECTRICITY.

DEAR SIR : If you can give the necessary space in your columns, I should like to add a few words of appreciation to those heard on every hand of your outspoken antagonism to that modern octopus, the General Electric Company.

The constantly increasing antipathy toward its methods on the part of the public, past and present employees, and all who are much thrown into business contact with its officers must certainly have an effect in due time, and it is refreshing to see at least one Electrical journal with sufficient disregard for "policy" to take an outspoken position.

A somewhat intimate contact of several years' duration with Mr. C. A. Coffin and the select few whom he has found most ready to sink their own personality in attaining true perfection from a Thomson-Houston Electric Company standpoint, has filled the writer with surprise that a gentleman of such marked and acknowledged business qualifications, and withal the ready capacity for making friends whenever it suits his purpose to do so, should allow himself and his executive officers to make enemies of the very men who have helped secure for him his present success, through utter disregard of verbal or written agreements, and continual favoritism for those in a position to exert political or social influence.

A greater contrast can hardly be imagined than that between the *esprit de corps* which permeated the whole working force of the Thomson-Houston Company when "the boys" were content to take part pay in promises, and the "every-man-for-himself" feeling which has come as a natural result of their non-fulfilment, with continued acts of petty injustice.

Should it ever become your painful duty to chronicle the downfall of the present oligarchy, I shall be pleased to add a few facts and figures to the volumes which will then be at your disposal, to show "on what meat doth this our Cæsar feed that he is grown so great," but in the meantime I must, for obvious reasons, confine myself to other lines of service.

Very truly yours,
ATLANTIC AVE.

Statistical Information.

Various Ways of Procuring It.

The following blank forms, copies of which have been sent out for some time in large numbers, are self-explanatory :

GENERAL ELECTRIC COMPANY,
Edison Building, Broad Street,
New York.

.... 189 ..

GENTLEMEN :

In its issue of ...., 189 , the ....
states that you have purchased from the ....
Company a plant of the following description : ....
....
....

Will you correct or confirm this statement by filling out and mailing to us the enclosed postal card, and oblige

Yours very truly,
S. D. GREENE,
Assistant General Manager.

This information is desired entirely for statistical purposes.

(POSTAL CARD.)

Name ....
Business ....
Address ....(P. O.) .... (State) ....
Date plant was installed.................................. 18..
SYSTEM—Name .. ..
Alternating or direct..
Two-wire or three-wire......................................
GENERATORS—Style...
Rated capacity in kilowatts..................................
Or in 16 C. P. lamps...
INCANDESCENT LAMPS—Maker..................................
Estimated No. connected, 10 C. P.............................
16 C. P......................, other C. P.......................
Voltage at generator.............at lamps.....................
ARC LIGHTS—Maker...
No..............., current.............., C. P...............
STATIONARY MOTORS—Aggregate rated H. P. of electric motors supplied...
What are motors used for?....................................
(Signed) ....
(Date) ....

The General Electric Company has long made a specialty of statistics. The records in their office are voluminous, and contain more or less detailed information in regard to every electrical plant and manufacturing concern in the country. They include, among many other points, the capital stock of the various manufacturing companies, amount paid in, time they have been in business, profits made, percentage of those profits made on goods controlled by the General Electric Company, price required to buy out each company in a legitimate way, and diverse Mems. as to personality of the managers and chief stockholders.

Mr. Coffin has not trusted wholly to his young men in the gathering of these statistics. He is an artist in this line, and does not depend on circulars. Personal interviews have been more in his way.

Mr. John Doe of Oshkosh receives a polite invitation to call at 44 Broad street to discuss the matter of purchase of a controlling interest in his business. He feels honored. The profits which he has worked for so long seem at last to be his, and all at once. Of course that corporate Crœsus, the General Electric Company, will pay a handsome figure.

Mr. Doe takes the first train for New York, and the first cab to 44 Broad street. Sometimes he waits three days for an audience, but New York is a great town, and he enjoys himself. At length he is ushered into the Presence. Mr. Coffin dispenses with servants, and himself takes Mr. Doe's hat, top-coat and umbrella, and lays them carefully away.

And here begins an Exhibition of Magnetism, surpassing Tesla's experiments in brilliance. Indeed, Mr. Coffin's Exhibitions are no experiments; they have been conducted scores of times, and have failed just often enough to prove the general rule.

Mr. Coffin smiles (who has known him to do anything else?). "Why, Mr. Doe, I am surprised to find you so young a man. Knowing all that you have accomplished, I had supposed you were a man well along in years; but you are only a boy."

Mr. Doe feels at once entirely at ease, and mentally raises his price $5,000. The Exhibition of Magnetism continues for a half-hour or so, and then Mr. Doe begins to wonder where he is at. He has told about all that he knows, and the offer made for his property is about one-quarter of what he expected.

Sometimes the climax is postponed for two or three sittings, but is almost always the same.

Mr. John Doe returns to Oshkosh, and reflects. If he is a man of brains and courage, he sets to work with doubled energy to work out his own salvation. But meantime he has placed himself at a disadvantage. His enemy knows his vulnerable points.

How many men, when they read of Mr. Doe's experience, will imagine that they have been dreaming of a recent occurrence in their own lives?

We think these Exhibitions of Magnetism have gone far enough. A man's business secrets are not well kept in the books of his adversary.

Mayor Pingree Wins.

The Boodle was Wasted.

The Michigan House of Representatives has passed the bill authorizing the city of Detroit to own and operate its own electric light plant. By the terms of the bill the amount which the council can expend for this purpose is $600,000. Any expenditure in excess of that sum must be authorized by the vote of the people.

If Mayor Pingree and Controller Black will now stick closely to Frank Rae, Detroit will have a lighting plant which will be the envy of her neighbors.

Wyandotte Still in Trouble.

On March 1 the common council rescinded their action giving the contract for a lighting plant to the Western Electric Company of Chicago, and voted to give a contract to the Wyandotte Electric Light Company for five years. Saturday Louis George and seventy-four other Wyandotte taxpayers filed a petition in the Wyane Circuit Court asking for an injunction against the mayor and common council to enforce the contract made with the Western Electric Company. Judge Hosmer granted a temporary injunction. Meantime the Western Electric Company is proceeding to carry out its contract as rapidly as possible. The probabilities are that Mayor Campan will win.

The Break in General Electric.

Views of Financial Authorities.

(*New York Tribune.*)

The only decided weakness shown yesterday in the market was in General Electric stock, which fell about 5 per. cent. on unusually heavy transactions. The decline was ascribed by the bulls to sales for the short account, but there were many shrewd observers who contended that liquidating sales were responsible.

(*New York Times.*)

Yesterday the star performer was General Electric Trust. It opened above 104. It closed a little above 99, a drop of about 5 points. The heavy selling was from Boston. Many stories circulated as to the cause of the drop, but none of them was accepted as satisfactory. It was announced some time ago that the Electric Trust was in a snarl with New England money lenders, and this rumor was revived yesterday and elaborated. There were supplementary reports suggesting that the Electric Trust proposes to issue a big block of new bonds.

(*New York Mercury.*)

The sensation of the day, however, was a bad break in Edison General Electric, which a couple of weeks ago was selling around 111, when it was reported that the Board of Directors was seriously considering the division of surplus earnings. Yesterday the stock broke from 100 at the opening to 99¾, and only recovered a few fractions before the close of the day.

. . . Edison General Electric, which sold last week at 108, was marketed about 11 o'clock yesterday morning at 98. When it looked as if the bottom would fall out of this particular specialty, Van Dyke & Williams appeared on the floor and bought 5,000 shares in one block at 99 and gave up Drexel, Morgan & Company as their principals. The traders immediately recognized that a battle royal was imminent, and they bought Edison General on the discovery that the millionaire banking-house was protecting the stock. It rallied to 102¼ on very few sales and closed at a net gain of 3⅛ per cent. over the lowest price of the day.

The weakness of General Electric is more deep-seated than the financiers would have us believe.

It is entirely unnecessary to explain why something worth 75 cents does not sell for $1.50. As we have before stated, the manufacturing plants of the General Electric Company could all be duplicated for about $10,000,000 to $12,000,000.

Probably less is known about the actual value of this stock than of any stock dealt in on the Exchange. *Electrical men*, who ought to know a little about it, have not been buyers.

It is probable that even the Wall Street speculators are being frightened out by the prospects of a Congressional investigation, and by the enormous legal expenses—expenses which cannot be estimated in advance—with which the company is handicapped.

On September 7, and again on October 12, we predicted in these columns that this stock would soon sell below par.

If any one is surprised at the slump, it is not electrical men, who know that the PROFITS OF THE COMPANY WILL NEVER PAY INTEREST, no matter how ingenious the annual statements may be in their construction.

It is believed by well-informed men that the Chicago branch of the company has made a *loss* in the past ten months of over $500,000. This office ought to be profitable if profits are to be made anywhere.

When the stock has dropped about thirty points further it will be somewhere near its intrinsic value.

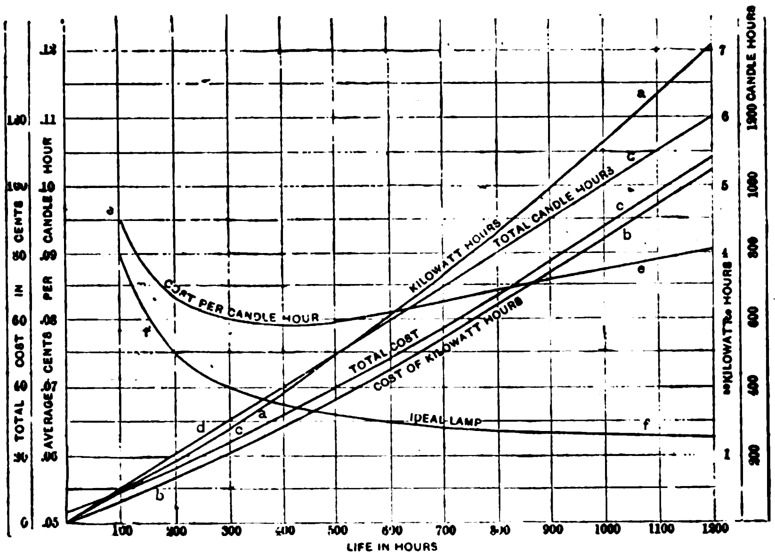
The Most Economical Age of Incandescent Lamps.

BY CARL HERING.*

It is generally supposed that it is an advantage for incandescent lamps to have a long life; the object of this paper is to show that this is a delusion, and that it is not substantiated by facts, but that on the contrary under normal conditions a very much shorter life represents an actual gain in dollars and cents; or in more homely language, if the lamps do not die a natural death, it is more economical to break them at a comparatively early date than it is to keep them in use. The results obtained in the present deductions are so different from what is generally believed that they will doubtless be discredited by many.

TABLE I.

	Watts per mean horizontal candle power.							
	A.	B.	F.	G.	K.	L.	M.	Av.
Hours.								
0	3.9	4.4	4.1	4.2	3.9	3.8	4.8	4.2
100	4.3	4.8	4.3	4.6	4.3	4.2	4.7	4.5
200	4.6	5.1	4.6	4.9	4.6	4.6	4.7	4.8
300	4.9	5.4	4.9	5.0	4.8	4.9	4.8	5.0
400	5.2	5.6	5.1	5.3	5.0	5.2	4.9	5.3
500	5.5	6.1	5.5	5.5	5.2	5.5	5.1	5.6
600	5.8	6.4	5.8	5.7	5.4	5.8	5.5	5.9
700	6.1	6.7	6.1	6.0	5.6	6.1	5.8	6.3
800	6.4	6.9	6.4	6.3	5.9	6.3	5.9	6.6
900	6.7	7.1	6.6	6.6	6.2	6.4	6.1	6.8
1 000	6.8	7.1	6.8	6 7	6.4	6.2	6.1	6.8
1,100	7.0	7.2	6.7	6.8	6 5	....	...	7.0
1,200	7.1	7.2	6.7	6.7	6.5	.	..	7.6



At the June meeting of this Institute last year a very able and valuable paper† was presented by Prof. Thomas and Messrs. Martin and Hassler on "The Life and Efficiency Test of Incandescent Lamps." This paper gives a very complete life-history in the form of data and curves of representatives of almost all the incandescent lamps made in this country. With this very complete and reliable data as a basis, I have endeavored in the present paper to deduce some figures to show what the best life of a lamp is, everything considered. It is well known that lamps deteriorate and blacken with age, becoming less efficient, and it is therefore an important question to know at what age they should be replaced by new ones; it is this point which the present paper is intended to answer.

The method by which the best age is to be deduced is the new and very rational one suggested by Mr. O'Keenan and described in *L'Industrie Electrique*, Nov. 25, 1892, page 510, also in *The Electrical World*, Dec. 24, 1892, page 404. As it is fully described in these articles I will merely state it briefly here. Calculate *for each hour* in the life of a lamp the *total quantity of light* given off by it in candle power hours *from the time the new lamp was first started;* similarly, calculating *for each hour* in the life of a lamp the *total cost* of this light, that is, the original cost of the lamp added to the cost of all the energy consumed by it *from the time the new lamp was first started* up to that particular hour. Now, it is evident that if for each hour in the life of a lamp we divide this total cost up to that hour by the total quantity of light up to that hour, we will obtain the *average* cost of a candle power hour of light from the beginning up to this hour. From this final data it can readily be shown at what age this total average cost is the least. If based on actual measurements of the lamp made throughout its life, it is evident that this method will give the most rational and only strictly correct way of determining the real cost of the light actually produced; the only factor which it does not include is the interest on the cost of the lamp and power which evidently are negligibly small. It includes the effect of the blackening of the bulb and of the lowering of the efficiency. It should be distinctly understood, however, that this method is based on the actual amount of light produced and on the actual cost of the power; whenever therefore either or both of these factors are not of importance, the results deduced here are also of less importance. I desire to emphasize this as it will doubtless be claimed by many, and with right, that the diminution of the light is of less importance to some consumers than the cost of a new lamp would be.

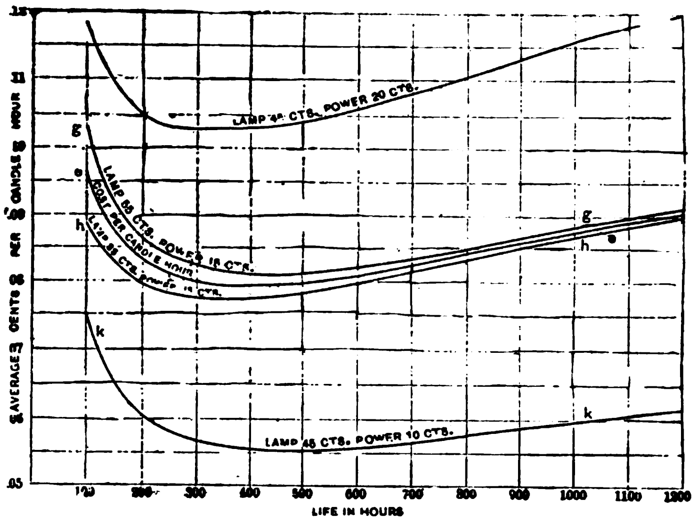
---

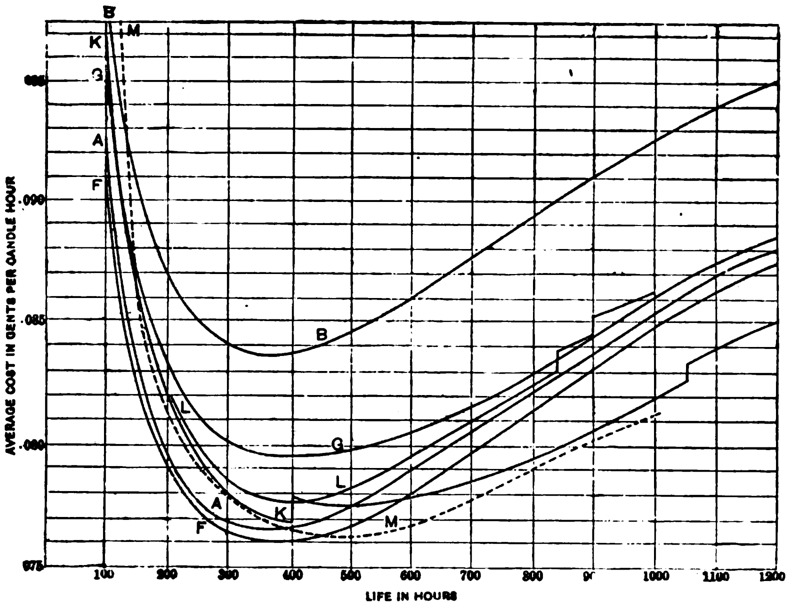
* A paper read at the seventy-fourth meeting of the American Institute of Electrical Engineers, New York, February 21st, 1893.

† TRANSACTIONS, vol. ix, 1892, p. 271.

Having given the candle power and the power consumption of a lamp throughout its life, any one can by this method deduce the final results as described. In the present case, however, the work, which is somewhat tedious, is greatly simplified by taking the data from Table V in Prof. Thomas's paper giving the watts per mean candle power. This data is given here in Table I for the seven most important of the thirteen makes of lamps; the last column giving the average, is the average of all of the thirteen lamps of that paper and not of the seven which we have here taken as the most important. By using the watts per *one* candle power it is evident that the candle power curve in the present calculations becomes a straight line, thus reducing the work by more than one-half.

To illustrate the method let us deduce the results given for the average lamp in the last column. Instead of calculating the results for every hour, which is a very tedious process, it is sufficiently accurate to do so for every hundred hours. From the last column of Table I calculate for each hundred hours the total kilowatt hours consumed per candle up to that age, the result gives the curve *a* Fig. 1. Multiply these values by the cost of a kilowatt hour of energy; fifteen cents is the price assumed here; this gives curve *b*. Add to these values the original cost of the lamp *per candle*, that is, the total cost of the lamp divided by the candle-power at the start; this gives curve *c* which is evidently parallel to curve *b*. Draw curve *d* representing the total candle-power hours from the start; in this case this line will evidently be straight; it would be curved if the watts consumed by the whole lamp and if the whole candle-power had been used instead of the watts per one candle. Curves *c* and *d* are those sought for. These curves are evidently the integrals of those represented by the numbers in the table. The process of integrating is effected most readily by purely arithmetical means as described above, that is by simply calculating the totals for each hundred hours, and it can, therefore, be performed by any one without a knowledge of algebraic integration. These curves, however, need not be plotted, they are given here only to illustrate the method. Now





divide each ordinate of the cost curve *c* by the corresponding ordinate of the light curve *d*, and the result is the curve *e* which is the final curve sought for.

This curve *e* gives for each age the cost of a candle-power hour of light, that is, *the average cost for the whole time from the time the lamp was first started up to that particular hour.* This is the curve which gives us the final results. The interesting feature about it is that it has a minimum point at about 400 hours, which means that at the end of 400 hours you are paying the least for a candle-power hour of light, that is to say, your light is then the cheapest during the whole life of the lamp, all things considered. If you continue to use those lamps longer than 400 hours the *average* price for the light will again increase and will continue to do so. Strange as it may seem, therefore, it is more economical to break the lamp at that age rather than to continue running it, even though this means buying a new lamp. This result will naturally be discredited by many but it is nevertheless true, always remembering that we are concerned with the cost of a candle-power hour of light under normal conditions and over an indefinite period. If the amount of light is of no great importance, but the price of the lamp is, then run them until they die a natural death; the same if the power cost nothing. If your lamp costs nothing, but your power does, then replace them as often as possible. The effect of different relative costs of lamps and power will be discussed later. The data assumed in this curve is that the average lamp costs 45c. and the power costs 15c. per kilowatt hour; the latter figure was obtained from a well known central station manager as a fair average for 110 volt continuous current circuits from central stations or for private installations of about 500 lamps; for installations of less than 500 lamps the cost will be greater, and for more it will be less.

As this curve must always have a minimum point for lamps which deteriorate, there is no question that there is such a minimum value in the cost of the light. Mr. O'Keenan calls this point by the appropriate name "smashing-point." To show the results of an ideal lamp, curve *f* has been drawn. This ideal 16 C. P. lamp, costing 48 cents and consuming 4 watts per candle, is supposed not to blacken or to change in any way. It is evident that in this case there will be no minimum point and the longer such a lamp is run the cheaper the light is, although after a few hundred hours the cost diminishes very slowly, being practically the cost of the power only.

To show what the curve *e* really means in dollars and cents let us calculate an actual case. If run 1200 hours the average cost per candle-power hour is .0903 cents or a total of 108.4 cents per candle for 1200 hours. A 16 C. P. lamp therefore represents a total cost of $17.344 for power and lamp, assuming for the sake of simplicity that it continues to give 16 candle-power. If stopped at 400 hours the cost of the light is only .0792 cents per candle hour or a total of 31.7 cents per candle for 400 hours; if renewed three times in the 1200 hours the cost will be 95.1 cents or $15.22 for 16 C. P. This shows that replacing the lamp after every 400 hours represents an actual saving of 13.3 cents per candle during a period of 1200 hours or a total of $2.12 saved per 16 C. P. lamp every 1200 hours. This amount of money represents the cost of almost five lamps at 45c., which might be interpreted so as to show some very curious results, namely, if you bought eight lamps originally, used only three of them for 400 hours each and threw the other five away, it will in the long run cost you the same as to buy one lamp and run it for 1200 hours, assuming that you are paying for light actually received. As the cost of the light at 400 hours is over 12 per cent. less than that at 1200 hours, it is an actual saving of 12 per cent. in dollars and cents if the lamps are replaced every 400 hours.

Another curious result which it will be hard for many to believe, is shown by the fact that the curve *e* cuts the .09 line at 1200 hours and also at about 130 hours, which shows that the light costs just as much whether the lamp is broken at 130 hours or run for 1200 hours. The curves being flat near their minimum points shows that it makes practically no difference (always remembering that we are considering the cost of a candle-power hour of light) whether the lamps are replaced every 300, 400 or 500 hours. It might at first be thought that at 300 hour renewals the lamps will make the cost greater than at 500; but this is not the case as the curve includes the cost of these new lamps. The explanation of this is that we are considering a constant amount of light, and if run to 500 hours more lamps must be used to give the same amount of light owing to their reduced candle-power. Of course in practice they will be renewed at 500 instead of 300 hours because the difference in the light would be noticed less than the price paid for the more frequent renewals.

EXHIBITS AT THE ST. LOUIS CONVENTION. (FIG. 1).

Another interesting and somewhat surprising result which may be deduced from the curves is that an ideal lamp of 16 C. P. which remains constant may cost originally as much as $5.75 and will then give precisely as cheap light during 1200 hours as the existing lamps, and even then it will be cheaper during the next 1200 hours than the others. An ideal lamp equal to the others at 400 hours instead of 1200 can cost as much as 75 cents and will even then be considerably more economical after those 400 hours. This theoretical deduction only goes to show how very great the value in dollars and cents is of a lamp which remains constant.

To show the effect of the price of the lamp and the price of the power, the curves in Figure 2 have been drawn. Curve *e* is, as before, that for the average lamp costing 45 cents while the power costs 15 cents per kilowatt hour. In curves *g* and *h* the cost of the lamp was taken at 55 and 35 cents respectively. They show that the minimum point is reached only about 50 hours later when the lamp is 10 cents dearer, and only about 50 hours earlier when it is 10 cents cheaper. The minimum cost is about 2½ per cent. more in the first case, and 2½ per cent. less in the second. The cost of the lamp therefore makes comparatively little difference in the best age of the lamp; it affects the cost considerably more at 400 hours than at 1200 hours where it is practically insignificant.

If for the same price of the lamp, namely 45 cents, the cost of the power is taken at 20 and 10 cents, the resulting curves will be *i* and *k* respectively. This shows that the minimum point is about 100 hours earlier in the first case and 100 hours later in the second. This point is furthermore more decided when the power is more expensive (see curve *i*), showing that for expensive power it is very much more important to replace lamps earlier, while for cheaper power it will make less difference. For cheap power with cheap lamps the position of the minimum point with respect to time will be altered very little from that of the mean curve *e*; this is also true for expensive lamps with expensive power. The five curves show the following: that even for considerable ranges the best age remains at between 300 and 500 hours; that the effect of the cost of power is much more important than that of the price of lamps; that the latter is not of so much importance as is generally believed. All the curves show that while there is a minimum point it is not very definitely located as to time, that is, it makes but very little difference if the lamps are replaced at 300, 400 or 500 hours, but after that the difference becomes apparent.

So far we have been considering the average of all the lamps in Professor Thomas's paper. In order to show the relative differences, as well as the absolute values for the different lamps, the curves in Fig. 3 have been drawn for seven of the most important of the thirteen lamps; they refer, though not in order, to the Thomson-Houston, Packard, Edison, Beacon, Perkins and Pennsylvania lamps. The letters of reference are the same as those in Professor Thomas's paper. He selected these seven as the most important and gave me the price of each lamp. These prices were divided in each case by the initial candle-power of each make, as given in that paper, to obtain the cost prices per candle. These candle powers were as follows: A = 16.0, B = 13.1, F = 14.2, G = 17.1, K = 17.0, L = 13.2, M = 12.5.

A comparison of these curves with those in Professor Thomas's paper will show the effects of certain features. Such a comparison will be far more interesting and instructive were we allowed to know the names of each one of the lamps.[*] We can merely say here that *B* and *G* are evidently poor lamps, while *M*, *F* and *A* are the best, notwithstanding that one of the *M*'s died very early, which is equivalent to increasing the price of the other nine lamps. *K* would have been among the best had not one lamp broken at the critical point. The best age of all but *M* are between 300 and 400 hours.

The scale of ordinates in Fig. 3 is much larger than that in Fig. 2, and the minimum point is therefore much more marked. The offsets in curve *K* and *L* are due to breakages among the 10 lamps of which these results are the mean. Curve *M* is dotted merely to distinguish it from those which it crosses at a number of places.

In addition to these curves attention is called to those shown in *L'Industrie Electrique*, Nov. 25, 1892, page 510, or in *The Electrical World*, Dec. 24, 1892, p. 404, deduced by Mr. O'Keenan for foreign lamps, in which the best age is less uniform and somewhat earlier.

Whatever other deductions may be made from this investigation, the most important is that lamps might to advantage be forced much higher than is customary, at the expense of their life This, though it requires more frequent renewals, will be a gain to the consumer as well as to the central stations; the former will get better and cheaper light, while the latter will be able to increase their output in lights or run the same number of lights at less loss in the mains, or what is equivalent, run the same number of lamps on considerably smaller mains. How far the lamps may be forced before the other extreme is reached, is a question to be determined when we have the data for such new lamps.

In conclusion I desire to state that while some of the results obtained from the present investigation are somewhat striking, it must not be forgotten that we have been considering the cost of *a candle-power of light*; as it is far more difficult to notice slight differences in the light than it is to notice the bills for lamp renewals, it would not be wise to adhere too strictly to what theory tells us. In practice, therefore, lamps need not be renewed as early as these deductions point out; at the same time, however, the results clearly show that it is absurd to keep lamps running too long, and that the life of our present lamps is more than sufficiently good. Perhaps the best practical rule for renewing lamps is to run them until the diminution in candle power becomes noticeable; after that point is reached we may rest assured that it is economical to throw them away. It might be argued that the original data is of too crude a form to admit of making deductions involving small differences. The differences, however, are not slight but very apparent, and, I presume, much greater than any possible inaccuracies in the original measurements. Furthermore, they show the existence of a uniform law. This paper should be considered more as an investigation of the subject and not as one claiming to show that present practice is radically wrong. I merely wished to prove conclusively the well known fact that it is absurd to run lamps too long. By far the most important conclusion is, that it would be far better to force lamps at the expense of their life than to run them at the present efficiency.

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[*] Just before going to press I have received permission from the makers to state that the lamp marked M is the "Pennsylvania" lamp.

Convention Exhibits.

The exhibits of supplies, etc., at the St. Louis Convention were not so numerous as in previous years, but several concerns made handsome showings.

Our Frontispiece shows the most elaborate of the exhibits this year—that of the new General Incandescent Arc Light Company—which attracted a great deal of attention.

The Eureka Tempered Copper Company, of North East, exhibited a great variety of their specialties (Fig. 1), and the Bryant Electric Company, of Bridgeport, Conn., and George Cutter, of Chicago, also made creditable showings (Fig. 2).

There were, as mentioned in the last issue of ELECTRICITY, many other fine exhibits, of which, however, we were unable to obtain photographs.

Death of D. A. Andrews.

Mr. D. A. Andrews, President and Treasurer of the Pettingell-Andrews Company, Boston, died at Washington on Saturday last. Mr. Andrews had been in attendance at the inauguration festivities, and contracted a severe cold, which finally developed into the fatal attack of acute rheumatism.

Mr. Andrews was highly respected in Boston, and was looked upon as a man with brilliant prospects in the trade.

General News.

What is Going on in the Electrical World.

Jacksonville, Fla.—The electric railway is now open, and cars are running regularly.

Owego, N. Y.—There is talk of organizing a company here to build an electric railway.

Toronto, Can.—The American Watch Case Company are going to erect a new factory, and will use electricity as a motive power.

Boonsboro, Md.—The proposition to supply the town with an electric light plant was carried at the municipal election on the 7th.

Jersey City, N. J.—The North Hudson Railway Company has decided to give up cable and horse power and to use the trolley entirely.

Dayton, Ohio.—The report that the Dayton Electric Light Company had sold its plant to the General Electric Company of New York is denied.

Massillon, Ohio.—If the council of Navarro grants the right of way, an electric railway will be built between Massillon and that town without delay.

Detroit, Mich.—A bill has passed the House of Representatives authorizing this city to establish an electric lighting plant, limiting the cost to $500,000.

Olyphant, Pa.—The Olyphant Suburban Traction Company has been granted a franchise for an electric railway in the town and out to the borough line.

New Orleans.—The receipts on the new Carrollton Electric Railroad are already 100 per cent. over those of the old line on which mules were employed.

Harrisonville, Mo.—At a special election held here the proposition to issue $12,000 worth of bonds to erect an electric light plant was carried by a vote of 287 to 29.

Augusta, Ga.—The contract for the entire construction of the Murray Hill line has been awarded to Messrs. White & Company, electrical and civil engineers, of New York.

Watertown, N. Y.—At an election held here on Monday, there was a majority of 87 in a vote of 817 in favor of the city putting in a plant and doing its own street lighting.

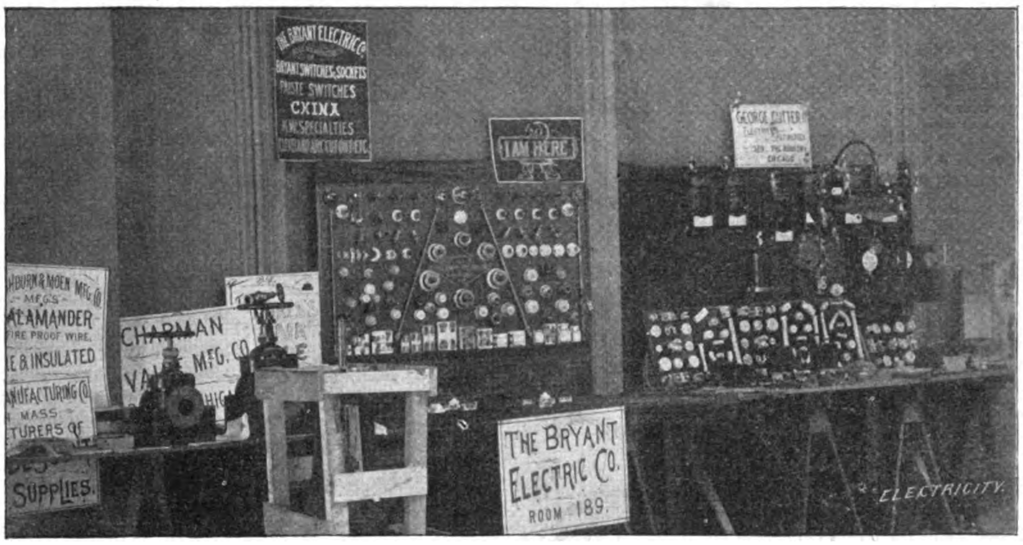
Alton, Ill.—The old street railroad lines have become the property of the Alton Electric Street Railroad Company. The roads will be changed into electric lines and some changes made in their routes.

Grand Island, Neb.—The city council has granted to the Grand Island Street Railway Company the right to construct and operate an electric street railway system and operate in connection therewith a system of incandescent lights.

Kalamazoo, Mich.—The street railroad property, for two years in litigation for the foreclosure of a mortgage, has been formally transferred to the General Electric Supply Company of New York, the last of the $32,000 purchase price having been paid.

Asbury Park, N. J.—The township committee has granted the application of the Asbury Park and Belmar Street Railway Company for a franchise to operate and maintain an electric railroad on Main street, between Wesley Lake bridge and Shark River.

Owego, N. Y.—A franchise has been granted the Owego Railway and Navigation Company to build an electric railroad in Owego. Work must begin in three months; one and one-half miles to be built by next September and the whole route to be finished in five years.



EXHIBITS AT THE ST. LOUIS CONVENTION. (FIG. 2).

Dubuque, Iowa.—At a sale under order of the court, the Dubuque Electric Railway, Light and Power Company's plant was recently purchased by a bidder representing the Old Colony Trust Company of Boston for $225,000. A new company will probably be formed.

Bridgeton, Pa.—The Bridgeton Rapid Transit Company, which was granted a franchise to operate electric cars on January 31, and according to the State law had thirty days in which to accept the ordinance, has applied for and obtained an extension of the franchise.

Findlay, Ohio.—Putting salt on the tracks during the recent heavy snows had a damaging effect on the electric street railway, and many cars were rendered helpless. It has been discovered that a brine is formed that saturates the motors as the cars pass, and this has been slowly eating the insulation of the wires.

Waynesboro, Md.—It is said that Baltimore and Waynesboro capitalists contemplate building an electric railway from Pen-Mar to Waynesboro. The distance is four and one-half miles. It is urged that the railway would be a great convenience to guests of the Blue Mountain House and Buena Vista Springs Hotel.

Montreal, Can.—The Montreal Electric Railway Company will spend a good deal of money during the coming summer. They have purchased 57,000 feet of land in St. Ann's ward, and will erect a motor house capable of furnishing 6,000 horse power. The company expects to lay sixty miles of track during the summer.

Portland, Ore.—The Portland General Electric Company has entered into an agreement to light the city for two years from the 1st of April next at the following prices : For each electric arc light of 2,000 candle power, $9.50 per month; for each similar lamp thereafter established, $9; for each incandescent light of 25 candle power, $1.95.

Bristol, R. I.—A petition to the General Assembly to incorporate an electric railway company to establish and maintain rails and supports for wires to connect the towns of Bristol, Warren, Barrington and immediate towns and villages with the town of East Providence, is being circulated and signed very generally by taxpayers of Bristol.

Norwalk, Ohio.—The Norwalk Incandescent Light and Power Company have filed a deed of assignment in the probate court, F. H. Jones and J. W. Foster being the assignees. The liabilities of the company are estimated at about $35,000. The company claims its assets are worth from $35,000 to $40,000, and that every claim will be paid in full.

Altoona, Pa.—The Altoona *Times* says: "Th work has been completed of fitting up car No. 1. of the City Passenger Railway Company with th Westinghouse motor, set in a Robinson truck, which replaces the Brill truck and Thomson-Houston motor. The trials of the car have demonstrated the superiority of Westinghouse motors in various ways."

Glen Cove, N. Y.—Curtis & Dean, of New York City, have been granted a franchise for "stringing electrical wires and lines of cable for transmitting electric light and power in, under, over and upon the highways, roads and streets of the villages of Glen Cove, Glen Head, Locust Valley and intermediate places outside the limits of the incorporated village of Sea Cliff."

Lewiston, Me.—There is a scheme on foot to connect Lewiston, Me., with North Conway by an electric road. The line is to take in by the way Minot Corner, Hackett's Mills, Mechanics' Falls, Page's Mills, Welchville, Oxford granite quarry, Oxford, South Paris, Norway, Frost's Corner, etc. The route will cover twenty-two miles of the best towns in Maine.

Tampa, Fla.—The Consumers' Electric Street Railway Company's electric plant will be run by steam for the present, but the company proposes to utilize the fine water power of the Hillsborough River for that purpose in the future. The dam is six miles from the city, where there is a fall of fifteen feet, which will furnish power enough to run all the factories in Tampa.

Chicago.—The Controller, in a report to the City Council makes this statement : "The city is now paying to private corporations for electric lights in the Town of Lake and South Chicago at the rate of $175 per lamp per year. If the posts, etc., can be erected by special assessment double the number of lamps can be maintained for the same cost—viz., $35,000."—Forty-two firms in the Department of Electricity at the World's Fair have begun work on their displays.

Kansas City, Mo.—Eastern capitalists having bought up the properties of the Citizens' Electric Light Company and the Electric Street Railroad Company, will consolidate the two companies. A mammoth power house will be built at a central location. Charles E. Dustin, of Hartford, Conn., will be president of the consolidated company, A. T. Batchelder, of Keene, N. H., vice-president, and George A. Litchfield, of Keene, N. H., treasurer. The active management will be in the hands of J. W. O'Neill, of Kansas City.

Madison, Wis.—The Northwestern Electrical Association, which recently held a meeting at Milwaukee, will hold its next meeting at Madison in the third week of July. The association is formed of owners, stockholders, managers, superintendents and electric engineers for all electric light companies doing business in Illinois, Michigan, Minnesota and Wisconsin, and its objects are mutual benefit and the dissemination of knowledge concerning electrical appliances.

Indianapolis, Ind.—The policy of the new Citizens' Railway Company will be, it is stated by one of the officials, to build up the road and make it first class in every particular; to abandon the old lines and old cars and replace them with electric lines and the latest improved cars.

Muncie, Ind.—A dispatch to the Cleveland *Leader* from Muncie says: "The Muncie Electrical Works is the name of a new manufacturing concern that will employ about one hundred hands here. The gentlemen at the head of the enterprise are James Chamberlain, Fred McNamee and others, of Cleveland. The company is capitalized at $50,000, and will manufacture electric motors, dynamos, and general electrical machinery."

Paterson, N. J.—A Boston syndicate has been formed to build an electric car line through the valley east of the Orange Mountains. The road will extend from Paterson to South Orange, and will pass through Montclair, Bloomfield, West Orange and Orange proper. Consents have been secured to build the line from Bay Lane, Bloomfield, to Paterson, and also for the Montclair connection through the Watchung Heights and Whitsey and William tracts. In Montclair, it will connect with the Montclair line, which has already obtained its right of way.

Philadelphia.—The Schuylkill Traction Company, an electric trolley road, running from Locustdale through Ashland to Girardsville, and then to Shenandoah and Mahanoy City—about twenty-three miles in length—has been purchased by a syndicate of Philadelphia capitalists represented by William F. Harrity and Dallas Sanders. Thirteen miles of the road are now in operation, and it is expected to have the whole line completed by the middle of March.—The abandonment of the cable system has been decided upon by the Traction Company. Overhead electric trolleys will be substituted as soon as authority can be secured from the city councils.

Boston.—As a means of preventing such a terrible loss of life as that which occurred a few weeks ago at the Dover Almshouse a correspondent of the *Globe* suggests that all the locks on the doors in such institutions be connected by electricity with some central point easily reached by those in authority.—The American Bell Telephone Company has been given until August 25 to put in further testimony before the various examiners appointed by the United States Circuit Court in the suit of the United States against that company and Prof. Alexander G. Bell. This is the old suit brought wherein it is alleged that a certain patent upon the telephone was obtained from the Patent Department by means of fraud.

Grand Rapids, Mich.—The West Michigan Electric Company has let to the Siemens & Halske Electric Construction Company the contract for the machinery, wiring and other things necessary for the plant which is to be used in manufacture of electricity in Lowell and its transmission to this city. The specifications call for a 1,000 horse power dynamo. The local company first organized as the Michigan Electrical Company, but on filing the papers in Lansing it was discovered that a company bearing the same name had already been organized in Detroit, so the company reorganized as the West Michigan Electric Company with the same officers, as follows: President, C. Jesse Church; vice-president, E. F. Sweet; secretary, A. C. Sekell; treasurer, C. A. Church.

Newark, N. J.—The fine plant of the defunct Spiral Weld Tube Company has been sold to the Crocker-Wheeler Electrical Company of New York for $45,000, and that company will take immediate possession. The electrical works will give employment to over 1,000 hands.—Permission has been given to the New Jersey Traction Company to erect and equip in Kearny Township an electric railroad along Harrison avenue to the Hackensack. It is proposed to build the road through Harrison from Newark to Newark avenue, Jersey City, and thence to the ferries, and to charge ten cents fare.—The Newark Electric Light and Power Company has made a ten years' contract with the city for lighting the streets. There are now 2,600 street lamps in use nightly in the city.—To enable the syndicate which has gained control of the surface railroads in Essex, Hudson and contiguous counties in New Jersey to consolidate the railway, power and lighting interests involved, a bill has been prepared for presentation to the Legislature for that purpose.

Hartford, Conn.—A sub-committee of the representatives of the various city governments of the State have drafted a bill relating to street railway companies. The first section provides that any company chartered to operate a street railway in any town, city or borough, shall cause a plan of the streets and proposed grades, kind of tracks to be used and the motive power, to be presented to the Mayor and Common Council, selectmen or warden and burgesses, who shall give notice of a public hearing to all persons interested. If the plan is rejected an appeal may be taken to the Superior Court, where the matter will be heard and determined. Section 2 gives the officials full direction and control over the placing, erection, construction and maintenance of any tracks, wires, conductors, fixtures, etc., including the power of designating the kind, quality and finish thereof. Section 3 limits the time of the construction of any road receiving a charter from the General Assembly to the first day of December prior to the next session of the Legislature. Under Section 4 if any company fails for six months to operate its road, the proper authorities upon notice may remove the tracks and place the highways in suitable condition for public travel. Any expense incurred the company may be sued for in an action under the statute. Section 5 regulates the payment of a tax upon the gross receipts for the year, which probably will be 4 per cent.

Boston Notes.

The towns located immediately to the north of Boston are in a fair way of being, at a not distant date, as well supplied with electric street railway facilities as any territory in this country. Already several such roads are in successful operation, while many others are projected, and energetic steps are being taken by the promoters for commencing their plans. The shore towns of Stoneham and Wakefield are specially favored in this respect, for there are no less than three rival companies seeking for authority to put their projects through. The names of these companies are respectively the Boston, Malden and Stoneham, and the Mystic Valley Railway Companies. They all desire much the same location for their tracks in Stoneham, and matters are becoming more than a little lively in consequence. The selectmen have given hearings to various petitions, but the local governing body seems to favor the first-named company. Should it secure the authority it seeks, a track will be laid through to Malden, thence to Somerville, and so connect with the West End Railroad of Boston. Such a road will prove a great boon to the entire district, and the general hope is that conflicting interests will not make against the speedy carrying out of the plan.

The subject of rapid transit for this city is again engaging public attention to a degree that has not before been equalled. Elevated and underground systems have each their advocates, and plans innumerable are being submitted and discussed for the solution of the problem. The ever increasing congested condition of the main business thoroughfares, particularly Washington street, is forcing this matter to the front. The public is up in arms against the overhead trolley road through that street—not simply in opposition to electricity, but rather because it is more and more being felt that the West End Railroad ought never to have been allowed to run even horse cars along there, owing to its narrowness and tortuous windings. When the plan that is for all time to solve the problem has been finally agreed upon i.e., the streets to be traversed and whether an elevated or an underground system, electricity is certain to be adopted as the motive power; there appear to be no diversity of opinion on that point in the public mind.

New England electrical enterprises were well represented at the St. Louis Convention. Quite a number of gentlemen from Boston and elsewhere were present, while those who were too busy to leave home and travel so far didn't fail to let it be known in the West that they are still in the business and willing to increase their list of patrons. And it was because business is simply rushing at home that many more did not go, for everybody is just now enjoying a first rate demand for their goods, and indications are that the demand will continue.

The Union Telephone Company's Private Line Telephones.

The Private Line Telephones of the Union Telephone Company are especially adapted for rapid, cheap and direct private communication with offices, banks, stores, mines, factories, warehouses, stables, hotels, hospitals, private dwellings, etc., and do away with the high rentals of the ordinary telephone companies. The Union Company's telephone is said to work perfectly at any distance up to two miles, and as there are no electric batteries or appliances of any kind necessary, it will last a life time. The instruments are sold outright to those desiring them, and thus become the absolute property of the buyer. The accompanying cuts represent the manner of affixing the instruments for operation.

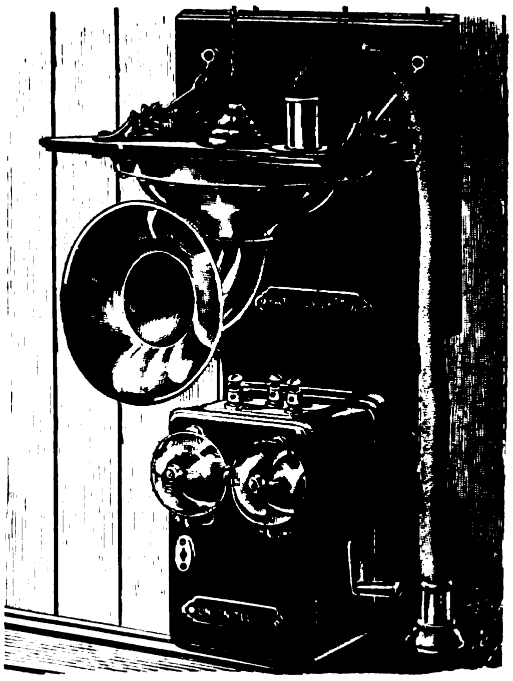


FIG. 1.

Fig. 1 represents the Simpson Acoustic Telephone, horizontal arrangement, with upright mouthpiece, especially adapted to meet the wants of those wishing to place the telephone back from the window, or in any part of an office or hall-way. Fig. 2 shows the main board of the multiple-duplex system, used where several lines from different points are brought together. It will be seen there is a horizontal bar with annunciator drops over the top of each mouthpiece. When a party from a distant point desires to communicate, he simply rings his call bell, when the drop over the corresponding mouthpiece at the central board will fall, indicating exactly which line is being operated. On the other hand, if the party at the main board wishes to call any department, he throws the drop down by hand on the line which he wishes to speak over and rings the bell, when the party so called will be simultaneously notified, without disturbing any of the other lines.

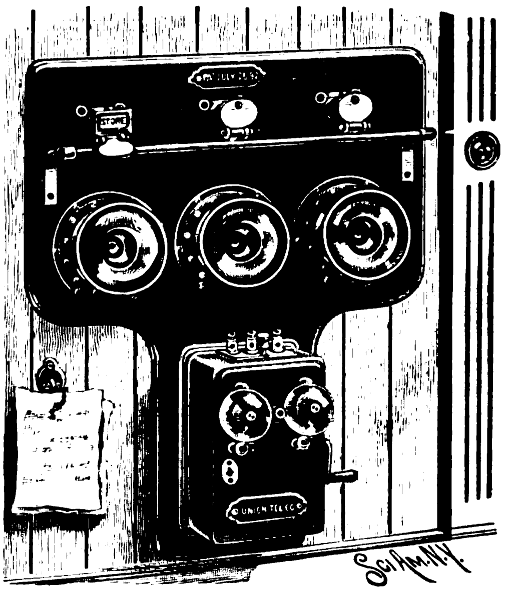


FIG. 2.

These telephones are manufactured by the Union Telephone Company, whose principal office is at 50 Broadway, New York, where the telephones can be seen in practical operation.

COMMERCIAL PARAGRAPHS.

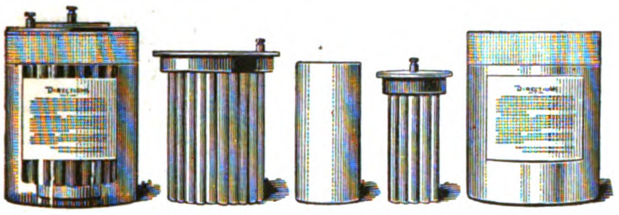
The Mica Insulator Company filed articles of incorporation March 1, 1893, at Elizabeth, N. J., the authorized capital stock being placed at $100,000, all paid in. The company's plant is located at Schenectady, N. Y., while its office and salesroom will be at 218 Water street, New York City. The officers are Eugene Munsell, president; Franklin Brooks, vice-president, and Lewis W. Kingsley, secretary and treasurer. The company will manufacture micanite for electrical insulation, a description of which has appeared in our columns. Through a process controlled by this interest, small scrap mica is now utilized in all forms and shapes for insulating purposes where sheet mica was formerly used, at a much reduced cost, and with no diminution in efficiency.

The New York office of the Eppinger & Russell Creosoting Works, now at 160 Water street, will be removed about April 1 to the Morris Building, corner Broad and Beaver streets, rooms 72, 73 and 74.

The J. T. Case Engine Company, New Britain, Conn., manufacturers of the well-known Case Automatic High Speed Engine, have issued a novel and elegantly printed "folder," illustrated with engravings representing the various types of engines which the company turn out in their extensive works. The "folder" gives a great deal of information relative to their machines which will be useful to customers in making up their orders, and the latter are invited to write for the new illustrated catalogue of the company now in the hands of the printer.

A New Primary Battery.

The accompanying cut shows the various parts of what is known on the market as the High Rock Primary Battery, and is a specialty invented and manufactured by the High Rock Battery and Novelty Company, Lynn, Mass. The makers do not make any claim for any special features in this battery, its construction aiming at strength, durability and efficient service; and in these respects success has been achieved. This battery consists of a glass jar 6 feet x 8 inches, in which fits a cover of birch wood well shellacked. Into the under side of this cover are inserted the ends of twenty-four carbon rods seven inches long and one-half inch in diameter. The usual style of porous cup is placed in the glass jar, and in the cup is placed a cylinder of zinc pencils. This battery has a long life and may be used with either chromic acid or nitrate of potash solution.



The usual objection raised against the unsavory odor emitted from a primary battery does not apply in this case, as the tight-fitting cover prevents any escape of fumes. Quite a demand has sprung up for this battery, so that the company is busy handling this and the novel electric reading and photograph developing lamp it makes.

ELECTRICAL COMPANY ELECTIONS.

The Postal Telegraph Company, Philadelphia. President, Albert R. Chandler; vice-president, Edward C. Platt; secretary, Charles C. Adams; treasurer, George R. Williamson; directors, Albert B. Chandler, Edward C. Platt, Charles C. Adams, George W. Dunn and Wilbur L. Stanger. The same directors were also elected for the Postal Telegraph Cable Company No. 1, No. 2 and No. 3.

Electric Railway Company, Augusta, Ga. President, Malone Wheless; secretary, Peter F. McAnnally; treasurer, Eugene J. O'Connor; directors, Malone Wheless, of Washington, D. C.; Joseph A. Vincent, of Philadelphia; Eugene J. O'Connor, Thomas Murray, Patrick Walsh, A. J. Scheers and Peter F. McAnnally, of Augusta.

Peekskill Surface Railroad Company, Peekskill, N. Y. President, Clark D. Rhinehart; vice-president, Edwin B. Lent; treasurer, George C. Gillully; secretary, Nelson G. Foshay.

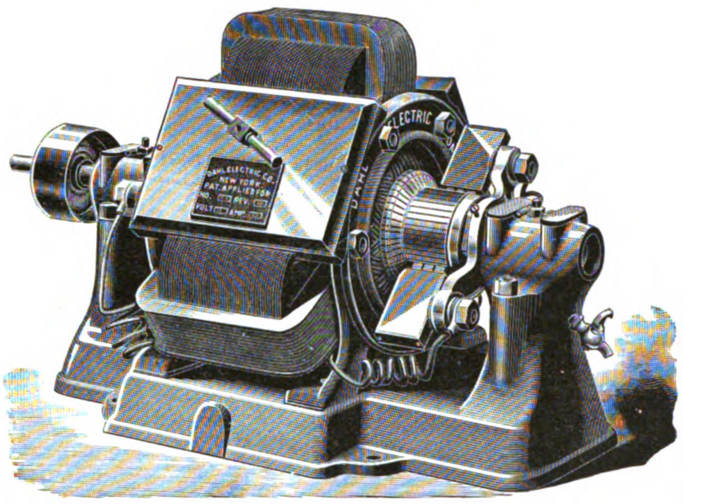
The Street Railway Company of Little Rock, Ark., has been completely reorganized, Col. S. W. Fordyce, president of the St. Louis, Arkansas and Texas Railroad, being elected president.

The Central Electric Railway Company, Baltimore. President, George Blackistone; secretary, Norman Jones; treasurer, Nelson H. Bell; directors, Wesley M. Oler, Miles White, Jr., Charles W. Slagle, Seymour Mandelbaum, George Blakistone, Peter Thomson and David Stewart.

New York and New Jersey Telephone Company. The old officers were re-elected at the annual meeting on the 3d inst. They are as follows: Charles F. Cutler, president; W. D. Sargent, vice-president and general manager; Joel C. Clark, secretary; Union N. Bethell, treasurer; directors, Charles F. Cutler, Alexander Cameron, Morris F. Tyler, Joseph P. Davis, Charles A. Nichols, Joel C. Clark, Hugh Kinnard, William D. Sargent, David B. Powell, George H. Prentiss, John H. Cahill and Union N. Bethell.

George Cutter's Catalogue.

The catalogue of George Cutter, the universally popular dealer in Electric Specialties, who transacts business at No. 329 The Rookery, Chicago, is a handsome and most attractive book throughout from the startling little image of Satan on the first page of the cover to the beautiful switch that serves to adorn the last. It would take several columns more than we can spare to describe the illustrations or the electrical devices illustrated in this catalogue. The index gives the names of about one hundred different articles dealt in by Mr. Cutter, numbers of which are of his own invention. Among these are ammeters, voltmeters, conduit connectors, cutouts of various kinds, combination shades, insulators, globe holders, lightning arresters, sockets, switches, rosettes, pulleys, mast arms, etc., and other articles are Simplex caoutchouc wire, paint and tree insulators, Germania shade holders, hard rubber tubing, awning insulators, cleats, buttons, current-breakers, etc. Some handsome cuts are given in the book of insulators, rosettes and switches made of the celebrated Syracuse china, which is said to be unusually tough. It need scarcely be added that special pains have been taken in the selection of the articles in Mr. Cutter's list, and buyers can therefore depend on their merit. The catalogue, which is very conveniently arranged for speedy inspection, will be forwarded on application at the address given above, 329 The Rookery, Chicago.



Motors for Alternating Currents.

BY F. H. LEONARD, JR.

The alternating system has heretofore been lacking in a very essential feature detracting from the earning capacity of a central station from which it is operated. We have until now seen in practical operation no motor operated from simple single phase alternating current which could be termed a commercial success.

The use of three wires, which is necessary with the multiphase system, not to mention the added parts of the generator, complicates the system, which must be balanced up in much the same manner as the Edison or Hopkinson three-wire system without gaining the advantage in the reduction of copper.

The converters required to operate motors from a multiphase system must have a capacity enormously in excess of what is actually required in watts to perform the work for which the motor is calculated, and when it is desired to operate incandescent lights from the same circuit a special transformer of complicated form is required, and to operate to best advantage this transformer must have both branches equally loaded.

It is doubtful if such a system can be successfully introduced into this country, where the simple single phase alternating system has taken root and branched so rapidly and extensively. Consider what such a change would involve. The present generator must be abandoned, the present system of wiring must be entirely remodeled, and a third wire added. The present converter must also follow the generator to the scrap heap, and the system of inside wiring must be altered to suit the changed conditions.

We might put up with the change in generators alone, for the sake of adding to our income the revenue to be derived from motors, and complacently consider the much evener curve in the ampere output of our central station plant, which would then be earning almost as much during the hours of daylight as during the hours of darkness; but shall we do the rest—shall we abandon our present system entirely, and go down into our pockets for the price of an entirely new equipment? No! We trust we shall never be compelled to, for already in our dreams we see the ideal central station, which we have every reason to believe will be realized in the near future.

Let us briefly sketch this ideal. A central station operating night and day with practically the same output in ampere hours from 6 A. M. to 6 P. M. as from 6 P. M. to 6 A.M., equipped with high pressure boilers, furnishing steam to triple expansion upright engines coupled direct to alternating current generators, without collector rings, commutators, or brushes, or any moving wire, furnishing a simple two-phase current at a primary pressure perhaps not materially different from the present standards, except for special long distance transmission, when by changing armature connections the same generator may produce much higher pressure, or the E. M. F. increased by step-up transformers, the current from these generators transmitted over the same system of distribution as used at present, except where conditions might warrant underground wiring, at the house transformed by one single phase converter, improved as to regulation and leakage loss to a safe pressure for commercial and domestic use, furnishing arc lights, incandescent lights, and power not only for stationary purposes but for locomotive purposes in propelling street cars, suburban railways, and even by sections the trunk lines of the country; and not to forget electro deposition by motor generators furnishing direct currents for plating as well as for charging storage batteries.

Mr. Olof Dahl, of the Dahl Electric Company, has produced such a motor, and a number of them are already in daily use. These motors can be made in any size, from one H. P. upwards, are synchronous, hence *must* run at a uniform speed, provided the generator runs steadily, and are self-exciting, starting with a torque about equal to their normal capacity. They have a commercial efficiency equal to the best direct current motors, the one H. P. size having an efficiency of 75 per cent. and increasing with the size of motor up to over 90 per cent. There is no undue heating in any of the parts, and neither armature nor field coils rise in temperature more than 30 degrees above the surrounding atmosphere under normal load, and there is no heating of the field cores. Should the armature be stalled, and this does not occur till the motor has 50 per cent. overload, the armature is not injured and no serious heating of the coils takes place, the current being choked by the self-induction.

This motor is designed to operate on the alternating system in use at the present time, without any reduction in the number of alternations which is called for in the use of the multiphase, involving as it would more expensive transformers greater in weight proportional to the reduction of alternation.

We can start at once to increase the earnings of our alternating central stations without the slightest change in our system of distribution from the lines already erected; and from the same transformers used for lighting at night motors can be operated in the day time, and both motors and lights at night, if the capacity of the transformer is sufficient.

The Shawmut Fuse Wire.

The proper use of fuse wire in electrical systems is succinctly treated of in a neat little pamphlet sent forth by the Shawmut Fuse Wire Company, 161 High street, Boston, Mass. The diagrams inserted make the meaning of the text clear, and among the facts demonstrated thereby are the fusing points in amperes for length of fuse, diameter of wires, and time required for fusing. It is clearly shown that for lengths above three inches the fusing point is constant, while in very short lengths that point rises rapidly owing to the conduction of the heat from the fuse by the terminals or binding screws.

The Shawmut Company claim for their fuse wire absolute uniformity, and give in their certificate of test the proper length for each size wire, and the fusing point and carrying capacity for this length. If a shorter fuse must be used, the curves show the action of the different sizes, and one may be chosen of such diameter as will fuse at the point required.

INCORPORATIONS.

Articles of incorporation have been filed in Passaic County, N. J., by the Speer Electric Transit Company of Passaic, with a capital of $100.000. The system which the company proposes to test is the invention of Alfred Speer, who claims that by it a speed of from two to three miles a minute can be attained. The tracks are to be elevated and the cars suspended.

The Eastern Lighting and Heating Company, Bangor, Me. Capital stock, $50,000. President, D. M. Yeomans, of Portland; treasurer, Henry McLaughlin, of Bangor. Organized for the purpose of acquiring and dealing in letters patent connected with lighting or heating by the use of oil, gas, electricity, steam, or any combination thereof.

The Marshall Electric Light and Power Company, Marshall, Mo. Capital stock, $80,000. Incorporators: Thomas E. Wardell, Harry M. Ruby and Wm. E. McCully.

The Onondaga Telephone Company. Capital, $200,000. To construct lines of telephone in Onondaga County, N.Y., with the central office in Syracuse.

A stock company has been formed at Georgetown, Col., which embraces the electric light and power company and the gas company, with a capital of $35,000. It is the purpose of this company to keep both systems in vogue and also to run a line to Silver Plume for the purpose of lighting up that town.

The Hancock County Electric Light and Power Company, Peoria, Ill. Capital stock, $15,000. Incorporators: E. B. Hillman, L. T. Bradley and H. T. Hay, who are also incorporators of the Farmington Electric Light and Power Company. Capital stock, $12,000.

A joint stock company, with an authorized capital of $25,000, for the building of a 100-barrel flouring mill and furnishing electricity for power and lighting purposes, has been incorporated in Butte, Boyd County, Neb., with the following officers: President, G. T. Bastedo; vice-president, M. H. Green; secretary, M. Arendt; treasurer, D. W. Forbes; directors, G. T. Bastedo, M. H. Green, J. E. Forbes, S. C. Sample, C. T. Smith, W. T. Wills and George Saunders.

Automatic Electric Light Extinguishing Company, Baltimore. Capital stock, $10 000. Incorporators: G. Milton Hughes, George T. Reed, Thomas M. Dobbins, Bowie H. Bittle and Robert A. Dobbin.

Vicksburg Electric Transit and Lighting Company, Vicksburg, Miss. Capital stock, $200,000. President, John J. Mulligan; secretary and treasurer, Chester R. McFarland; directors: Chester R. McFarland, John J. Mulligan and L. W. Magruder, of Vicksburg; Henry Smith, of Kansas City, Mo., and H. D. Butts, of Valley Falls, Kansas.

The Citizens' Electric Railway Company, Pottsville, Pa. Capital stock, $200,000. Directors: L. R. Keefer, Cressona; R. H. Koch, J. H. Zeibey, P. K. Filbert, C. K. Acker, R. A. Zerberg, Pottsville. The road will be operated by electricity and will be ten miles long. It will run through the streets of the borough of Pottsville, thence to Minersville, through Jonestown, Primrose and adjoining villages.

Electrical Conduit Traction Equipment Company, Newark, N. J. Capital stock, $200,000. Incorporators: John D. Griffen and Joseph C. Pearse, of New York; William C. Burling and A.H. Kearny, of Brooklyn, and Eugene F. Fuller, of East Orange. The certificate sets forth that the company will make and deal in all kinds of electrical appliances, especially those adapted to the use of traction companies.

Alton Electric Street Railroad Company, Alton, Ill. Capital stock, $250,000. Incorporators: Manning Mayfield, Henry G. McPike, John S. McGinniss, J. G. White, A. M. Farnum, E. H. Harrison, G. H. Walbridge and I. H. Porter. The objects of the company are to build, construct and operate street railroads through Alton, Upper Alton, North Alton, Godfrey Township and suburbs, and to construct and operate electric light plants and furnish power to corporations or persons.

The Pacific Sanders Electric Light and Manufacturing Company, San Francisco, Cal. Capital stock, $500,000. Directors: Frank C. Stover, Robert A. Rose, George C. Holbrook, Andrew White, John F. Sanders, Walter C. Lewis, W. C. Stadfeld.

The Mutual Electric Light and Power Company, Chicago. Capital stock, $75,000. Incorporators: Charles D. Wright, William A. Conover and Alfred R. Hechman.

Col. W. N. Woodruff, Judge W. F. Henney and Dr. Geo. S. Miller are organizing a joint stock corporation to be located in Hartford and known as the Green Electric Lamp Company. The inventor of the incandescent lamp to be made by the company, Henry Green, of Hartford, says that it does not interfere with any patents already existing. The company expects to organize with a capital of $100,000.

A charter has been granted at Harrisburg, Pa., to the Royersford and Spring City Street Railway Company of Montgomery County, to run from Royersford to Spring City, Pa. Capital, $12,000. Directors: G. Mortimer Lewis, Wilkesbarre; Henry M. Brownback, Norristown; C. J. Lewis, Philadelphia; Henry G. Kulp, Pottstown; E. L. Hallman, Royersford, and William Albright, Spring City.

The Union Electric Light and Power Company of Waterford, N.Y., (a consolidation of the Union Electric Light and Power Company and the Waterford Electric Light and Power Company). Capital stock, $150,000. Directors: William M. Lea, of Lansingburgh; Charles McKallor, of Waterford; Horace C. Train, of Green Island; William E. Acker, Sumner T. Dunham and E. S. Kaufman, of New York City.

The Essex Illuminating Company, Newark, N. J. Capital stock, $75.000. Incorporators: William H. Powers, Charles W. Anderson, E. M. Harrison, F. J. Drescher, Paul Wilcox, W. W. Egbert. all of Montclair. The company was formed to manufacture and sell electricity.

The Philadelphia and Allentown Electric Trunk Railway Company. Capital stock, $1,000,000. President, W. R. Grace, of New York City; directors: Thomas J. Swift, of Poughkeepsie; W. L. Turner, of New York; John F. Gwinner, N. A. Fulmer and W. F. Pascoe, of Easton, and W. F. Dannyhower, of Norristown, Pa. The line will extend from Allentown to Philadelphia and touch all the principal points between the two cities, including South Bethlehem, Coopersburg and other places.

The Glens Falls Electric Engraving Company. Capital stock, $8,000. Dr. A. H. Phelps, of Glens Falls, N. Y., is the principal stockholder, and the company has been formed to enter upon the business of engraving on glass by means of an electrical machine invented by Dr. Phelps.

The Middletown Street Railway and Power Company, Middletown, N. Y Directors: W. D. Stratton, C. Macardell, F. D. Youngblood, Leander Brink, M. D. Stivers, A. V. Boak, E. A. Brown and T. A. Weller. The purpose is to construct and operate an electric street railway in Middletown.

The Scranton and Carbondale Traction Company, for the purpose of conducting its business in the cities of Scranton and Carbondale and the intervening and adjacent towns and boroughs and in towns and boroughs adjacent thereto in Lackawanna and Luzerne counties. The general office of the company is to be located at Scranton. Capital stock, $10,000. Directors: Alford U. Chandler, Philadelphia; William Walker, Mayfield; John W. Towler, Samuel D. Pettit, Henry H. Sivelly, Scranton.

The Schuylkill Highlands Railway Company, to run through the streets of the boroughs of Conshohocken and West Conshohocken. Capital stock, $100,000. Directors: Frederick Phillips, Villa Nova; Samuel T. Kerr, William M. Kerr, Philadelphia; Clinton Gage, Boston; H. C. Landis, Camden, N. J.

The Ashland Electric Power and Storage Company, Ashland, Wis. Capital stock, $100,000. The company intends to establish works at Ashland and manufacture electric accumulators or storage batteries under the patent secured by Leslie B. Rowley, of Ashland.

The Elwell-Parker Electric Construction Company, at Chicago. Capital stock, $500,000. Incorporators: Frederick C. Phillips, Robert L. Tatham and Charles S. Webster. The company's purpose is to manufacture electrical, steam, hydraulic and pneumatic machinery.

The Panther Valley Electric Light, Heat and Power Company, Lansford, Pa. Capital stock, $10,000. Directors: W. W. Thomas, G. W. Davis, J. E. Dauer, Thomas M. Whilden, J. A. Quinn, J. W. Maloy. W. Drumheller, Lansford.

The Standard Electric Company of Denver, Col., has amended its corporation so that the name of the company is changed to the Electrical Specialty Company and the capital stock is changed to $75,000. P. G. Dodd, Ernest Maltmann, H. A. Triggs, R. P. McDonald and F. T. Cochrane are the new directors selected.

ELECTRICAL PATENT RECORD.

Letters Patent Issued February 28—March 7, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

492,627. Apparatus for Electrically Propelled Cars. Charles J. Kintner, New York, N. Y. Filed July 30, 1892.

492,659. Electric Railway. Michelangelo Cattori, Rome, Italy. Filed July 23. 1892.

492,737. Conduit Electric Railway. James H. Bates, Hoboken, N. J. Filed Aug. 2, 1892.

492,881. Leading-Piece for Overhead Electric Railways. Henry D. Winton, Wellesley, Mass., assignor to the Hersey Manufacturing Company, of Portland, Me., and of Boston, Mass. Filed June 20, 1892.

492,882. Street Car. John O. Adsit, Hornellsville, N. Y., and Charles H. Wickham, Tioga, Pa. Filed May 14, 1892.

493,089. Truck for Electric Locomotives. John C. Henry, New York, N. Y. Filed Dec. 18, 1891.

493,125. Electric Railroad Danger Signal and Bell. Paul Seller, San Francisco, Cal. Filed July 13, 1892.

493,212. Trolley-Wire Support. Frank E. Head, Toledo, Ohio, assignor of one-half to Elmer E. Kuney, same place. Filed June 13, 1892.

DYNAMOS AND MOTORS.

492,456. Switch for Operating Shunt-Wound Electric Motors. Frederick H. Berry, Milwaukee, Wis. Filed March 3. 1892.

492 493. Automatic Speed Indicator and Recorder. Wendell C. Fletcher, St. Louis, Mo. Filed April 29. 1892.

492,681. Armature for Dynamo-Electric Machines. George Hoare, Newark, N. J. Filed March 24, 1892.

492,524. Electric Motor. Franklin H. Beers, Newark, N. J. Filed April 2, 1892.

492,588. Dynamo-Electric Machine and Motor. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Company of Connecticut. Filed Oct. 29, 1892.

493,104. Dynamo-Electric Machine. William M. Mordey, London, England. Filed April 28, 1891.

ELECTRIC LIGHTS AND APPLIANCES.

492,638. Electric Lighting System. Robert W. Rollins, Hartford, Conn. Filed Aug. 16, 1892.

492,650. Electric-Arc Lamp. William P. Wieman, Alleghany, Pa. Filed April 18, 1892.

492,808. Adjustable Lamp Hanger. Nicholas Jenkins, Waterbury, Conn. Filed April 19, 1890.

492.809. Incandescent Lamp. John von der Kammer, Chicago, Ill. Filed Jan. 23, 1893.

492,815. Electric-Arc Lamp. Carl K. MacFadden, Chicago, Ill. Filed Aug. 12, 1892.

492,847. Balanced Electric-Drop-Light Hanger. Truman E. Stevens, Blair, assignor of one-half to W. J. C. Putnam Cramer, Omaha, Neb. Filed June 21, 1892.

492,913. Electric Lamp Lighter. Josephus C. Chambers, Detroit, Mich. Filed Nov. 21, 1892.

493,100. Incandescent-Lamp Socket. James F. McLaughlin, Philadelphia, Pa. Filed Sept. 13, 1892.

TELEPHONE AND TELEGRAPH APPARATUS.

492,467. Long-Distance Electric Telephony. Charles M. Haynes, Omaha, Neb. Filed Jan. 12, 1892.

492,171. System of Combined Telephony and Telegraphy. Frank A. Pickernell, Newark, N. J. Filed April 29, 1892.

492,483. Busy Signal for Telephone Circuits. Edward J. Hall, Morris and Frank A. Pickernell, Newark, N. J. Filed Oct. 13, 1892.

492,484. Telephone Central-Station Circuit. James L. McQuarrie. Boston, Mass. Filed Sept. 8, 1892.

492,789. Speaking Telegraph. Thomas A. Edison. Menlo Park, N. J., assignor to the Western Union Telegraph Company, New York, N. Y. Filed Sept. 5, 1877.

492,883. Telephone Transmitter. Charles T. Bloomer, New York, N. Y. Filed Dec. 14, 1892.

BATTERIES.

492,422. Battery Jar. James F. McLaughlin, Philadelphia, Pa. Filed June 2, 1890.

493,007. Secondary-Battery Electrode. Isaac H. Bartholomew, Northford, Conn. Filed May 31, 1892.

493,221. Apparatus for Transferring Secondary Batteries. Mathias Pfatischer, Philadelphia, Pa., assignor to the Accumulator Company, same place. Filed July 22, 1892.

MISCELLANEOUS.

492,394. Insulator Bracket. William N. Eichnerg, Chicago, Ill. Filed Nov. 28, 1892.

492,398. Closed Electric Conduit for Railways. Adolph Heiser, Chicago, Ill. Filed May 31, 1892.

492,402. Electric Train-Controlling Apparatus. Frank E. Kinsman, Plainfield, N. J. Filed Feb. 24, 1892.

492,403. Means for Operating Throttle-Valves of Steam-Engines. Frank E. Kinsman, Plainfield, N. J. Filed Feb. 24, 1892.

492,457. Electric Railway Block System. Francis O. Blackwell, Boston, Mass. Filed Feb. 15, 1892.

492,478. Electric Burglar Alarm. Charles F. A. Sturts, San Francisco, Cal. Filed Sept. 30, 1891.

492,480. Transformers and Means for Developing Rotary Magnetic Fields. Charles R. Bradley, Avon, N. Y. Filed March 17, 1892.

492,482. Signaling Apparatus and Circuit. Edward J. Hall, Morris and Frank A. Pickernell, Newark, N. J. Filed Oct. 13, 1892.

492,492. Electric Car Brake. Wendell C. Fletcher, St. Louis, Mo. Filed April 15, 1892.

492,497. Electric Signaling Apparatus. William H. Kenyon, New York. Filed June 3, 1892.

492,512. Lightning-Rod Ball. Edward K. Hum, Pittsburg, Pa. Filed Sept. 24, 1892.

492,519. Electrical Annunciator. John Randolph Hard, New York. Filed Oct. 8, 1892.

492,544. Lightning Arrester. Charles F. Scott, Pittsburg, Pa. Filed July 29, 1892.

492,545. Electric Signaling Apparatus. Wesley Trafford, New York. Filed Oct. 17, 1891.

492,547. Thermostatic Fuse Device. Alexander Wurts, Pittsburg, Pa. Filed Jan. 14, 1892.

492.548. Lightning Arrester. Alexander Wurts, Pittsburg, Pa. Filed March 12, 1892.

492,549. Lightning Arrester. Alexander Wurts, Pittsburg, Pa. Filed Aug. 29. 1892.

492,563. Keyed Musical Instrument Actuated by Electricity. Paris E. Singer, London, Eng. Filed June 17, 1892.

492,592. Detecting Apparatus for Coin-Actuating Boxes. George A. Tauberschmidt, Washington, D. C. Filed Dec. 6. 1892.

492,645 Electric Railway Signal. Howard St. C. Wait, New York. N. Y. Filed Aug. 11, 1892.

492,646. Electric Alarm for Money Drawers. William J. Walker, St. Louis, Mo. Filed Oct. 29, 1892.

492.649. Lightning Arrester. Thomas Wheatley, Wilkesbarre. Pa. Filed Nov. 14, 1892.

492.679. Relay. Jacob W. Lattig, Easton, Pa. Filed Nov. 28. 1892.

492,694. Electric Alarm for Hotels. John McMurrow, Jr., Philadelphia, Pa. Filed July 21. 1892.

492,713. Welding Metals Electrically. Charles L. Coffin, Detroit, Mich. Filed Oct. 29, 1892.

492,757. Rheostat Plate. Charles E. Carpenter, Bridgeport, Conn. Filed Oct. 27, 1892.

492,770. Railroad Crossing. Wendell C. Fletcher, St. Louis, Mo. Filed May 27, 1892.

492,773. Electro-Magnetic Brake. Andrus D. Ayres, Kalamazoo, Mich. Filed Dec. 21, 1891.

492,786. Automatic Electric Switch. Andrew M. Coyle, Baltimore, Md.. assignor to the Standard Screw Elevator Manufacturing Company, same place. Filed Feb. 18. 1892

492,807. Automatic Circuit Breaker. Delos Irish and John G. Williams, Salt Lake City, Utah; said Williams assignor to said Irish. Filed Sept. 14, 1892.

492,837. Apparatus for Automatically Stopping Railway Trains. Edward W. Robinson, Boston, assignor of one-half to E. B. Welch, Cambridge, Mass. Filed July 13, 1891.

492.850. Combined Indicating Electric Switch and Current Reverser. Almon B. Strowger and Walter S. Strowger, Chicago, Ill., assignors to the Strowger Automatic Telephone Exchange, same place. Filed Feb. 12. 1892.

492,866. Automatic Electric Sprinkler and Alarm. Charles S. Hurd, Cleveland, Ohio. Filed April 13, 1892. Renewed Feb. 8, 1893.

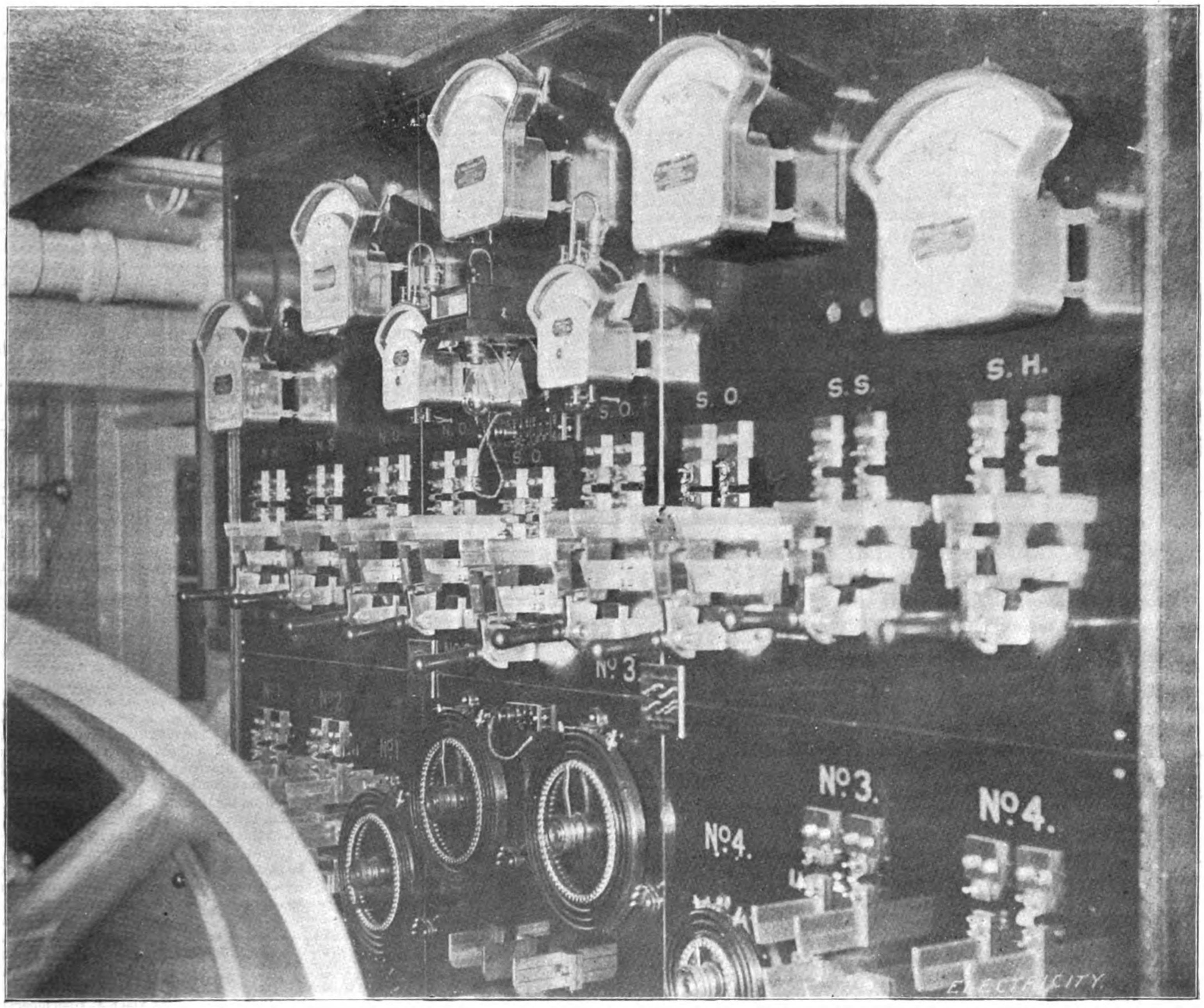
492,971. Electric Programme Clock. Andrew J. Reams, Wichita, Kan. Filed Aug. 3, 1891.

493,000. Electric Steering Gear. Lewis S. Van Duzer. U. S. Navy, assignor of one-half to Newton E. Mason, U. S. Navy. Filed Nov. 26. 1892.

493,067. Hotel Time-Annunciator. Franklin S. Carter, Burlington, N. J. Filed Aug. 15, 1892.

ELECTRICITY.

Vol. IV. New York. MARCH 22, 1893. Chicago. No. 10



SWITCHBOARD, HAVEMEYER BUILDING, NEW YORK. (See Page 126.)

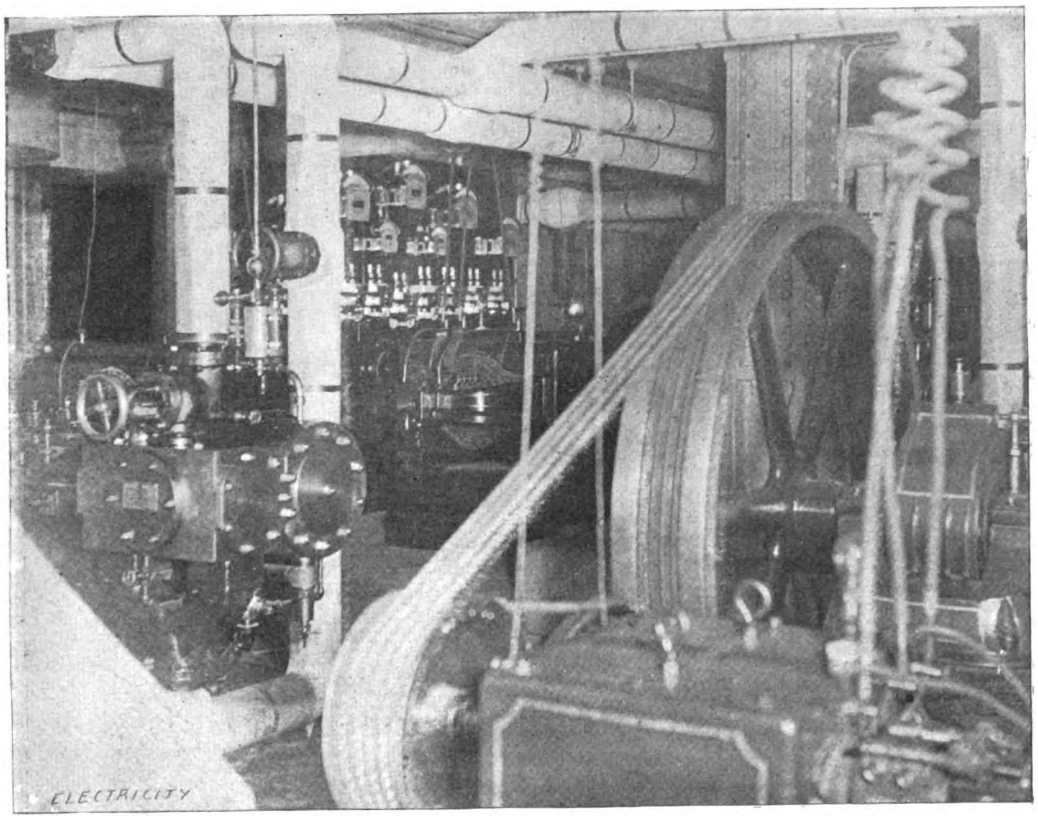
A Compact Plant.

The Electrical Equipment of the Havemeyer Building.

The electric lighting plant at the Havemeyer Building in this city, which has recently gone into operation, deserves more than ordinary attention, as it contains the most recent developments in incandescent electric lighting for isolated plants.

The plant is one of 3,000 lights. There are four McIntosh & Seymour engines and four Eickemeyer dynamos. Three of the engines are of 65 H. P., and directly coupled upon the shaft of each of these engines is a dynamo of 40 K. W. The fourth engine is 20 H. P., and an entirely new and very interesting rope drive connects the engine to a dynamo of 12 K. W. This small engine and dynamo are for use during periods of light load.

The switchboard (shown in our Frontispiece) is of highly polished black marbleized slate, and has mounted upon it all the instruments and switches for the control of the dynamos and of the several feeders leading therefrom to the stores, offices and halls of the building.



Dynamo Room, Havemeyer Building, New York.

The slate is supported at the back by a skeleton frame, and the whole is surrounded by a highly finished cherry frame, which forms an attractive setting for the polished black board, studded with its array of bright instruments and switches.

Mounted upon the board are five ammeters and two voltmeters, made especially for the contractors by the Weston Electrical Instrument Company and of their Central Station Illuminated Dial type. One ammeter is in circuit with each of the four dynamos, while the fifth shows the output of the entire plant.

One of the voltmeters is connected to the bus bars of the system, the second voltmeter being provided with a multiple switch for reading the E. M. F. at the various centres of distribution in the building, and the voltage at the brushes of the different machines, or can be used as a ground detector. When used in the latter capacity it shows not only whether the system may be grounded, but if there is a ground it likewise measures the resistance of the same.

The board is further equipped with a galvanometer for use when throwing the machines in multiple.

Mounted upon the face of the board under the respective ammeters of the several machines are four Carpenter Enamel Rheostats, and their neat appearance and the exceedingly small space occupied by them are most gratifying, especially to one that has formerly been obliged to disfigure an otherwise fine appearing board by mounting a large box rheostat on its face, or by cutting a large hole in it in order to bring the face of a rheostat anywhere near the surface of the board.

There are fourteen Ajax switches upon the switchboard, one for throwing the entire building onto the mains of the Edison Three-Wire Central Station service, one for each dynamo, eight for the office lights of the various floors, and one for the hall lights.

All cables are brought down at the back of the board, and are sweated into copper lugs for connection through the slate board to the switches and instruments.

All cables and connections are well protected by rubber insulation and insulating tubes at the back of the board, so that it would be impossible to cause a short circuit at this point by carelessness in the handling of tools or connecting of additional wires at any future time.

The wiring of the building is done with metal covered interior conduit throughout, the wire used being that of the Habirshaw Company. Edison cut-outs and incandescent lamps are used.

The entire plant was installed by H. Ward Leonard & Company under the supervision of Mr. Frank A. Pattison, the consulting electrical engineer of the architect, Geo. B. Post.

Promptly upon completion the entire plant was subjected to an exhaustive test by Mr. Pattison, lasting two days. The dynamos were subjected to a full load test of ten hours, and operated very perfectly in every way. The rise in temperature was 100 degrees Fahr. at the end of the ten hours run.

Indicator diagrams from the various engines showed a very perfect steam distribution and very close governing. The insulation of the system of conductors was extremely high, being 160,000 ohms with everything in circuit. The plant was immediately passed by the fire underwriters and accepted by the owners.

This plant is the first of its type in this country; that is, one in which bipolar dynamos are operated by being directly connected to standard engines running at 375 revolutions per minute, and the satisfactory results obtained reflect credit upon the contractors, to whom the selection of the apparatus to be used was left.

The extremely small space occupied by the plant, and the entire freedom from all noise and vibration, leave no room for doubt that plants of this nature will soon become almost universal for buildings of this description.

It is a matter of interest to note that the floor space occupied by the entire plant, including the space between the dynamos and surrounding them, is only five square feet per kilowatt.

The Incandescent Lamp from a Commercial Standpoint.

BY EDWARD WESTON.*

In the absence of the information asked for it is impossible to judge of the statements except as they appear in the paper. As I have had some experience in the manufacture of incandescent lamps, I would like to say a few words on the subject; and, Mr President and managers of the Association, if I get tedious or the time of the Association is being taken up without interest to the members, I shall not feel at all hurt if you will kindly notify me.

The modern incandescent lamp consists essentially of three elements—the carbon conductor, the glass envelope, and the leading-in wires. These are the essential elements of the lamp as the art exists to-day. The older incandescent lamps contained these same elements arranged in substantially the same manner; for you will find in nearly every case the carbon conductor or its equivalent, the glass envelope surrounding it and protecting it from the influence of the atmosphere to a certain extent, and thirdly, the leading-in wires or their equivalents, adapted to carry the current to the conductor, to be raised to a high degree of incandescence by the current.

The creators of the art of electric lighting—and I speak in this way because I do not think it fair to disregard the work of everybody who has preceded us—I say that the creators of the art of electric lighting understood the subject a great deal better than a great many people had given them credit for.

The fact that the incandescent lamp played so small a part in practical work until a comparatively recent period, does not warrant us in neglecting to give due credit to the early workers. This is true of all arts, but it is particularly true of the art of electric lighting, since, as a matter of fact, the methods and means now employed in making lamps and producing light by them are very similar to those employed by the early workers, and the essential elements of the present lamps are substantially identical with those of the early workers. Furthermore, the principles upon which the operation of the modern lamp depends, are precisely the same as those involved in the early lamps, notwithstanding recent decisions. Indeed, the fact that no incandescent lamp was commercially used until a recent date is not due to the causes generally ascribed, but to other causes, almost if not wholly overlooked by writers on the subject. The writers on the subject so far may, in my opinion, be divided into two general classes.

1st. Writers who have attained distinction in some other branch of scientific work, many of whom are apt to express their opinions rather hastily and without due consideration of the principles involved, on the possibility or impossibility of the application of some single scientific fact, or a number of such facts, to a useful art. Such writers always abound, and generally express their opinions fully in a very authoritative way whenever a new industry begins to attract attention.

2d. Writers whose opinions are based on sentiment, or who are biased or interested and are therefore frequently unable to look at things fairly or reason logically.

The former class of writers are generally honest, and firmly believe that they have good grounds for the opinions they form and express. Of the other class, those who are influenced by sentiment only deserve our consideration, but those writers who either wilfully close their eyes to the facts in the history of the art, or have no knowledge of the history, or wilfully endeavor to pervert the facts and seek to manufacture history, deserve the fate which will surely befall them.

Among the first class of writers, you may remember that a number of distinguished scientific men expressed very strong opinions on the absolute impossibility of economically sub-dividing the electric light, either arc or incandescent. What they said at that time was accepted by many as Gospel truth. Two notable instances of the kind which will serve to show how unwise it is to prophesy unless you carefully study the subject and take into consideration all the facts, ought to serve to make scientific men more careful. The two instances I refer to are those of the French electrical engineer, Mr. Hippolyte Fontaine, and the well-known English electrician, Mr. H. Preece. The former is well known from his early work in connection with the introduction of the Gramme machine and its use in electric lighting. Mr. Preece has for many years been chief electrician of the English telegraph service.

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* In discussion of Mr. Townley's paper, read at the St. Louis Convention.

Mr. Fontaine was a strong advocate of the arc light, and of that system which necessitates the use of a separate generator for each lamp, and was engaged in the effort to generally introduce such a system. He had little faith in the success of any other system of arc lighting, and practically none in the possibility of success with the incandescent system.

Mr. Fontaine made a series of experiments on incandescent lamps grouped in series, and also grouped in parallel. The current to operate the lamps was derived from voltaic batteries variously grouped. In these experiments a rough effort appears to have been made to ascertain the strength of the current used with a single lamp, or a number of lamps in circuit, and the value of the illuminating power of the lamps was, apparently, roughly determined under the different conditions of grouping of batteries and lamps. But the experiments were wholly misleading, for several reasons. In the first place, there was no absolute determination of the strength of the current, no determination of the difference of potential at the terminals of the lamps, and consequently no determination of the energy required to bring a single lamp or a group of lamps to a certain candle power.

The experiments were therefore of the crudest character, and wholly insufficient to enable any one to draw any conclusions regarding the economy of the incandescent light, or the possibility or impossibility of economically sub-dividing it.

It may be truly said that the whole of the experiments were misleading, and were evidently conducted without even an elementary knowledge of the simple principles involved in the sub-division of the electric light, whether arc or incandescent.

Mr. Preece attacked the matter from a similar point, and fell into errors fully as great, if not greater, than those made by Fontaine. He wrote an elaborate mathematical paper on the subject, which was published in one of the oldest and best scientific journals in the world, and it was republished in many of the best scientific and engineering journals of the world, and the substance of the paper was embodied in nearly all the books published on the subject of electric lighting, and was endorsed by the authors of such books as an extremely valuable paper. The paper had the approval of many scientific men; it had the stamp of authority, and passed current as sterling gold, so to speak. In it he from dynamical considerations mathematically demonstrated the impossibility of economically sub-dividing the electric light, either arc or incandescent. Notwithstanding this (with all due respect to Mr. Preece), the paper did not embody the truth; on the contrary, the whole mathematical reasoning was founded on error and a misconception of the elementary principles involved in the production of the electric light.

I believe it will serve a useful purpose, and be of some interest, to examine these experiments and conclusions rather closely, and to show where the mistakes of these and other writers of about the same period arose.

Do you conceive it possible that a man will be so foolish as to suppose that if he put a kettle containing two gallons of cold water on the fire it would take no more heat to raise that two gallons of cold water to a temperature of 212 degrees than it would take to raise one gallon to the same temperature? Does it not appear reasonable to suppose that almost any school boy who had passed through the curriculum of one of our high schools would be able to answer that question correctly, and at once without resort to any mathematical formula. Is it not perfectly clear to the mind of any one in this room that it would require at least twice the heat or work to be done on two gallons of water to raise it to a given temperature as would be required to bring one gallon of water to the same temperature? Substitute for water any other form of matter, and is not the answer necessarily the same? Furthermore, substitute for heat any other form of energy, and is not the answer necessarily the same? Of course it is. Simple as these facts may appear, they embody the fundamental principles of the electric light and its sub-divisions, whether it be arc or incandescent.

Substitute for the water and the kettle a mass of carbon equal to 1-10 of an ounce, and so proportioned and disposed as to permit it being brought to a sufficiently high temperature to become highly luminous or incandescent, by heat from any source of energy. Measure the energy expended in maintaining its luminosity or degree of incandescence constant. Now split this 1-10 of an ounce of carbon into ten equal parts, lengthwise or crosswise, and arrange them so that the ten equal parts can be made to constitute ten separate luminous centres. It is manifest that we shall now have ten parts of carbon each equal to a 1-100 of an ounce. Now let them each be subjected to heat from any source of energy sufficient to raise the temperature of each of the ten small masses to the same point as that to which the large mass was raised and which they originally composed. Does it not follow as a matter of necessity that each mass of 1-100 of an ounce will require substantially 1-10 of the energy applied to the large mass to bring it to the same temperature, and that each of the ten small luminous centres will give a light substantially equal to 1-10 of the light of the large mass, and that consequently the light from the whole of the ten small masses will be substantially equal to the light of the large mass which they originally constituted.

If these principles are so simple, how is it that there has been so much mystery and misconception in regard to this subject? How is it possible that men like Mr. Preece should have used such language as appears at the end of the elaborate mathematical paper referred to, language which unquestionably denies the possibility of the economical sub-division of the electric light?

The explanation of the error is, that Mr. Preece assumed that when lamps were introduced in series in the circuit there was an increase in the total resistance of the circuit which diminished the current flowing, and he failed to perceive that to overcome the increased resistance in the series lamps and bring each of the lamps in series to the same degree of luminosity as was the case when only one was in circuit it was only necessary to increase the electromotive force to such an extent as to force through the circuit of two or more lamps in series the same amount of current as was needed to bring a single lamp to its normal degree of brilliancy, or normal candle power, if you prefer it. Surely, if a certain amount of energy was needed to obtain a light of certain candle power, it ought not to require more than *twice* that amount of energy to run two lights, each of the same candle power as the single light, and so on in the same proportion. Mr. Preece utterly failed to grasp the simple fact that if a certain amount of energy was needed to raise a certain lamp to a certain candle power, two such lamps require twice that amount of energy, and if two or more such lamps were put in *series*, it was necessary, in order to deliver the amount of energy required by each lamp to bring it to its normal candle power, to increase the electromotive force of the generator in simple proportion to the number of lamps in circuit in series.

In discussing the multiple arc system, he made an equally serious mistake, and made the remarkable statement, "*The total amount of heat generated in the resistances will vary inversely as the number of the latter in the circuit.*" Now, every one of you knows, and every electrician should know, that just the opposite is necessarily true. For with a suitable battery or dynamo the amount of heat generated in the lamps, or resistances, is directly proportional to the number of lamps put into circuit. Thus with ten lamps in the circuit you necessarily have ten times the heat generated in the circuit that you have with one, and so on for any number, however great or small, provided the same difference of potential be maintained at the terminals of the lamp.

Long before the date of Mr. Fontaine's experiments and Mr. Preece's mathematical demonstration of the impossibility of economically sub-dividing the electric light, it was an accomplished fact in this country.

Careful students and inventors in this country held views entirely different from those of Mr. Fontaine and Mr. Preece; views identical with those I have already referred to in dealing with the simple principles involved in the sub-division of the light. Mr. Brush and myself had already quite economically run arc lights in series. In my early work I looked at the matter more from the point of the simple principles previously referred to, supplemented by the further belief than if one lamp could be run on a machine and yield commercially useful results, (of which there was no doubt,) then there ought to be increased economy in running many lamps from a single machine, whether in multiple arc or in series. Because I believed that the electrical losses could not possibly be relatively greater in a machine adapted to run several lights than in a machine adapted to run one light.

But to return to the incandescent lamp, which was the subject of the paper open for discussion.

I am certain that it was not the conviction of the impossibility of sub-dividing the electric light that restrained its development at a much earlier date. For one, I can say, in perfect truthfulness, that I saw less real, serious difficulties in sub-dividing the incandescent light than in sub-dividing the arc light. But there was the staggering fact of the inefficiency of the incandescent as compared with the arc lamp. From the one it was only possible to obtain a small fraction of the light per unit of power expended that it was possible to obtain from the other; and, as you know, that difficulty has never been overcome.

. I hope I have made clear the fundamental principle that the energy required to raise a definite mass of matter up to a certain temperature and degree of luminosity, and to continuously maintain it at that temperature and degree of luminosity, is fixed and determined for that kind of matter, and is always the same for a given set of conditions. Furthermore, I hope I have also made it clear that if such a definite mass of matter emits a light, say equal to 100 candles, and it is desired to divide it into a series of small lights of ten candle power each, it is only necessary to suitably divide the mass into ten equal parts and to expend 1-10 of the energy on each part to get the number of lights each of the desired candle power.

Following the line of thought in the minds of those denying the possibility of the economical sub-division of the electric light, there was another class of writers who pronounced it impossible to distribute the energy without such an enormous waste or enormous cost for conductors as would render the investment wholly unprofitable. This in my opinion was the most just objection urged to any extensive system of distribution.

They next claimed that there was no system of ammeters which would meet the requirements and avoid enormous loss by escape before reaching the lamps. This objection was just as illusory as the objections to the possibility of sub-dividing the light.

Still another objection was that the light would be so costly as to prohibit it competing with gas. And here let me say that the people engaged in the development of the business were guilty of the worst form of bad faith, on account of the absurd statements made by them concerning the cost of the lights, and the still more outrageous statements of the amount of power required to produce them.

Some quite well known scientific men expressed opinions in a very public manner nearly equally preposterous in the other direction, and claimed that there was no possibility of the light ever competing with gas, because it would be too expensive. Now if we were always guided solely by the question of expense, we should not make much progress in the world. Expense, if not too great, is but a small factor in our modern life.

There are many very expensive things which we could readily dispense with, yet we use them. In general, if one thing is better or more convenient than another, people can be found in sufficient abundance to buy it, and sooner or later the general public willingly pay more for something better than anything they previously used.

Passing over the objections urged against electric lighting and the hasty glance at the principles involved, we will now deal with a matter which I have no doubt will interest you more as business men and station managers, namely, what is the best lamp—that is, the most efficient and most durable lamp?

It might as well be understood at once that efficiency and durability are, so to speak, antagonistic with a given kind of carbon; that is to say, with a given kind of carbon and equal skill in making the lamps, as the efficiency of the lamps is increased the durability or lifetime of the lamps is necessarily decreased. But, as you know, there is a great difference in this respect between lamps made by the various companies. I am aware that many have claimed that the very noticeable difference in the durability of the various lamps is solely due to the differences in their efficiency. But this is not invariably the case, for some lamps which are just as efficient as others with which they may be compared are also much more durable.

As a matter of fact, there are a number of things that affect the efficiency and durability of lamps. Much depends on the care and skill displayed in making lamps; but supposing equal care and skill be employed in making lamps, there will always exist great differences in the efficiency and durability of lamps, due solely to the physical characteristics of the material out of which the carbons are made, and in some instances to the treatment to which the carbons are subjected either before or after they are put in the lamps.

The material from which the carbons used in the modern incandescent lamp are almost invariably made is that substance known to chemists as *cellulose*. This is a general term employed to cover a series of substances of substantially the same chemical composition, and which forms the principal part of most trees and plants. It covers woods generally, such as cane, bamboo and other woods; woody fibre and fibres of plants generally; cotton, linen and similar substances, and material made from them, such as paper, thread, etc.

In a few cases a substance somewhat resembling cellulose is employed, namely, silk.

Mr. Townley in his paper divided the lamps in use into three classes, based on certain characteristics of the carbons. While it is undoubtedly true that all lamps at present in use differ practically only in regard to the physical characteristics of the carbons used, setting aside the question of care and skill exercised in making them, or the slight differences in size and form of the loop yet the classification by Mr. Townley is too restricted to do justice to the subject, because on the physical characteristics of the base from which the carbon is made the practical value of the lamp will largely depend.

In most of the very early forms of incandescent lamps the carbons were made from substantially the same material as the arc-light carbons with which you are so familiar; that is, from powdered coke or powdered gas-retort carbon, mixed into a paste with some cementing substance like sugar, tar or pitch, which serves to bind the particles of pulverized carbon together into a pasty mass capable of being worked into the desired form. The cementing material is, during the operation of baking, decomposed, the volatile constituents escaping and leaving behind some carbon which bind the particles of gas-retort carbon or coke into a porous but quite strong mass.

On examining such a carbon under the microscope, you will find that it has a fine granular structure, the size of the cemented particles being dependent on the fineness of division of the original powdered carbon.

It is generally supposed that such carbon is unsuitable for use as the slender carbons of incandescent lamps. This is an error. If properly prepared, it is very good indeed, much better than two of the carbons used by Mr. Edison in some of his first lamps. It is also quite flexible and quite strong when made as thin as the carbons now generally used.

I would suggest the following classification as being more useful than that proposed by Mr. Townley:

1st. Carbons made from cellulose, the physical characteristics of which have been modified by some process of manufacture which has more or less broken up the fibres or rearranged them and bound them together mechanically. Under this head I would include paper, cotton or linen thread or braid, and as being closely allied I would also include silk thread or braid.

All such bodies have the fibres more or less broken up and interlaced in a more or less irregular fashion, but are not cemented together by cementing material such as binds woody fibres together in their natural condition.

Thus the fibres of paper are not parallel, but lie crisscross in every direction, like the fibres of wool in a felt hat, and the points of contact are uncertain and very irregular.

The fibres of cotton, linen or silk thread are longer, are not parallel, but are twisted in several strands, without any cementing and binding material to unite the strands firmly. 2d. Carbons made from the previously named manufactured products, but which have subsequently been subjected to some chemical process, such as parchmentization to cement more or less perfectly the separate fibres, and thus form a more or less perfect mechanical and chemical union between the interlaced fibres. 3d. Carbons made from wood, by simply splitting the wood in a direction as nearly coincident with the direction of the fibres as possible. 4th. Carbons made from either of the above, but for reasons which I shall presently mention exposed to the flashing process or hydrocarbon treatment. 5th. Carbons made from a perfectly homogeneous base, about which I shall have more to say later on.

To those engaged in the manufacture of lamps it is well known that the structure of the carbon resulting from the use of any one of these primary bases, or substances, out of which the loop is first cut, is precisely the same as the original base.

Thus, if paper be used as a primary base, every fibre and every defect existing in the paper will exist as perfectly after carbonization as before. Examination under a high power lens will disclose the criss-cross interlaced arrangement of the fibres, and the fibres will be as perfect in form and arrangement as they were in the paper. The same is true of carbon made from any other material. That is to say, the carbon preserves with absolute fidelity the arrangement, structure and shape of the substances of which they are made. It follows, therefore, that every defect existing in the material of which the carbon is made, no matter how great or how small, exists also in the carbon.

You as electrical men will readily understand that any defective contact in any part of an electrical circuit causes the appearance of much more heat at that spot than would appear if the defective contact did not exist. You also know that if some section of a conductor carrying a current be thinner than it ought to be much more heat appears at that section than would be the case if the conductor was of the proper cross section throughout. None of you would think for a moment of taking a lot of thin copper wire, cutting it into short lengths, and simply interlacing them together and use them as the bus bars or main conductors for your circuits. You know well enough that such an arrangement would cause you much trouble by defective contacts, and possibly result in fusion or burning of the mains.

Now, untreated carbon made from paper is substantially such a main, and of course it is very defective. Defective, first, because the fibres are not firmly bound together, and secondly, because the paper not being of uniform thickness, nor of uniform density, the carbon is also not of uniform thickness or uniform density. Put such a carbon into an electric lamp, put the lamp in a circuit where you can control the strength of the current, turn on a *very* feeble current at first; if no part of the carbon begins to glow increase the strength of the current very gradually, and you will notice that some part or parts of the carbon begin to glow before the remainder shows any visible signs of heat. Increase the strength of the current again, and you will generally find that some part or parts of the carbon are vividly incandescent before the other parts are above a dull red.

These vividly incandescent spots are the spots of greatest electrical resistance in the loop—the spot at which the loop will fail long before the period of usefulness of the loop as a whole has ceased.

Now what is true of carbons made from paper is more or less true of carbons made from cotton thread, linen thread and silk thread.

The average life of such carbons would probably not exceed 150 hours; somewhat more in the case of thick carbons, and much less in the case of thin ones. With such carbons, I question whether the incandescent light would be in existence as a practical art to-day.

And here I hope you will pardon me if I say a few words in regard to some of my early work on the incandescent lamp. I met with these very difficulties in trying to secure uniform carbons very early in my work on the incandescent lamp. And these difficulties appeared in a very exaggerated form in the kind of carbon I first attempted to use, and with the means then at my disposal to secure them thin and long enough to meet my needs. To overcome these, and some other difficulties I shall refer to later on, set me thinking. I was very familiar with the process of gas manufacture, and had known for years of that bugbear of the gas engineer, namely, the deposition of solid carbon on the inside of gas retorts resulting from the decomposition of the vaporous and gaseous hydrocarbons evolved during the destructive distillation of the coal. I was also aware of the fact that the deposit of solid carbon formed very irregularly inside the retort, and seemed to be greatest where the temperature of the retort was highest. The thought occurred to me that if I placed my defective carbons in a carbon bearing liquid, vapor or gas, and then passed sufficient current through the carbon to at first raise the temperature of the defective spot to a red heat, the carbon would be deposited on the spots of highest electrical resistance and build them up, thus making the very agency potent in the destruction of the carbon serve the purpose of building up and obliterating the defective spots. It worked, and in a short time I brought the hydrocarbon treatment to a degree of perfection which left little more to be done. From my experiments I soon found that it was also very difficult to secure two or more carbons of anywhere near the same electrical resistance. I clearly foresaw that to get uniform lights it was necessary to do just as the gas engineer does. You know if one gas burner has a larger slit than another the one with the larger slit will permit the passage of more gas than the other, so that if a gas engineer wants to secure lights of the same degree of illuminating power he makes the slits in the burners all of one size. If he wants a larger light, he makes the slit larger; if a smaller light, he makes the slit smaller. So with the electrician, if he wants uniform lights he must have practically the same amount of matter in each lamp, and the resistance of the carbon must be substantially the same. With the hydrocarbon process this was easily accomplished by making the carbons all slightly smaller in cross section than was actually needed and then depositing carbon on them in the manner described until the defective spots were all built up, and continuing the process a little longer it was quite easy to make the carbons all of substantially the same electrical resistance, so that with a given electromotive force substantially the same current would pass through all when placed in multiple arc, or if placed in series they would all have substantially the same electrical resistance, and therefore all require substantially the same expenditure of energy to bring them to the same degree of illumination.

Some of you may remember that Messrs. Sawyer & Man were the first to patent this process of treatment, and it was not until some time after the issue of their patent that I filed my application for a patent for the same invention. The case was bitterly and stubbornly fought before every tribunal in the Patent Office, but was invariably decided in my favor. Some time after the issue of the patent, the United States Electric Lighting Company brought suit against the Edison Company for infringement of my patent. No effort was made to push the case on either side for several years and until long after I severed my connection with the United States Electric Lighting Company. Then the United States Electric Lighting Company suddenly decided that the patent was a very valuable one, and decided to push the case vigorously. They applied to me for assistance, which for just reasons was refused, and they went to argument with a case which was essentially weak in every point where it could easily have been made conclusive, for an abundance of irrefutable proof existed of all my early work in this direction.

Your worthy vice-president read a paper on the morals of corporations. I can truly say that I have honestly endeavored to discover the existence of any moral qualities in some electric light companies, and failed to find any. In this particular matter, the course of both parties would bring a blush of shame to the face of an honest man.

So much for that class of carbons covered by the first division.

I will now refer to the characteristics of the second class. In this class some of the defects due to imperfect contact of adjacent fibres are overcome by reason of the fact that the parchmentizing process converts the outer layers of the fibres into a glutinous mass which unites the fibres to form a more or less solid body of cellulose. But this parchmentization of the outer surface of the fibres does not wholly destroy the fibrous character of the mass, nor does it make the cross section uniform throughout the length of the loop. It follows therefore that carbons made from this class of bodies are still very imperfect, and exhibit in use some of the serious defects of the carbons of the first class. Hydrocarbon treatment is nearly as essential with these carbons to obtain satisfactory results as with carbons of the first class, and that because of the existence of defective spots as well as the necessity of equalizing the resistance of the carbons. The parchmentization process appears to yield better results with thread loops than with loops made from paper.

We now come to that class of carbons made from substances I have placed under the 3d head. They are referred to by Mr. Townley as untreated or natural carbons. They are only natural in the sense that they are prepared from a substance found in nature, such as wood, bamboo, cane, or other similar substances the fibres of which are more or less parallel and continuous and bound together by the natural cementing substance between the fibres. The principal objection to these substances as the base for making carbons for incandescent lamps arises from the fact that it is almost impossible to get two samples of wood having the same density, and the great difficulty of splitting the wood into thin long lengths in places parallel to the fibres.

Mr. Edison showed excellent judgment in selecting bamboo as the base from which to make carbons for his lamps. For of all the woods available it is probably the best for the purpose. Its fibres are very straight, and it is quite close grained, and splits admirably. Notwithstanding these advantages, it is not by any means perfect, and there has been much complaint regarding lamps made from it. Most of the lamps under proper test show defective spots in the loops, and few of them die as good lamps ought to. That is to say, they do not gradually die all over, so to speak, but fail at some particular spot which was initially weak.

Moreover, the variations in electrical resistance of the carbons obtained from loops of the same cross section and length is very great even when great care is taken, and unless the carbons are submitted to some subsequent process after the first baking, it is practically impossible to obtain even moderately uniform results. It is not to be expected that it is possible to find a natural product like wood to have the same density or even more than approximately so. Consider for a moment the conditions of growth of plants. Are they not similar in many respects to human beings, products to a large extent of their surroundings? Is it reasonable to suppose that any two trees growing either close together or a long distance apart shall have the same properties exactly? I think not. In other words, there must of necessity be considerable differences in the properties of the wood of such structures, due to climatic and other conditions, as well as those differences which are known to exist in the strength and character of the wood taken from the same tree.

Carbons of the 4th class include carbons made from any of the other three classes already referred to but subsequently subjected to the hydrocarbon process.

There is no doubt about the general correctness of Mr. Townley's views concerning the advantages of treated carbons over untreated carbons. I am quite sure of the absolute necessity of treating carbons of the 1st class, and possibly of the 2d class, in order to get commercially useful results. I am also quite sure that carbons of the 3d class, straight fibre, natural fibre, or bamboo type, or whatever you may choose to call them, are greatly improved by the hydrocarbon treatment properly applied.

I believe enough has been already said on the effect of the physical characteristics of the base on the resulting carbon, and its influence in determining the life and efficiency of lamps, to make it clear that what is really required to secure the perfect lamp is an absolutely homogeneous carbon. With an absolutely homogeneous carbon of uniform cross section from end to end of the loop, the loop will not suddenly fail at a single point long before the principal part has suffered sensible injury by use. Such a carbon will gradually die, so to speak, all over. It cannot fail at some sharply defined spot, because there is no defective spot to be raised to a higher temperature than the other parts of the carbon. Such a carbon, even if subjected to the most searching tests, will exhibit an absolutely uniform degree of incandescence from end to end of the loop, owing to the non-existence of defective spots. This kind of carbon may be raised to a much higher temperature than ordinary carbons, and so be much higher in efficiency, and still give a much greater average life than any other carbon I know of. To obtain such a carbon it is necessary, of course, to secure a base having also a perfectly homogeneous structure. I secured such a base many years ago in several ways, but after securing the base it took several years of work to overcome the difficulties encountered in making carbons from it. But the difficulties were all overcome, and the result amply repaid me for the labor and time expended. The best way of securing the base is fully described in U. S. Patent No. 264.987, dated Sept. 26, 1882.

The characteristics of the carbon and its advantages are set forth in another patent issed to me on Sept. 26, 1882, No. 264,986. Within the past year I have made many improvements in the method of making these carbons.

Such a carbon requires no treatment to make it better adapted for use in an incandescent lamp. If properly made it most perfectly fulfils all the requirements of the art as it exists to-day. It makes the most efficient and durable lamp known—the thing you want. It is cheap. It exists, and yet you cannot get it. Why? Turn to the people who have been conducting the manufacturing branch of this business and ask them that question. Do you think you will get a satisfactory answer? In the struggle for the control of this whole business—and it has been a bitter one, and is still a bitter one—the general interests of you gentlemen as station managers, and the broad interests of the art as a whole, have been largely overlooked. Yes, even the best interests of the manufacturing companies have also been overlooked. I am of the opinion that if the manufacturing companies had turned their attention from the suicidal effort to annihilate each other, and had devoted to other ends some portion of the enormous sums expended in various ways, honest and dishonest, to effect that object of annihilation, the art as a whole would have profited by it, and you in particular. The condition of the incandescent lamp business to-day is a peculiar one and fraught with great interest to you as station managers. There are here to-day the representatives of two of the largest companies engaged in the business, each endeavoring to gain some advantage over the other. The litigation of the incandescent lamp has pretty well terminated. It has been a bitter and in many respects an unjust battle on all sides. I take it that the present paper is the outcome of the existing situation. One has the old lamp to sell, the other has a new lamp to introduce. A new lamp did I say? The glass stopper lamp is not new; the iron wires are not new; the carbon is not new. The absence of the information asked for in regard to what is meant by "super-treated burner" makes me hesitate to say that that is not new, but I think it improbable that those engaged in the use and experimental investigation of the hydro-carbon process left anything to be done in the way of extra treatment in that direction.

If the lamp stands service as Mr. Townley's paper indicates, the result is in a measure new.

Despite the fact of the presence of both these companies, I am sorry to have to say that I do not think that either of them are engaged in giving you the best they can give. I believe that statement is true, and I utter it in all sincerity.

Time alone will settle the question of the practical value of the lamps offered.

I shall not attempt to deal with the formula presented concerning the durability and efficiency of the various lamps referred to. It would take too much of your valuable time, and would probably not interest you; but I will say that with the facts before you you will be able to perceive that it is a simple matter to make a lamp of any efficiency desired. By simply reducing the amount of carbon in the lamp the carbon can be raised to a higher temperature, or a higher degree of luminosity with the expenditure of less energy.

It is claimed that a 2½ watt lamp can be made to give a satisfactory life. I believe that is possible with good low voltage lamps under close regulation. It has been known for many years that a good low voltage lamp will be more efficient and still as durable as a high voltage lamp.

I thank you for your kind attention, and apologize for taking so much of your valuable time

The "Vulcanizing" Process for Preserving and Strengthening Poles, Cross Arms, Ties, etc.

BY HARRY C. MYERS.*

When we consider that the annual consumption of timber in this country equals twice the amount of material supplied by the annual growth of our forests, it is apparent that the subject of wood preservation, wood strengthening and the utilizing of certain woods now considered as worthless, is a most important and vital one.

Wood as it occurs in nature consists of cellulose impregnated with resin, volatile oils, sugar, gum, tannin, protein bodies and the usual mineral constituents of plants. The percentage of these various constituents, of course, depends not only upon the kind of wood, but upon the season of year, locality, nature of the soil, and part of the tree from which any given sample is taken, hence any results or tests would be only approximate ones.

When wood is heated, as in ordinary wood distillation, the cellulose decomposes and a chemical change takes place between it and the natural constituents of the sap, resulting in a most powerful antiseptic mixture containing acetic acid, methyl alcohol, acetone, methyl acetate, tarry matter containing phenol, creosote, carbolic acid and about thirty other chemicals of lesser practical importance.

It must be borne in mind that these chemicals and antiseptics result from the action of *heat* on the natural sap of the wood, and are *entirely different* from the original sap which allows of the attacks of microscopic fungi and decay. Why has it occurred to no one to heat timber at a temperature which would produce the above change, and then to *keep the changed antiseptic mixture there under pressure*, instead of distilling it *out* of the wood? Such is the entirely new and original process known as "wood vulcanizing," viz., heating of wood and timber under great pressure.

Hundreds of processes for preserving wood have been patented, but these are not very effective, and all of them may be divided into two classes: 1. Those in which wood is impregnated with a preservative material by immersion. 2. Those in which a preservative agent is forced into the pores of the wood.

In the process of "vulcanizing," wood is heated in closed cylinders from eight to twelve hours at a temperature ranging from 300 degrees to 500 degrees Fahrenheit, and under a pressure of from 150 to 200 pounds to the square inch. A circulation of superheated and dried compressed air removes the surface moisture and any water that does not take part in the reaction and combine with the woody constituents. Hence, wood or timber, in any condition, may be immediately treated. These cylinders for the treatment are 105 feet long, 6½ feet in diameter and are made of steel. As the treatment penetrates to the heart of the timber, considerable time is required for cooling, which is, of course, done in the cylinder and under pressure. Timber is introduced and treated upon cars which run into the cylinder upon small tracks.

This process apparently makes decay impossible by sealing up the pores of the wood with antiseptic matter which becomes solid and firm on cooling and standing, and which is produced *within* the wood by the action of heat and pressure upon its original sap.

The orignal sap is colorless or pale yellow, and the changed sap very dark or black, hence a most desirable dark antique color may be imparted to oak and other woods.

The Hon. B. F. Tracy, Secretary of the United States Navy, with a view of adopting vulcanized wood in naval construction, appointed a committee who visited the vulcanizing works in New York City, made tests of their own on yellow pine, showing an average increase in strength of 18 per cent. and a decrease in deflection of over 18 per cent.: hence, they reported that vulcanizing increases the durability and strength of timber, and recommended such timber for use as backing in one of the monitors.

Untreated cross arms which had been painted and used by the Bell Telephone Company for from two to three years showed, by actual test, an average *decrease* in strength by exposure of 18.78 per cent. as compared to new untreated cross arms. Other pine cross arms which had been in service on Western Union telegraph poles for three years and over showed an average loss in strength by exposure of 38.12 per cent. The process of vulcanizing seasons all timber, thoroughly preventing any further warping, checking or cracking. Such timber is not influenced by atmospheric agencies, bacteria or spores, and requires no paint for protection, as it is saturated with antiseptic preserving material of its own.

This timber when vulcanized is as durable as ordinary timber and ties used in railway construction. Other woods are seasoned and rendered beautiful by vulcanizing, which produces very desirable colors for interior decoration.

The life of vulcanized timber is not known; none of the timber or ties used in railway construction during the past ten years have been known to decay. I personally examined some 12 x 12 pine timber which had been placed in a machine shop in 1882, part being vulcanized and part untreated. The treated timber is perfectly sound and still in use, while the untreated had completely rotted and crumbled away after five years' use. I also find by personal investigation that timber placed on the Manhattan elevated roads of New York City as far back as 1888 shows no signs of decay, and is as sound and sweet as if fresh from the tree, while untreated timber laid at the same time has rotted away and been replaced.

As vulcanizing changes the sap from the liquid to the solid or semi-solid state, does not char or make the wood brittle, saturates and seals up the pores of timber with solid matter instead of liquid soluble matter which nature provides, considerable strength and durability are added by vulcanizing, the wood being rendered more cohesive, harder and denser. The spike-holding quality is naturally much increased, and even after ten years' service railroad spikes seem to be as firmly imbedded as when just driven.

It is also a curious fact that the electrical resistance of most woods is very greatly increased by vulcanizing.

Morals of Corporations.

BY E. A. ARMSTRONG.†

That there is a popular distrust, if not actual hatred, of corporations as such is undoubtedly true. I suppose a myriad of causes may be found and properly credited as the source of this.

A corporation of to-day, however, is vastly different from those not half a century old. In most of the States I apprehend their creation is very similar to that of my own State, New Jersey. With us corporations are formed under general laws passed for particular classes—lyceums, libraries and miscellaneous business corporations all having their respective acts.

We have often taken occasion to complain of the unfair treatment given companies by municipalities, but too often the treatment has been invited. When a corporation such as ours makes a large investment for public lighting, and while it continues to regard what I have indicated as its duty regarding service and charges, it has the right to expect a continuance of the municipal—patronage, I was about to say—service, I will substitute. Any deviation from this, while not a violation of an express is the violation of an implied contract; something in law just as binding when defined, and therefore, surely ought to be in morals.

I imagine I might amplify this to a considerable extent, but I will not, further than to say what applies to corporations acting with each other and with individuals, as may hereafter be stated, will all apply, and really with more binding force, upon the relation with the municipal or governing corporation. Such a corporation being a part of the governing machinery, it is bound in law, as well as in justice, to treat with absolute fairness every person alike. It is dishonest for it to take anything for public use from its citizens at less than cost. When that is accomplished, that most undesirable of all things, municipal ownership of electric lighting plants, will be undreamed of and unconsidered. No matter how reasonable may seem the idea of the Government doing everything possible, it is the idea most foreign to our notion of government—especially the American idea. Everything possible is to be left to the people, with as little government as possible.

It is the duty of a corporation to use the best methods it knows or can learn, adopt all the improvements, and render the best possible service, and that at as reasonable a figure as it can afford to do it, having a just appreciation of the risk the capital invested sustains, which is entitled to an adequate return. If you can furnish light or power at a less figure than you are now receiving and still pay your stockholders a fair return, it is your bounden duty to voluntarily reduce your prices, so that those who make your business possible may have their share in your prosperity.

As corporations we can do what as individuals would be impossible. The aggregation of the littles will accomplish wonders, just as brick after brick makes the tallest and grandest structure. But the beauty and the strength, and indeed the utility, of the world is absolutely dependent upon the perfection of the single one, the individual.

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*Abstract of Paper read before the National Electric Light Association at its Sixteenth Convention, held at St. Louis, Mo., February 28 and March 1, 2, 1893.

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"Electricity," under its present ownership, has never solicited the advertising patronage of the General Electric Company.

I do not know that I can say very much as to the policy to be pursued on this question. I know what mine shall be: that I will never buy one cent's worth of material from the General Electric Company until they do that thing. (Applause.) I shall never buy one cent's worth of supplies from that company that I can possibly buy from an independent concern; and I shall do all in my power to advance the sale of any lamp which is put on the market which can be manufactured without coming under the law of infringement.—*T. Carpenter Smith, of Philadelphia, before the National Electric Light Association.*

THIS is the slogan: No man should buy one dollar's worth of supplies from the Trust which can be purchased elsewhere. Independent concerns should be aided in every practical way, and there is no more practical way than this.

The Incandescent Lamp. We print in another column the remarks of Edward Weston at the St. Louis Convention in regard to the history of the progress of incandescent lamp manufacture and the essential qualifications for a lamp of long life and high efficiency. The fact that a homogeneous structure of perfectly even section throughout its length is desirable for the carbon filaments is too apparent to need argument, and the methods employed by the different manufacturers to attain these ends practically determine the value of the lamp as far as its length of life is concerned.

Besides avoiding the destruction of the filament at certain spots which burn more brilliantly than the rest of the carbon, the hydrocarbon treatment permits the lamps to be turned out with more uniformity as to the candle power of individual lamps, and in this respect considerable discrepancy is now found not only among lamps of different makers but in similarly rated lamps of any one maker. In almost any lot of new lamps labelled 16 C. P. there will be found some which vary as much as three or four C. P. from the normal figure.

The practical value of lamps for central stations is not to be judged by their performance when new, but by their *average* efficiency during their life, as well as the *average* C. P. maintained.

In general the lamps of the highest initial efficiency are not the most economical in the long run. A lamp of this class may be made to consume say three watts per candle at first, and on this basis it is estimated that fifteen 16 C. P. lamps per horse power may be supplied; but after a use of them for two or three hundred hours customers will complain of poor light, and it will be found that the lamps have diminished considerably in candle power. At the end of its life if allowed to burn for six hundred or eight hundred hours, the candle power of such a lamp will not exceed probably fifty per cent. of its normal amount, and instead of three watts per candle it will consume seven or eight watts. As the customers are paying for light and not for watts, trouble naturally ensues, and taking the average consumption of these lamps during their life, it will be found to come nearer five or six watts than three.

On the other hand, it has been shown that lamps of an initial efficiency which starts nearer this average maintain their normal candle power during their life with considerably less variation than occurs with the high efficiency lamps, and for this reason, as the total consumption of current for both is practically the same, the low efficiency lamps are far more satisfactory to the customers and are no more expensive to the central station.

From this it may be concluded that the claim for the greatest number of lamps per horse power is not the principal desideratum. What is needed by the central station manager is a lamp of the highest efficiency consistent with the least variation of candle power.

* * *

Changing Defeat into Victory. A contemporary calls attention to the monumental effrontery displayed by one of the badly defeated parties in the libel suit against the proprietors of the *Electrical Review* of London, noticed in our issue of March 15.

After losing its case on the evidence of Lord Kelvin, Prof. Thompson, Mr. Swinburn and other eminent electricians, who testified to the inefficiency of its electrical apparatus, this company comes out with the following advertisement:

> "Lord Kelvin, President of the Royal Society, and other leading electricians have recently confirmed Mr. Harness's theory—viz., that when the elements in the electropathic belt are properly connected, mild currents of electricity are generated and enter the human body."

This is the most noticeable case of the advantages of notoriety which we have seen, and is probably unique in turning the most damaging kind of evidence into a favorable advertisement. We expect to see this brilliant stroke of business sagacity adopted by the electric quacks on this side of the water as soon as circumstances permit.

* * *

IF the *Electrical Engineer* is estopped, through financial arrangements with one of the leading manufacturing companies, from telling the truth and reporting the actual condition of affairs, it should lose no time in making official announcement of the fact. It would thus free itself, in a large measure, from unfavorable criticism. In any event, until it is at liberty to say *something*, either on one side or the other, it should abolish its so-called editorial page. Electrical men are not all high-rollers, but they are good livers, and do not relish a weekly dose of dishwater.

* * *

THE publication in the *Electrical World* of the statement that the Sawyer-Man Electric Company had filed an application for dissolution was false in every particular; and it would have required little investigation upon the part of the *Electrical World* to have learned this, if it was ignorant of the facts. The truth is, the *Electrical World* does not care to be correct; but it will lose no opportunity of publishing statements, true or false, which will give pleasure to its benefactors, the General Electric Company.

"Out of Darkness Cometh Light." When Henry Villard said to Mr. Charles Ambitious Coffin, "You have bitten off more than you can chew," he uttered no original thought, but in homely language expressed a plain truth.

The capacious maw of the Trust is in a fair way to have its gastronomic powers severely tested at an early date. Opposition is arising which it cannot smother, cannot buy, or bluff, or frighten; opposition which will not be swallowed. Miscalculating its own power to first erect a fence around the whole earth and then appropriate the enclosure, its insane greed has antagonized the good sense of the entire community, while acting as an inspiration to be up and doing to many an enterprising and ingenious mind, with this inevitable result: that in the matter of incandescent lamps, the only device to which the Trust has established its claim to exclusive right, several new inventions are all but ready to be placed on the market.

Thus the only solid foundation which the Trust has ever had will be speedily undermined; and it is only a question of months when the abnormal structure will totter and fall.

It is only a matter of a very few days before the problem now confronting the entire fraternity, as to where the future supply of lamps is to come from, will be settled for all time, and the business of manufacturing incandescent lamps go on as briskly as ever, regardless of the squirming of the tentacles and mandibles of the huge octopus now striving to choke and strangle every fair and honest competitor.

And we make this positive statement, *knowing fully whereof we speak.* It is frozen truth, and our assertion will be borne out to the minutest letter.

It has been our good fortune not only to see, but to examine and to test in the most trying manner, a new and efficient incandescent lamp, which is no mere toy, no mere experiment, but a long-lived, practical, commercial lamp, pronounced by the most eminent patent experts in this country to be entirely beyond and outside the Edison patent which has been sustained in the various suits recently tried.

In the decision on appeal awarding the incandescent lamp to Edison, which was rendered October 4, 1892, the debatable point centered in the second claim of Edison's patent, which runs as follows:

"The combination of carbon filaments with a receiver made entirely of glass, and conductors passing through the glass, and from which receiver the air is exhausted for the purposes set forth."

In the new lamp to which we call attention the foregoing claim is in a most markedly practical and efficient manner rendered of non-effect. The receiver is composed of several parts and various substances, and in view of this fact the device must and will prove an eye-opener to many. It is owned by men who can command millions of undiluted capital, which is more than can be claimed for the Trust; and so certain are they of the value of the patents they own, the efficiency of this lamp and its absolute freedom from every element or suspicion of infringing on any other known lamp—Edison or other make--that they are already laying out large capital in preparing to manufacture on a scale that may be considered almost gigantic.

At the proper time we shall have a little story to tell of the evolution of this new candidate for popular favor, together with some startling figures proving its high efficiency; meantime we beg of all purchasers of incandescent lamps not to allow themselves to be bulldozed, scared or coerced by the bullying Trust or its army of hirelings into signing away their right to purchase in the open market, and carefully to keep their weather eye open for every new movement in the lamp business; and we wager dollars to doughnuts that they will learn something to their advantage before—well, before General Electric reaches 120.

"There's a hen on," and at least one of the brood will be a fighting game cock.

* * *

As we have heretofore stated, it is our opinion that every man who signed Form D or any other long-time contract with the General Electric Company made an ass of himself. The pressure was of course strong, but it should have been remembered that no concern built like the Electric Trust could succeed ultimately. Better have closed down your plants and burned tallow candles than to commit business suicide. Our advice now is to every man or company who signed such a contract:

Ignore it!

Buy your supplies where you see fit, and

Fight it out!

No honest man will say you are not justified; and

You will win!

* * *

Any report that Mr. Coffin will lay down the reins of power, whoever may pose as the President of the General Electric Company, is ridiculous. His name is not yet Charles Ausgespielt Coffin.

* * *

Electricity has positive and authentic information that a number of successful and non-infringing lamps will be on the market before the ides of June.

* * *

With the prospective advent of new lamps, consumers and supply dealers should not forget their duty. The General Electric Company will soon be on its knees begging for trade and for the services of the middle-man in securing it. But *non-infringing lamps should be the only ones used or sold.*

* * *

Threatening some of the leading metropolitan dailies with suits for infringement because they persist in using the lamps that suit them best is one of the latest mistakes of our friends the enemy. Proceed, gentlemen. Electricity is not lonesome, but we really would not object to a little discussion of Trust Methods by our contemporaries. We will supply the points.

* * *

If an independent paper, covering the entire field, is of any value to the independent interest, *it should be supported by every independent concern.*

We believe the Electric Trust is beaten.

* * *

We believe Mr. C. A. Coffin is beaten.

* * *

We believe Lee, Higginson & Company are beaten.

* * *

We believe Monopoly in the Electrical Industry is beaten forever.

The New Lamp.

The Trust is rapidly losing its hold
On the business world; it also lacks gold;
And the stockholders feel that they've been sold,
Because there's a New Lamp.

While the Trust has bulldozed day after day,
Inventive genius has kept on its way,
And 'twill soon receive its well-earned pay
For its New Lamp.

Let the Trust keep gloating—let its bummers sing;
They'll do something else when they see that ring
That solves the problem—the pesky thing!—
On the New Lamp.

Yes, the trade will see darkness dispelled by light,
And find their way out of wrangle and fight,
And the Trust itself sink away out of sight,
When appears the New Lamp.

Light Ahead.

Monopoly's Days Are Numbered.

One New Lamp for the Success of Which "Electricity" Vouches.

A new incandescent lamp will be placed on the market within sixty days which will, without doubt, solve the problem as to whether the General Electric Company owns sole and exclusive rights in a monopoly on lamps and release the community at large from the thrall of this huge Trust.

We have seen this lamp burning, made tests as to its efficiency and length of life by actual service.

We can vouch for its having been submitted for examination to five of the most eminent patent experts in this country, all of whom have given an unqualified opinion that it is a practical and commercial success and is not involved or affected in the slightest way by the Edison patent which has been sustained in the various suits for injunctions that have been tried of late.

We are well aware this will be startling news to the General Electric Company itself, and at the same time particularly gratifying to the trade at large and to the public, which would very soon have been in open revolt against the grasping, grinding impositions of the most vicious, bloodsucking vampire in the commercial world to-day.

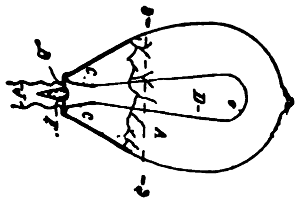
Other Recent Lamp Patents.

Chicago in the Front Rank.

The Von der Kammer Lamp.

John von der Kammer, of Chicago, has received a patent for an incandescent lamp, dated March 7, 1893, for which the application was filed January 23, 1893. The details of this lamp are shown in the accompanying illustration and the claims specified are as follows:

In an incandescent lamp the combination of a substantially flat metallic base composed of two portions in the same plane connected by a bridge of glass or the like to form a flat continuous base with a glass portion rising from about the edge of said base fused upon the edge and outer surface only of such base and forming therewith a receiver or globe, with a filament supported upon



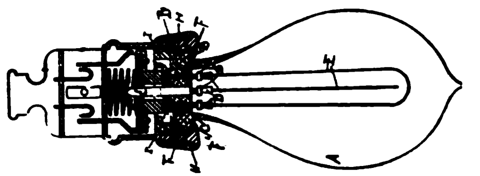
THE VON DER KAMMER LAMP.

such metallic base and conductors leading to or through such metallic base.

In an incandescent lamp, the combination of a receiver made partly of glass and partly of sheets of metal, said sheets at the base of the lamp, a carbon filament within the receiver, conductors leading the current to the sheets in the base of the lamp and upwardly bent portions of the metal sheets to each of which one end of the filament is secured.

The Applegate Lamp.

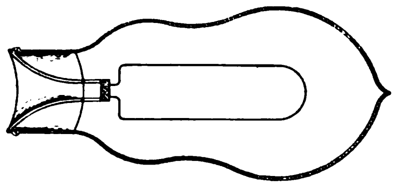
A patent for the lamp illustrated herewith was issued to Eugene W. Applegate, of Omaha, Neb., on December 6, 1892, of which the following description is given: An incandescent lamp of a suitable configuration, provided with a stem-opening and a flanged stock B, the cap C adapted to fit within and upon said opening and stock, and provided with the central tube C′, the projecting carbon clamps D, provided with the nuts D′. The spring-sleeve F is provided with an outwardly-extending groove at its upper and an inwardly-extending flange at its lower end. The lower portion of said sleeve is further interiorly and exteriorly threaded, the sleeves H′ and collar I, in combination with a socket, comprising the shell K, and the spring-actuated contact-arms M M are adapted to be in electrical connection with the carbon clamps D D.



THE APPLEGATE LAMP.

The Green Lamp.

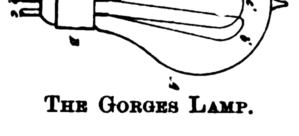
A patent was issued to Henry Green, of Hartford, Conn., on May 24, 1892, which is illustrated in the following cut. The principal claims for this patent read as follows: In an incandescent lamp made entirely of glass, a pair of circuit wires or conductors attached in the usual manner to the platinum wires and trained up the sides of the hollow recess in the neck of the lamp and fastened thereto by fusion of small portions of glass. The neck is provided with a number of bead-like projections to hold the lamp in a socket.



THE GREEN LAMP.

The Gorges Lamp.

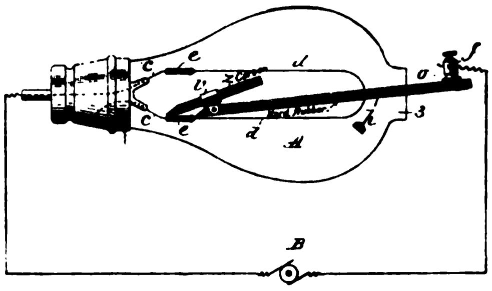
This patent, which was issued to Johannes H. F. Gorges, of Berlin, on November 29, 1892, describes an incandescent lamp provided with three terminals connected with each other through three independent filaments of equal resistance, as illustrated in the following cut. The patent also includes any number of filaments of equal resistance similarly connected.



THE GORGES LAMP.

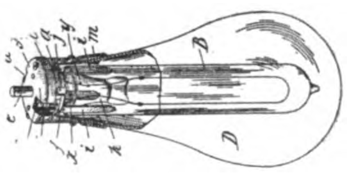
The Frei Lamp.

The Frei lamp is illustrated below, and consists of an incandescent lamp with leading-in or circuit wires consisting of a single tube, one end of which receives an end of the filament, which is secured thereto, and the opposite end receives an end of the leading-in wire to which it is fused. The patent was issued November 22, 1892.



THE FREI LAMP. (FIG. 1.)

Another patent issued to Mr. Frei on December 6, 1892, is illustrated and described as follows: In an electric incandescent lamp, the combination, with a head having the rabbet *a* and the recesses *d d*, the spindle *e*, passed through the head and having the angular extension *f* with the binding-screw 12 in one of the recesses, the ring-plate *g*, having the prongs *i*, and the lug *h*, with the binding-screw 15, located in the other of said recesses, and the lug *j*, extended across the surface of the rabbet, of the globe engaged by said prongs and having the filament and leading-in wires which are detachably connected to the binding-screws and the ferrule *m*, seated in said rabbet and connected to the head and in contact with the lug *j*.



THE FREI LAMP. (FIG. 2.)

More Injunctions.

In the case of the Edison Electric Company vs. the Germania Electric Company, and the Edison Electric Company vs. the Boston Incandescent Lamp Company, which came up before Judge Colt in the United States Circuit Court, Boston, on Friday last, when the court opened Mr. Fish, as counsel for the plaintiff company, informed the Judge that there would be no hearing as both defendants concurred in the application for an injunction and had agreed to accept service of same upon them. These two companies therefore now stand enjoined against making any more incandescent lamps.

The Germania Company Forced to Quit.

Notice has been sent out that the Germania Electric Company, of Boston, has made an assignment for the benefit of its creditors to Mr. Charles A. Williams, 18 Post Office Square, Boston.

The Germania Company has pursued a conservative business policy, and had many friends who will join with ELECTRICITY in regret at the unfortunate turn of affairs.

Two newspapers of Dundee, Scotland, the *Advertiser* and *Evening Telegraph*, are now being printed by electricity. These are the first papers in Scotland to adopt this method.

Electric Installations.

And Some Radical Changes in General Systems of Wiring.

BY C. G. ARMSTRONG.*

It is not my intention this evening to enter into a general discussion of isolated electric installations, but simply to point out some common errors and suggest some remedies that would seem in my judgment to make a better plant.

In planning a building it is true that the designing of the electric plant is left until the last, everything else being considered first.

In my experience I have found it not an unusual thing to be called upon to design a plant, when upon receiving the plans I find that the architect has left room for the plumbers' pipes, has prepared excellent runways for drainage, has looked after his catch basins, has located his elevator pumps and given them plenty of room in the basement, has provided ample space for everything except the electric light plant. There are no raceways in the building, space left for dynamos and engines is totally inadequate, boiler capacity is about half what it ought to be, no place for storage of coal, and yet the most important feature of the entire building is light. It becomes necessary of course to at once make a claim for more space and provide raceways or some substitute therefor. Having obtained all the space possible, the next item that confronts the designing engineer is, how to lay out his plant.

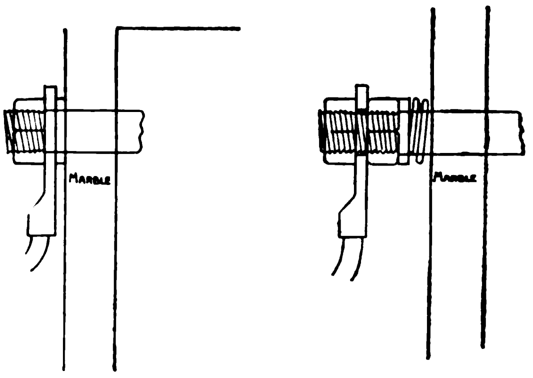


FIG. 1.

One cause of a bad plant is through lack of forethought on the part of the designer of the building, another is, desire to save a little expense on the first cost, third is from force of circumstances.

Generally, when a man has concluded to put in an electric light plant he wants it as soon as he can get it, and although he takes six months or a year to make up his mind, he wants the plant put in at once. I prefer to get dynamos as close together as possible. The only two conditions to be considered are, first, that they will not be reversed in polarity by proximity of like poles, and second, that the armature of any machine can be removed without disturbing the other. A modification of this lay-out could be made where space is very limited by running one of the smaller machines in tandem, but as a general rule I do not like to run in tandem.

On the matter of foundations for dynamos I confess to be something of a crank. I like to have a good foundation under the dynamos. While not as absolutely essential as a good foundation under the engines, yet a concrete or brick foundation, in which the best quality of Portland cement has been used, is a very desirable thing for dynamos. I have handled almost all machines in the market and have never yet found one that runs as well without a good foundation as it did with one.

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* Abstract of paper read before the Chicago Electric Club, February 20, 1893.

Switchboards are the next item of importance. The switchboard should be placed within six or eight feet of the commutator of the dynamo or as near that as is possible ; a greater distance is unnecessary and a less distance is not so desirable.

There is one precaution which should be taken, however, in all marble switchboards, that is, fastening instruments thereto. From the unyielding properties of either marble or slate, it is advantageous to have a coil spring and that connections should be made somewhat as shown in Fig. 1, otherwise the instruments will soon become loose by jarring of the board. In no case should the wire connections to the instruments be so placed that they can jar loose, as there is great danger of arcing.

It should be the object of all designers of switchboards to get the board as simple as possible; to avoid all complications and yet have the board to accomplish the purpose designed, requires no little ingenuity on the part of the designer.

It often happens in very large buildings that the motor load amounts to quite a considerable per cent. of the light load; when such cases arise I believe in having a third bus bar on the board which shall be used for motor connection. This applies only of course to such plants as have two or more dynamos. Where motor connections are used it is quite desirable to have an ampere meter to measure the amount of current used on the motors. This ampere meter should be "dead-beat" and should have a range equal to all motors in the installation. A careful attendant would know if his motors got into trouble or blew a fuse, and could also tell how his different loads were being handled throughout the building.

As to other meters on this board I would prefer non-polarized, from the fact that they are less liable to get out of calibration. There is one slight disadvantage perhaps, that if a machine should get to running as a motor an attendant might not as quickly understand it, but it is seldom indeed that this would occur, and where it does it does not require much intelligence on the part of the operator to know that the belt is pulling the wrong way; in fact, cases of operating dynamos as motors are also caused by a faulty method of cutting out machines when dynamo tenders attempt to cut the voltage down before pulling out machines. The proper way to disconnect a machine is to pull the switch and let it die a natural death; the same is true of motors.

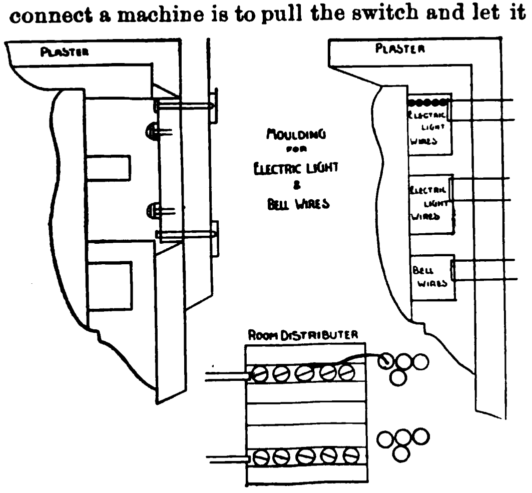

FIG. 2.

Dynamo switches should be made double-throw, one connection being on to the bus bars in such a manner that any or all dynamos can be thrown on to the motor circuit. By closing a switch the motor circuit is placed in multiple with the lighting circuit. By opening this switch and throwing down a dynamo switch a dynamo is connected to the motor circuit.

[At this point Mr. Armstrong displayed a large number of photographic views of various switch boards, typical of the principal lighting systems installed in this city. Space forbids their reproduction and that portion of his speech pertaining to these views is consequently omitted.]

Wire is perhaps dangerous ground to tread upon, for each manufacturer of wire is thoroughly confident that he has the only wire in the market that ought to be used, but there is nothing more important in an installation outside of dynamos than wire. Use always the best wire. Different methods are pursued in ascertaining which is the best. In making tests upon wire I do not believe in soaking it in chloroform, naphtha, sweet spirits of nitre, phenol, amyl, aldehyde or any other nonsensical methods. In the ordinary course of usage wire is not subject to the genial influence of any of the above named substances. The greatest enemy of wire is ammonia, an enemy which is most potent and which is found in any and all plastering.

The present method of running distributing wires in fire-proof buildings is, first, wire placed directly beneath the plastering with cleats; second, all wire being enclosed in interior conduit tubes; third, and the most desirable method, is the running of wires from the cut-out cabinets in moulding to the rooms and then under the plastering in interior conduit tubes to the outlets. This method I use almost exclusively.

Fig. 2 shows one form of corridor moulding which I use. It has three compartments, one for each polarity of the light wire and one for the bell wires. When leaving this moulding, interior conduits carry the wires to the outlets. This is a better method than all interior conduits, as architects are every day limiting the thickness of plastering. Originally one and one quarter inches of plastering was considered just about right, now one-half inch is almost too much; in fact many of them complain bitterly when asked to u e enough plastering to cover one-quarter inch tubing; but the greatest objection to running interior conduits clear back to the cut-out cabinets is that a large number of tubes are brought to one point and it is almost impossible to make the plastering adhere to them.

Many architects think that the only place to place interior conduits is in the flooring. I object to this very seriously because it is almost impossible to lay tubing in the flooring and prevent them from being broken to pieces by the workmen.

I do not wish to be understood by these remarks that I am not favorable to interior conduit, as in 95 per cent. of my work I use it, but I believe in restricting it to its proper place, using it in short runs between outlets and some form of moulding, which moulding will carry the wire back to the cut-out cabinets.

In office and hotel buildings this is especially applicable; the amount of conduit is reduced to a minimum and the liability of breakage from settling of the building is reduced in proportion.

There are three danger points in electric light plants—first, the switchboard; second, the cut-out cabinets, and third, the liability of ground on a circuit.

Grounds can be avoided by the use of good wire, by using insulators to carry all risers and feeders and by distributing in moulding and interior conduit as described.

Fig. 3 shows the common method of insulating fixtures. Electric gas lighting work I would not permit on my fixtures unless they were run with a quality of wire equal to that used in the electric installation. No ground should be permitted in the gas lighting circuit ; no drop cord smaller than No. 16 B. & S. should be used and no wire smaller than No. 14. These suggestions I am satisfied are in the line of better and cheaper construction.

The safety valve of electric lighting is the fuse. The most dangerous current that we can have is known by some as the "sneak" current, and is one that is so slight as not to affect the fuse and open the circuit.

As to the use of the eight amperes on a circuit instead of eight lights as is the present rule in Chicago, I believe there can be no serious objection made. "Lights" is an indefinite term and depends entirely upon the voltage operating for its value in current. The only object of limiting the amount of current on circuits is to reduce the liability to destroy sockets by short-circuiting. A number of experiences have convinced me that eight amperes properly protected by an eight-ampere fuse will not destroy a socket by short-circuiting.

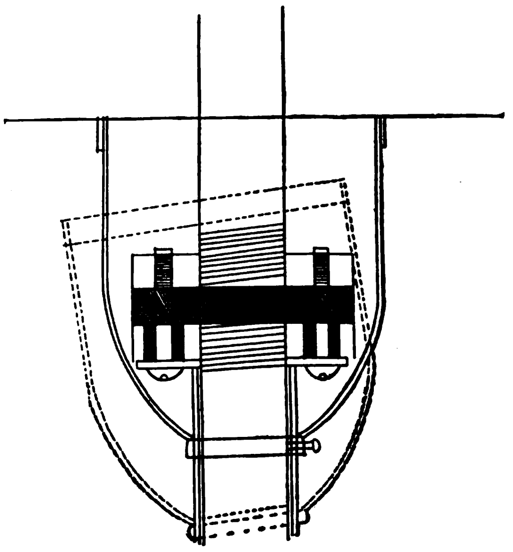

FIG. 3.

A plant should be designed with a small loss at the average load; this loss will vary with the use of the building. Very few buildings operate anywhere near their full capacity at any one time, but if they should for a few minutes in the day require their full capacity the excessive cost for coal expended for that short time would nearly compensate for the interest on the copper, which is a fixed charge against the plant. This method would reduce the cost of running the distributing to a minimum, danger of grounds would be almost entirely removed, and with improved fixture connections I doubt whether a better plant could be devised.

It is true that this plant would not coincide with the city inspection rules of Chicago to-day, but the history of our inspection department has been one of incessant warfare against bad work and in favor of better and safer installations. The gentlemen who compose Prof. Barrett's staff are progressive, active and thoroughly alive to the interest of the electrical profession, and I am satisfied are willing to make any change or alteration in the present rules that would make our work better, safer and more in accordance with good engineering, and we all feel that they are working to accomplish this laudable object.

Thanking you for your kind attention I will leave the paper to the hands of the critics of the club for the post-mortem examination and report.

Personal.

His many friends will be delighted to hear that Dr. F. A. C. Perrine, treasurer and general manager of the Germania Electric Company, has received the honor of an appointment to the chair of Electrical Engineering in the Leland Stanford, Jr., University, at Palo Alto, California. In the enjoyment of a full professorship in that institution, Dr. Perrine will find a congenial sphere. The best wishes of a large circle of acquaintances will go with the doctor when he betakes himself to the Great West next fall.

Correction.

In the article on "Motors for Alternating Currents," by Mr. F. H. Leonard, Jr., in our last issue, the single-phase current is called "two-phase." It should read "single-phase" in each instance.

SOCIETY NEWS.

Buffalo Electrical Society.

"Long Distance Transmission of Power by Direct Currents" was the topic of a talk by Frank Kitton before the Buffalo Electrical Society at a recent meeting.

He stated that the use of direct currents had not lately received the same attention as alternating currents for transmitting power, probably because it was thought by many that they could not be utilized with the same degree of economy in covering great distances; that perhaps the greatest difficulties in this respect appear when considered from a standpoint of constant potential transmission, when such factors as "pressure," "size of conductor," and "loss" appear to "whipsaw" with each other; and that it had not appeared practicable to transmit a large amount of power to a considerable distance with a satisfactory degree of economy by means of direct current at a constant potential, while on the other hand more or less success has been attained with power transmission by direct currents on a constant current system, such systems being in apparently successful operation at home and abroad. It was understood that the proposition to transmit power to the World's Fair at Chicago, obtained from the Falls of Niagara, was based on such a constant current transmission.

Mention was made of a constant potential transmission recently patented by Mr. Charles S. Bradley which presented some novel features that it is claimed will obviate the difficulties referred to. Mr. Bradley proposed to obtain a sufficiently high voltage for his purpose by connecting a number of generators of comparatively low potential in series, thus overcoming the difficulties experienced in constructing commutators, and securing insulation in armatures, which under ordinary conditions will not withstand the excessively high voltage necessary, and at the receiving end placing an equal number of motors in series for reconversion of the electrical energy into mechanical motion.

It is said that this system "involves features for rendering the operation safe, both for the machines themselves and for the operators who attend them"; that "such an invention brings the direct current machine, which has a very high efficiency, into the field of long distance transmission of power—heretofore such machines have been limited to power transmission over short distances"—and "are designed to render practicable the development of a direct current of high potential and its reconversion into power at the end of a transmitting line."

One of the novelties of the system appeared to be the use of series connected generators in a constant potential system of transmission. The question naturally arises, what are the advantages to be derived from transmitting power by such a system under constant pressure that are not already secured in a somewhat similar arrangement of generators for maintaining a constant current with an equally high pressure but which varies with the load.

A lengthy discussion followed, bringing out some interesting facts.

Mr. Frank C. Perkins, who has recently returned from abroad, where he had obtained much information on the subject, said:

"I do not see the novelty of the invention of Mr. Bradley, for the reason that in looking up the principal central stations for transmission of power—Austria, Switzerland, France, Germany and Italy—many different systems were found to be in use with varying success, and a station at Genoa, Italy, was among the most interesting, as it was operated by almost exactly the same arrangement as indicated by Mr. Bradley. The electromotive force used was 8,000 volts, a direct current being used for the transmission. The system is that of R. Thury, electrician of Cuenod, Sautter & Company, Geneva, Switzerland, and is on the same general principle as the plans they submitted for transmission of power by electricity from Niagara to Buffalo, at the request of the Niagara Commission. These plans took the highest prize awarded at that time—undoubtedly because the three-phase alternating system had not at that time been so thoroughly investigated.

"The total distance of transmission at Genoa is 26 kilometres. The company operating the station is 'The Societa Acquedotto Defewari Gallaiera,' with a capital of 5,000,000 francs. The power obtained is from a small stream in the mountains near Isoverda and Pontedicemo.

"The total fall is 450 metres, and there are three stations built up the mountain side, each having a fall of 150 metres, the same water being used over three times. The highest station is called Paccinotti, the second Volta, and the third Galvani.

"From each station there are two conductors running to Genoa, Italy, making three distinct motor circuits, each carrying from 4,000 to 8,000 volts, according to load. The motors are all connected in series and vary from 6 to 60 horse power, a constant current being used of 44 amperes and a variable voltage of from 50 to 1,150 volts for each motor, according to size. The current in the line is constant, and the pressure varies with the load. Each station has five turbines of 140 horse power. The speed of each turbine is 475 revolutions per minute. To each turbine two Thury dynamos are directly coupled, having a capacity of 70 horse power each, with a normal potential of 1,050 volts. The turbines were constructed by Faesch & Piccord, of Geneva, Switzerland, the firm whose plans for the Niagara plant took the Niagara Commission's highest prize for turbines. There are two pipes conducting the water to the turbines for each station, averaging about 250 metres in length and a half a metre in diameter. One of the turbines and two dynamos are held in reserve for use in an emergency.

"These generators are all connected in series, making a total pressure on the line of something over 8,000 volts when the eight machines are running. The line consists of two copper wires 9 millimetres in diameter, and each 26 kilometres long. At a careful test made on a rainy day the loss on the 52 kilometres of line was less than one one-hundredth of one per cent., the electromotive force at the time of the test being 4,000 volts.

"The governor used is an electric one of Mr. Thury's design. Two direct current machines of 150 amperes and 100 volts each are connected directly to a turbine of 15 horse power. One of the dynamos is held in reserve and the other used for regulating the field of the other dynamos. When a large electric motor is thrown out of use in the city of Genoa, the electric governor slows down the small water motor by an electric valve, and the exciter then furnishes less current to the field of the large generators, so that the potential of the line is reduced in proportion to the number of motors thrown out of the circuit. The regulator works very nicely, as was seen at the station Volta, while in operation. The generators have a guaranteed efficiency of 92 per cent., and the motors over 30 horse power also have an efficiency of 92 per cent., while the motors below 30 horse power are stated to have an efficiency of 88 per cent.

"The motors in the city of Genoa are directly connected to incandescent low potential machines and arc machines for distribution throughout the city."

Additions in the Department of Electricity.

The Director General of the World's Fair at Chicago has made an arrangement by which the Department of Electricity has the privilege of adding to the classification originally adopted by the National Commission. A new group has been formed which the officials have endeavored to make general enough to cover everything not heretofore classified. This group is as follows:

Class A—Construction tools, repairing tools, apparatus used in electrical construction.
Class B—Apparatus for transmission of power to electrical generators, (steam, compressed air, turbines, oil, friction, gearing belting, etc., etc.)
Class C—Processes of electro-engraving.
Class D—Carbon and its application.
Class G—Metals and their application in the construction of electrical apparatus.
Class H—The "kinetograph."
Class J—Direct coupled engines and dynamos.
Class K—Electric lubricators.
Class L—Application of electricity in testing and aging liquors.
Class M—Electric tanning.

Boston Notes.

There is one fact well worth bearing in mind in connection with the recent serious conflagrations in this city, that no one has thought to blame the electric wires. A few years ago not an incipient blaze was heard of but the "deadly electric wires" got the blame.

If there is one thing more than another that is influencing the value of General Electric stock, and setting the speculators' tongues a-wagging, it is the fearful inroads which the Westinghouse Electric Company is making into the business of the Trust throughout New England. Contract after contract for railway motors and generators are falling into the lap of the Pittsburg people. We have seen such an array of these contracts within the last few days that the wonder is how the Trust can stand it. Of course the Westinghouse Company is supremely happy; not so the other fellow.

The Hartford, Conn., Electric Light Company, after installing a big electric power plant for the operation of which the waterfall at Tariffville is utilized, has found the demand for service so much greater than was at first expected that it has determined to put in more generators, and has in contemplation the erection of a similar plant at another waterfall about the same distance from Hartford—ten miles.

The lecture on "The Movements of Atoms and Molecules" which was delivered a few evenings ago by Professor A. E. Dolbeare of Tufts College before the members of the Thomson Scientific Club at Lynn, was one of the rarest intellectual treats of the season.

The funeral service over the remains of the late Mr. D. A. Andrews, which was held in Trinity Church on Wednesday, was attended by a large number of friends, including many electrical men, who by their presence showed the esteem and respect in which the deceased was held by all.

The subject of rapid transit is still engaging a large share of public attention in this city, and the Council seems bent on having something of a practical character carried out. There is no sort of doubt that whether the scheme to be finally adopted be overhead or underground, electricity will be the motive power.

Chicago Notes.

At the last regular meeting of the Chicago Electrical Association a very interesting paper, on the "Practical Operation of the Storage Battery," was read by Mr. Fred L. Merrill.

Mr. Gustave Mourath has opened an office in room 1,602 Monadnock Building and established himself as an electrical engineer and contractor for electric light and power transmission. Mr. Mourath expects to make long distance transmission and high potential currents a specialty.

Mr. J. H. Dean, a well known electrical engineer in the Northwest, has been appointed to the position of superintendent of the West Side Electric Company of St. Paul.

Owing to ill health Mr. C. A. Daigh has resigned his position as manager of the National Electric Company and has taken charge of the Chicago office. Mr. F. A. Young has been appointed as his assistant.

Mr. E. F. Seixas, of the Chicago and St. Louis Railroad Company, left Chicago last Wednesday on a business trip to Europe.

Mr. Geo. Conover, purchasing agent, and Mr. Chas. Wirt, electrician of the Ansonia Electric Company, have gone East on a business trip.

The Western Electric Company, through their attorneys, Barton & Brown, have entered suit against the Brush Electric Company to restrain them from using or making an instrument known as the Rudd patent ground detector.

Sir Henry Wood, secretary of the British Royal Commission to the Fair, in a recent interview is reported as saying that he believes the electrical section of the exhibit from Great Britain will be a disappointment to most of the visitors of the Exposition. As an explanation, he said that the English manufacturers of electrical machinery and supplies realized that, except in the case of a few special electrical instruments, they could not hope to compete with the American manufacturers and therefore were somewhat discouraged in making a display.

The construction work on the elevated electric road that is to nearly encircle Jackson Park is almost completed. The workmen are at present employed in laying the rails. Work has begun on the stations, which will be located about every two blocks.

S. A. Carr has resigned his position as assistant manager of the electrical construction department at the Fair to enter the employment of the Consolidated Electric Light and Street Railway Company of Schenectady. Mr. C. T. Schovil has been appointed to fill the position vacated.

Five of the Westinghouse 15,000-light machines have arrived at Jackson Park and are being placed on their foundations. The armature of each machine required a standard 34-foot flat car to transport it from the factory.

One carload of Brush arc lamps arrived on the grounds last week. These lamps are now being placed in position in the different buildings. Three hundred have already been hung in the Agriculture building.

General News.

What is Going on in the Electrical World.

Waverley, N. Y.—Work will soon begin on the electric street railway.

Kissimmee, Fla.—There is talk of establishing an electric light plant here.

Danbury, Conn.—The trolley system is to be introduced on the street railways this summer.

Walla Walla, Wash.—The owners of the street-car line intend to substitute electricity for their horses.

Milwaukee, Wis.—The street car mule has totally disappeared, electricity having complete control of all our railway lines.

Lansing, Mich.—The experiment of municipal lighting in this city shows good results for the first quarter, ending February 28.

Cincinnati.—The extension of the new electric road to Fort Thomas, the Government post back of Newport, will be completed May 1.

St. John, N. B.—Electricity will take the place of animal power on the street railway as soon as the electric plant is completed.

Mount Vernon, Ill.—The electric light plant owned by Evans & Tanner, including four dynamos, was destroyed by fire on the 12th inst.

Oakland, Cal.—Mayor Chapman has approved the ordinance granting the Alameda, Oakland and Piedmont Railway Company a franchise.

Fall River, Mass.—The Electric Light Company has decided to petition the Legislature for permission to supply power as well as light.

Wabash, Ind.—George Webster, of Marion, has sold a half interest in the Wabash Electric Light Company to Thomas McNamee, of this city.

Bath, N. Y.—It is reported that a corporation is to be organized here for the purpose of building an electric railway between Bath and Kanona.

Goshen, Ind.—The Indiana Electric Power Company has been granted a franchise to build and maintain a street railway system within the city limits.

Toledo, Ohio.—The Toledo Electric Company has again raised its capital, and now it is $500,000. The raise is made to increase its facilities for electric lighting.

Columbus, Tex.—The firm of Towell & Shaw have been granted a franchise permitting them to establish and maintain an electric lighting system in Columbus.

Oshkosh, Wis.—The contracts for city lighting having expired, the council is considering whether the city would profit by establishing an electric light plant of its own.

Long Island City, N. Y.—Ex-Mayor Gleason has put a number of men at work on a new electric road from Hunter's Point to Flushing for which he claims to have a franchise.

Kingston, N. Y.—The United Columbian Electric Company of Philadelphia have leased a building in Prince street here, where they will manufacture their new patent electric motor.

Danbury, Conn.—The board of aldermen has concurred with the common council in granting permission for the use of the trolley on the street railways and the system will be applied at once.

Canon City, Col.—The Canon City Electric Light and Power Company has purchased a lot of new machinery, and will double the capacity of the plant to meet the growing demands of the city.

Fostoria, Ohio.—A large factory for the manufacture of electric light carbons is to be established here by Tremaine & Crouse, of Cleveland. The factory will cost $50,000 and will start with 100 men.

New Brunswick, N. J.—A new electrical road enterprise has appeared here. The new concern has secured the right of way from the property-owners on the Cranberry Turnpike from New Brunswick to Milltown.

Jamaica, L. I., N. Y.—The county clerk's office here is open to receive bids for lighting the following villages with electric lights: Morris Park, Woodhaven Junction, Chester Park, Brooklyn Hills and Clarenceville.

Toronto, Can.—Seventy three miles of additional track is to be laid during the coming summer in our street-railway systems, all of it for electric service. There are at present 55 miles of electric roads and 200 cars.

Hoosick Falls, Mass.—The owners of the electric-light plant at Hoosick Falls have in contemplation the building of a railroad from that enterprising village through North Hoosick and Walloonsac to Bennington, Vt.

Toledo, Ohio.—Electric street cars will ply between Toledo and Maumee this summer. A street railway line will be commenced within sixty days and completed by August or September. T. P. Brown is at the head of the enterprise.

Manchester, Va.—The supervisors of Chesterfield County have given the right of way to Col. William H. Palmer, T. William Pemberton, Col. T. M. R. Talcott and George H. Jewett to build an electric road from Manchester to Petersburg.

Albuquerque, N. M.—The city election occurs in April, and the *Citizen* urges the people to elect a mayor who believes in electric lights, new sidewalks, etc. A mayor who doesn't "believe in electric lights" would be a bad thing for Albuquerque.

Dayton, O.—The Dayton Electric Light Company's plant has been sold to New York parties. It is understood that a reorganization of the old company will be made and a new company formed The capital stock of the new company will be $500,000.

Seattle, Wash.—D. T. Denny & Sons have acquired a controlling interest in the consolidated electric railway system of the city by purchasing 8,550 shares at $100 a share—$855,500. The company will be reorganized and President Blunck will retire permanently from the road.

Tacoma, Wash.—The Point Defiance Street Railway Company is building a fifty-six foot steamer to be propelled by means of a storage battery, the invention of Nickolas Lawson. The boat, if successful, is to be the leader of a number to be placed on the Puget Sound routes.

Indianapolis, Ind.—The *Sentinel* states that the Verner-McKee syndicate have assumed control of the property of the Citizens' Street Railroad Company, and are now in absolute possession. The transfer of the stock occurred at Chicago, the last payment of $500,000 being made.

Baltimore, Md.—The *News* says that within a few days the Baltimore and Washington Boulevard and Tramway Company, as it is officially known, will be reorganized and plans will be adopted for building the connecting boulevard and electric railway between Washington and Baltimore.

St. Charles, Ill.—The Crown Electrical Manufacturing Company of Elgin have just completed an extensive factory here, which is now in full running order. St. Charles is on the Fox River, about twenty-five miles from the limits of Chicago. The water power at that point is the best on the river.

Bellaire, Ohio.—A company of Pennsylvania capitalists, including J. R. Jolly, of Pittsburg, and A. R. Leyda, of Beaver Falls, has purchased the street railway operated by J. Felix, and this is believed to mean the opening up eventually of 113 miles of electric railway passing through five counties in Eastern Ohio.

Utica, N. Y.—A scheme to utilize the water power at Trenton Falls in the production of electricity is reported here. It is to be hoped that whoever undertakes this enterprise will plan his work so as not to destroy the scenic beauty of the falls, which has attracted thousands of tourists from all parts of the world.

Albany, N. Y.—In a recent act passed by the Legislature and signed by Governor Flower, granting $258,000 for certain improvements on the State canals, it is stipulated that $10,000 of that amount may be expended in conducting experiments to determine whether electricity can be effectively and economically applied as a motive power on the canals.

Providence, R.I.—A new corporation, said to be the United Traction and Electric Company, has acquired control of the Union Railroad. Senator Aldrich is the reputed president of the new company, and the stockholders include Frederick P. Alcott and William C. Whitney, of New York; Lee, Higginson & Co., of Boston, and Marsden J. Perry, of Providence.

Denver, Col.—A Denver man has a patent on an electric conduit which is claimed to be serviceable for side streets, though it would not do for a great number of wires. It is a continuous insulated metallic box which takes the place of a curbstone and is said to be strong enough to answer all the purposes of a curbstone while it makes the wires very easy of access.

Bloomington, Ill.—Ex-Senator W. H. Patterson, of Mifflintown, Pa., is said to be at the head of a scheme to build an electric railway to connect Bloomington with Lexington, twenty miles away, and a similar road between here and Leroy, also twenty miles from Bloomington. The cost is put at $500,000. The company will furnish light and power as well as operate the railway.

Louisiana, Mo.—A St. Louis syndicate represented by Col. James O. Broadhead, W. J. Dougherty and O. C. Brison has been granted a franchise for the construction of an electric railroad on the Louisiana and Middleton gravel road between Louisiana and Ashley, a distance of eighteen miles. Work will be begun without delay, and the road is expected to be in running order by September.

Windsor, Conn.—The Eddy Electric Manufacturing Company has shipped one of the 250-horse-power generators that have for some months past been in the works, to the World's Fair at Chicago. The other of the same build is being tested and will go forward in a few days. Other machines of less power are also nearly ready for shipment. The entire force of employees is working overtime, and yet the company is behind its orders.

Jersey City, N. J.—The Crimmins street railway syndicate has been duly incorporated and has completed its organization. The principal incorporators are E. F. C. Young, president of the First National Bank, Jersey City, representing the Hudson County lines; Bernard Naighton, the Elizabeth lines, and Jeremiah O'Rourke, the Essex County lines. The field of operations of this mammoth corporation is of great extent, and besides covering populous cities and towns includes the several routes converging toward the Empire City.

Schenectady, N. Y.—An ice gorge in the Mohawk River at the Fitchburg Railroad bridge caused the water to overflow the banks, flooding that part of the city in which the Edison General Electric Company's works are situated. All the exhibits which the company was preparing for the World's Fair were practically destroyed by the water, as was also most of the machinery and stock on the ground floors of the buildings. Other factories in that section also suffered, and about 4,000 men were temporarily laid off. The damage done by the overflow was estimated at over a million dollars.

Chicago.—An injunction suit has been brought by the Western Electric Company against the Brush Electric Company of Cleveland, in the United States Circuit Court, to restrain the latter from manufacturing and using certain instruments for electrical testing which were invented by C. H. Rudd.—The Enamel Insulator Company of Chicago has filed a bill of complaint in the United States Circuit Court against the Carpenter Enamel Rheostat Company of Bridgeport, Conn. The bill alleges an infringement of an improvement in electric insulators. An injunction and accounting are prayed for.

Willimantic, Conn.—At the Woman's Club meeting a few evenings ago, "after a song by Mrs. Morrill," says the local paper, "the subject of electricity was introduced by Mrs. Nellie Crane in a talk illustrative of some of the earlier methods of producing electricity. Miss Page illustrated other methods of generating electricity—by the dynamo, galvanic battery and other apparatus. Mrs. Arthur I. Bill read a paper embodying the history of experiments in electricity, including most of those which Miss Page had illustrated. Mrs. Alice Crane continued the topic by reading an article on Prof. Morse and the telegraph."

Bethlehem, Pa.—The *Times* says: "The recent chartering of several long distance electric car lines in Pennsylvania is the beginning of a revolution in transit facilities. There are numerous isolated villages and extensive tracts of country which the steam railroads have not reached. In these secluded places land brings the lowest prices, and here the discontent of the farming population is most decided. The cheap electric lines, which scale hills and plunge into valleys with little or no grading, which need no expensive stations, engine houses, etc., will eventually find their way to and open up these regions."

New York.—Cary Smith, the yacht designer, has received an order for a 70-foot schooner which will have not only full sail power, but will be fitted with an electric storage battery. She is designed for cruising in Florida waters, and when the wind fails her battery will enable her to keep moving at a six-knot speed.—The Electric Power Company, which brought an action against the Metropolitan Telephone and Telegraph Company for cutting its wires on certain housetops in the city, got a verdict for $2.565.88.—The statement of the Edison Electric Illuminating Company, of New York, for February shows gross earnings of $105.778, against $77.344 last year; operating expenses $50,795, against $36,853, and net $54,983, against $40,490. From January 1 to March 1 the net earnings were $121,183, against $87,257.

Brooklyn, N. Y.—The Brooklyn City Railroad Company has ordered one hundred new open electric cars for summer traffic on its various lines. The company will also have four hundred cars altered and made into open electric cars.—Trolley cars have begun running on Fifth and Atlantic avenues to South, Wall and Fulton ferries.—The old bell-punch, which made conductors on the street cars lament their fate, is soon to disappear. An automatic contrivance on the electric cars relieves the conductor of keeping tally of the fares, and so far lessens his responsibility.—The Nassau Electric Railroad Company has petitioned the board of aldermen for the right to build a double-track surface railroad on Ninth avenue from Union street to Twentieth street; Rogers avenue from the city line to Bergen street, Nostrand avenue and Atlantic avenue, to New York avenue, Liberty avenue, East New York avenue, Douglass street, Ninth avenue, Union street and Hamilton avenue to Ferry place; Marcy avenue from North Second street to Fulton street, and a route from the foot of Marcy avenue, South Fifth street, Union avenue, Johnson avenue, Morgan avenue and Hamburg avenue to the Evergreens Cemetery.

We have received, too late for reproduction, a photograph of the exhibit case of the Norwich Insulated Wire Company, which attracted a great deal of attention at the St. Louis Convention.

Queen & Company.

Queen & Company, Incorporated, Philadelphia, reports a steady demand for their Standard Portable Resistance Sets, which enjoy a national reputation and are used in foreign countries.

This applies especially to "No. T 805" which is recognized as the most efficient portable apparatus for practical work on the market.

It can be used anywhere and everywhere, and is absolutely invaluable in locating faults or grounds in electric light, telegraph or telephone wires. An enthusiastic purchaser writes: ". . . it is the best portable set I have ever used or worked with, and consider any electric light or railway plant incomplete without one. The galvanometer I find works well even in close proximity to the intense magnetic fields of our dynamos."

Descriptive circular No. 430 will be mailed by the makers upon application.

Special Announcement.

To our Customers and Friends:

Desiring to take advantage of the opportunity offered by the World's Fair to evince our appreciation of favors in the past, received in such abundance from our customers and friends, and realizing that the demands of our business are such as to make it impossible for those actually engaged in its everyday transactions to extend to our customers and friends such courtesies as we should be pleased to have them receive from us, we beg to announce that for this and other purposes in connection with the Great Exposition we have organized a separate department, or World's Fair bureau, and have concluded arrangements to place this department in charge of Hon. Geo. B. Shaw, who has been recently elected to Congress and is well known in electrical circles through his former connection with the National Electric Manufacturing Company as its general manager.

It will be a pleasure to us to hear from our friends and to render them any possible assistance either before or during their visit to the Fair.

Trusting that we shall find that we may be of service to them, we remain, very cordially,

THE ANSONIA ELECTRIC CO.,
F. S. TERRY, Manager.

INCORPORATIONS.

The Madera Electric Light Company, Madera, Cal. Capital stock, $100,000. Incorporators: R. L. Hargrove, Sol Lazar, A. B. Ganyard, J. E. Newman and D. M. Tomblin.

The Edison Electric Illuminating Company, of Brooklyn, N. Y., has filed a certificate of an increase in the amount of its capital stock from $1,500,000 to $2,500,000. The purpose of the increase is to extend the company's business.

The Home Medical Electric Company, at Chicago. Capital stock, $5,000. Incorporators: C. O. Lindstrom, Theodore Paine and John P. Olson. The company will manufacture electric batteries.

South Milwaukee Light and Power Company, South Milwaukee, Wis. Capital stock, $15,000. Incorporators: Frank H. Brice, Wm. W. Williams and A. W. Bell.

At Harrisburg, Pa., charters were recently granted to the Columbia Traction Company, of Columbia, Pa., capital $10.000, and the Reading Traction Company, of Reading, Pa., capital $100,000.

The Forest Hill Electric Railway Company, of Kansas City, Mo., has applied for a charter. The capital stock is $150,000. Directors: C. H. Hammett, L. E. Davidson, George Law and others. The road proposed will be six miles long and will run to Waldo Park race track.

The Portable Electric and Power Company, Peoria, Ill. Capital stock, $250,000. Incorporators: Anson C. Tichenor, Robert H. Walker, Isador Mantz and Frank Covey. The purpose is to manufacture electrical inventions.

The Electric Propeller Company, Chicago. Capital stock, $200.000. Incorporators: William C. Marshall, David C. Kling and Louis C. de Proft.

The Springfield, Jacksonville and Winchester Electric Railway Company, Jacksonville, Ill. Capital stock, $1,000,000. Incorporators: James T. Self. George Huffaker and Warren Case, of Jacksonville; John Gibbs and Samuel G. Dewees. The purpose of the company is to construct an electric railway from Springfield to Winchester by the way of Jacksonville.

The Direct Acting Electric Gong Company, of New York City. Capital stock, $15,000. Directors: Thomas Butler, George P. West, Edwin G. Bates and E. A. Footman, of New York City: Henry B. Oakman and James F. Kelley, of Brooklyn.

A charter has been granted at Harrisburg, Pa., to the Pen Argyl, Bangor and Water Gap Electric Railway Company, to run from Wind Gap to Pen Argyl, West Bangor, East Bangor, Johnsville, Williamsburg, Middle Village, Portland, through the Delaware Water Gap to East Stroudsburg. Capital stock, $300,000. The president is A. J. Stroh, of Sunbury.

The Citizens' Electric Power and Street Railway Company, San Antonio, Tex. Capital stock, $30,000. Incorporators: A. H. Dillard, C. E. Harris, W. J. Clark, F. A. Barnaby, F. C. Dow, H. E. Barnard and C. C. Cisson.

Pacific Electric Regulator Company, San Francisco, Cal. Capital stock, $500,000. Directors: H. W. Chase, J. P. Moore, J. R. Hanify, William C. Stair and John P. Muller.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED MARCH 14, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

493,618. Electric-Railway Conduit and Contact. Joel Davis and Reuben M. Huntington, Denver, Colo. Filed Oct. 2, 1891.

493,623. Electric-Railway System. Thomas Harris, Detroit, Mich., assignor, by mesne assignments, to the Harris Electrical Propulsion Company, Limited, same place. Filed Jan. 8, 1892.

ELECTRIC LIGHTS AND APPLIANCES.

493,358. Electric Search-Light. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company, of Connecticut. Filed Sept. 16, 1891.

493,359. Electric-Arc Lamp. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company, of Connecticut. Filed 1, 1892.

493,360. Electric Arc-Lamp. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company, of Connecticut. Filed Oct. 14, 1892.

493,411. Base for Electric-Light Brackets. James T. Robb, Mount Vernon, assignor to the Edison General Electric Company, New York, N. Y. Filed Feb 24, 1891.

493,446. Support for Electric Lamps. John R. Protzman, Streator, Ill. Filed Sept. 17, 1891.

493,578. Electric-Lamp Supporter. Alvin G. De Witt, Detroit, Mich. Filed Feb. 7, 1891.

493,609. Lamp-Socket. Henry P. Ball and Amandus Metzger, Schenectady, assignors to the General Electric Company, New York, N. Y. Filed Aug. 3, 1892.

DYNAMOS AND MOTORS.

493,318. Dynamo-Electric Machine. Elihu Thomson, Swampscott, Mass., assignor to the Thomson-Houston Electric Company, of Connecticut. Filed July 28, 1891.

493,337. Armature for Dynamo-Electric Machines. Horace F. Parshall, Lynn, assignor to the Thomson-Houston Electric Company, Boston, Mass. Filed Sept. 15, 1892.

493,349. Armature for Motors and Generators. Norman C. Bassett, Lynn, Mass., assignor to the Thomson-Houston Electric Company, of Connecticut. Filed July 9, 1891.

493,361. Switch for Electric Motors. Moritz Immisch, London, England, assignor to the Immisch Electric Navigation and Power Company, of New Jersey. Filed Nov. 21, 1891.

493,375. Balanced Armature for Dynamo-Electric Machines or Electric Motors and Method of Balancing Same. Gano S. Dunn, New York, N. Y., assignor to the Crocker-Wheeler Electric Company, same place. Filed June 6, 1892.

493,425. Electric Locomotive. Thomas A. Edison, Llewellyn Park, N. J. Filed Jan. 19, 1891.

493,431. Electric Motor for Dental Work. Jeremiah Kellar, Canton, Ohio. Filed June 6, 1892.

493,439. Commutator for Dynamo-Electric Machines and Method of Constructing Same. Alexander W. Meston, St. Louis, Mo., assignor to the Emerson Electric Manufacturing Company, of Missouri. Filed Sept. 12, 1892.

493,447. Armature Connection for Dynamo-Electric Machines. George A. Rollins, Chicago, Ill. Filed Feb. 16, 1892.

TELEPHONE AND TELEGRAPH APPARATUS.

493,245. Ear Attachment for Telephones. George McC. Brown, Nashville, Tenn., assignor of one-half to Edward James Cahill, La Salle, Ill. Filed June 23, 1892.

493,253. Signaling-Telegraph. William E. Decrow, Boston, Mass. Filed Nov. 14, 1892.

493,297. Acoustic Telephone. Thomas B. Rogers, Brooklyn, N. Y. Filed June 3, 1892.

493,304. Telephone Index. Stillman L. Shaffer, Worcester, Mass. Filed Oct. 25, 1892.

493,620. Telephone-Relay. Samuel P. Freir, East Orange, N. J., assignor to the Western Union Telegraph Company, of New York. Filed Dec. 15, 1891.

MISCELLANEOUS.

493,243. Electric Switch. William F. Bossert, Utica, N.Y., assignor to the Utica Electrical Manufacturing and Supply Company, same place. Filed Feb. 17, 1892.

493,277. Method of Electro-Depositing Metals. Orazio Lugo, New York, N. Y., assignor to the Cosmic Alloy and Metal Depositing Company, of New Jersey. Filed Jan. 8, 1892.

493,314. Lightning-Arrester. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company, of New York. Filed Oct. 28, 1892.

493,328. Multiple Terminal Cut-Out. Lark P. Bonebrake, Maryville, Mo. Filed Nov. 10, 1892.

493,346. Personal-Equation Chronograph. Lionel De L. Wells, London, England. Filed June 17, 1892.

493,369. Electric Switch. Alfred Stromberg, Chicago, Ill. Filed Nov. 1, 1892.

493,380. Combined Cut-Out and Lightning-Arrester. Ernst F. Hammarstrom, Stockholm, Sweden, assignor of one-fifth to Axel Jungmarker, Worcester, Mass. Filed June 3, 1892.

493,422. Electrically-Heated Vessel. John V. Capek, New York, N. Y., assignor of one-half to Edward H. Johnson, same place. Filed Dec. 14, 1891.

493,485. Electric Switch. Andrew M. Coyle, Baltimore, Md., assignor to the Standard Screw Elevator Manufacturing Company, same place. Filed March 3, 1892.

493,558. Telethermometer. Leroy S. Norton and Frank S. Hoffman, Alpena, Mich.; said Hoffman assignor to said Norton. Filed Oct. 31, 1892.

493,601. Thermostat. Thomas W. Shepherd, Peabody, Mass. Filed Aug. 6, 1891.

493,602. Electric Controlling Device. Thomas W. Shepherd, Peabody, Mass. Filed Oct. 24, 1891.

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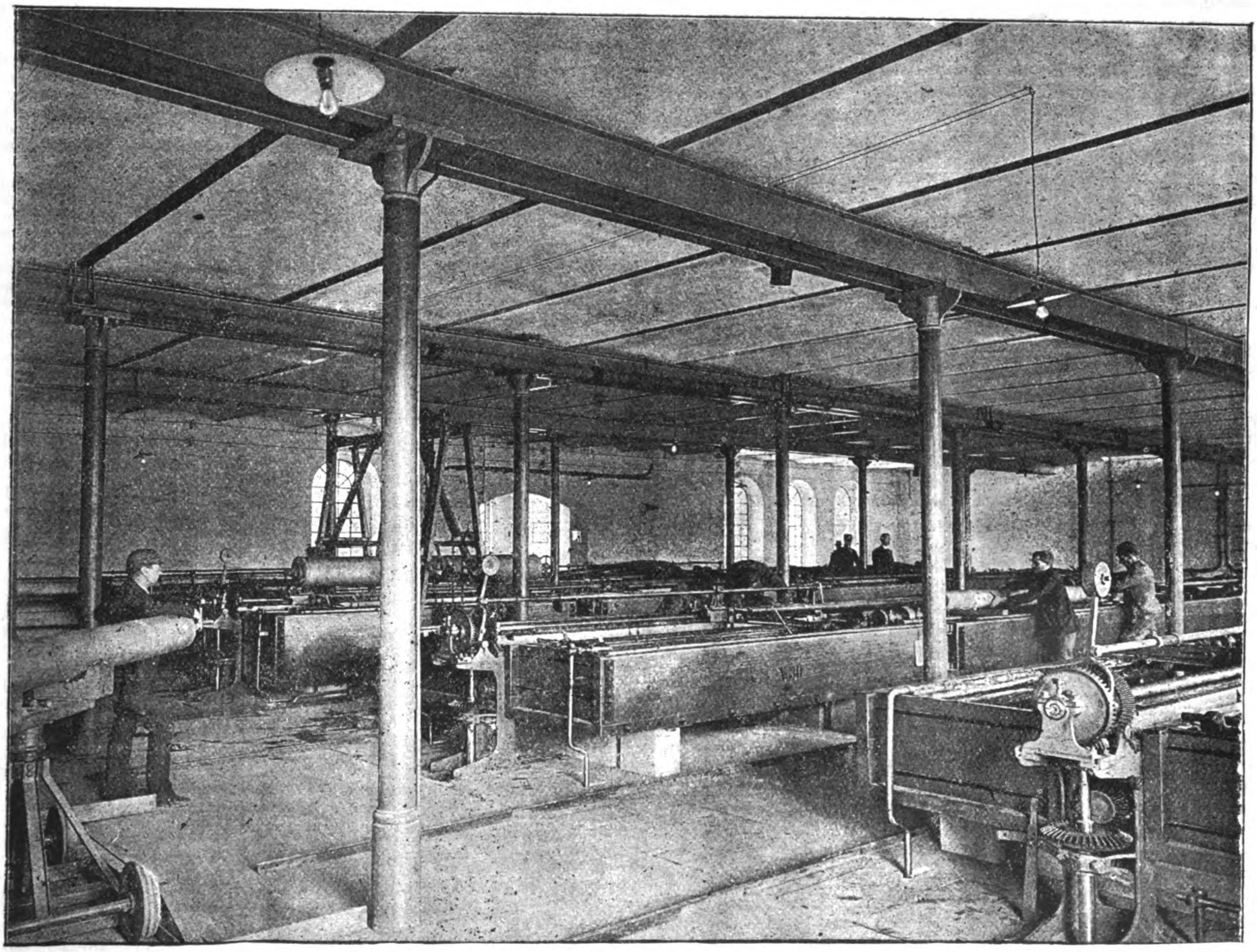

TANK ROOM—GERMAN ELMORE WORKS. (SEE PAGE 133.)

The German Elmore Works.

BY CLARENCE P. FELDMANN.*

The newly erected works of the Elmore's Metall Aktiengesellschaft are situated at Schladern, Rhenish Prussia, about 40 miles from Cologne, on the left bank of the Sieg, and not more than 300 yards from the railway station. The Sieg, which flows into the Rhine, winds its way in several large and nearly closed curves through the hills, and is able to furnish about 720 cubic feet of water per second. By negotiating one of these curves, and driving two 250 ft. tunnels, it was possible to get a total fall of 18½ feet, which, as the whole mass of water can be utilized, renders a total of 1,200 H. P. available.

Of the total available water power of 1,200 H.P. only 550 H. P. have been made use of so far. Two Knap turbines, by Messrs. Briegleb, Hansen & Company, of Gotha, have been laid down, and the power is transmitted by rope gearing to a common shafting in such a way that one or the other or both turbines may be coupled or disconnected by means of suitable couplings. Great care has been given to the bearings of the shafting, which are all provided with loosely-revolving lubricating rings. In spite of the rather high number of 160 revolutions per minute one of the wall bearings, which cannot be controlled during active service, made a record run of three months' continuous running, and was found to be quite intact when it was refilled with oil. This feature, small as it may seem to be, is an essential one, as with the Elmore process interruptions or disturbances might prove disastrous. From the common shafting the dynamos are driven by belts. They are four-pole Helios Company dynamos, running at 230 revolutions per minute, and having an output of 1,200 amperes at 50 volts. The main shafting also drives a small dynamo, which lights the building, and provides, by means of other auxiliary shafting, the necessary power for the tank rooms. The engine room has been designed for eight large dynamos and for one or more steam engines, which might possibly become necessary in very dry summers.

The tank rooms (see Frontispiece) are intended for 200 tanks corresponding to a total output of 85 tons a week. At present only 40 tanks are at work, and a second set of 40 tanks is just being put down. The tanks, similar to those of the Leeds works, allow of the production of tubes of 10 feet 8 inches in length and 22 inches diameter. All 40 tanks are connected in series. A room near the turbine house contains very large tanks, the special tanks, in which tubes of 15 feet length and 5 inches diameter can be made. This room also contains the cyaniding tank in which all the iron cylinders, hydraulic rams, etc., get the first thin layer of copper before they are passed into the tanks containing the sulphate of copper solution. Small electric motors drive rotating pumps, which produce the circulation of the liquor in the tanks; other electric motors are directly coupled to circular tube saws and polishing discs. A powerful testing machine, fitted up in a special room on the first floor, is in continuous use. Not a single tube is sent away, the qualities of which with regard to tensile strength, elongation and contraction have not been carefully tested and registered. These figures, together with a most complete system of daily reports, allow a very complete control of the whole output, and the origin of every tube, and all circumstances connected therewith, can be traced back at any time.

The greater proportion of the work done at Schladern is devoted to the production of tubes and the thickening up of calico rollers. Just lately another branch of the process has become of great importance, namely, the coating of seamless wrought-iron tubes. These tubes are first turned true on the lathe, and then covered with a firmly adhering copper deposit, varying in thickness from $\frac{1}{32}$ inch to ½ inch. The compound rollers obtained in this way are mostly employed in paper machines and in textile machines. They possess higher tensile strength than pure copper rollers without losing the advantages of the latter. It was also stated that large orders have come in lately for coating iron tubes for mining purposes inside and outside with a thin copper deposit, in order to protect them from oxidation. The adherence of the deposit to the rough iron surface is secured by a special process.

The situation of the works, which have been planned, built and are managed by Mr. Ernest Preschlin, in the most busy part of industrial Germany and close to the West Prussian Copper Mines, not only secures them skilled workmen and cheap raw material, but the selling facilities for their products are increased to a great extent by the close vicinity of all the large German calico printers' establishments and paper mills. However, the splendid water-power is the main advantage which these works possess compared with their associated companies in other countries.

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† *London Electrician.*

The Cost of Steam Power Produced With Engines of Different Types Under Practical Conditions; with Supplement Relating to Water Power.

BY CHAS. E. EMERY, PH. D.*

The paper of the writer on "The Cost of Steam Power," published in Vol. XII, Trans. Am. Soc. C. E., November, 1883, seemed to supply information desired on the general subject by many engineers not practising in that branch of the profession, and the writer has often been urged to modify the paper to suit more recent conditions. The prices of engines and boilers employed were higher than the ruling prices to-day, but these form a small percentage of the total capitalized values. The price of coal employed was also higher than the ruling prices in many localities at present, which directly affects the results, but it is evidently impossible to assume any price for coal which will apply to all locations. For these reasons it is believed that the table can still be employed with advantage by any one sufficiently familiar with the subject to make the necessary corrections for different conditions.

It has been decided at the present time, instead of revising the former tables, to compare the cost of developing a given amount of power with several of the different kinds of steam engines now in general use. A unit of 500 net horse power has been selected for the purpose, though some of the comparisons are on the basis that several such plants are in the same station. In order to make the comparison at the same speed, it is assumed in all cases that the power is delivered at a speed of 250 to 350 revolutions per minute, corresponding to the jack shaft speed of slow engines and the actual speed of high speed engines.

It will be attempted in this presentation to examine all the principal causes which affect the cost of steam power in engines of different types operated under practical conditions, but the substantial equalization of the cost of the power developed with engines of different types and different degrees of economy, when expenses independent of the coal consumed are considered, will necessarily form a prominent feature of the discussion, for the reason that such expenses have frequently been neglected or inadequately discussed, so that their very important bearing on the results is not generally understood. It will be shown that such additional expenses are fairly constant, independent of the type of engine, and that without considering interest or dividends they will in some cases equal the cost of coal. It will be seen, therefore, in comparing two engines of which both are good, so that one, for instance, will only affect a saving of coal compared to the other of say 12½ per cent., making the relative costs of fuel as 8 to 7, that, if additional costs equal to the former be added to *both*, the relative economies will be as 16 to 15, and the saving reduced to 6¼ per cent. simply by the summation of costs. If then we assume that all expenditures should pay 10 per cent. interest or dividends on capital invested and 10 per cent. of the difference in first cost of the engines equals an amount which represents a saving of 6¼ per cent. of fuel, then the cost to the owner of the steam plant will be exactly the same in the two cases, since in one case he will pay in additional interest or dividends or the capital invested the same sum as he will pay for additional fuel if he uses the cheaper engine.

In general it will be found, as in the above illustration, that the mere cumulation of costs, other than for fuel or interest, has the greatest effect in reducing the percentage of saving due to a more economical consumption of fuel, and that a consideration of interest and dividends may simply neutralize or reverse percentages that were already made very small from the first named cause.

The original cost of the plant is evidently of great importance where on one hand money is dear or on the other coal is cheap or the work irregular. When the interest or dividend charges and others akin thereto are duly considered, it will readily be seen that the number of hours an engine operates in a year has a very important influence on the question of first cost, as such charges for a given steam machinery will be exactly the same whether the latter be operated one hour per day during part of the year or twenty-four hours per day for the entire year, and the interest will also be the same whether the coal used cost $1.00 or $10.00 per ton. The saving in the total cost of coal consumed, either during the short hours or at the low price per ton, will evidently not be such as to warrant the adoption of high priced steam machinery.

It should be observed that various conditions in addition to those previously named operate to equalize the total cost of different kinds of steam machinery. For instance, with more economical engines smaller boilers are required, so the saving in the cost of the boilers partly compensates for the higher cost of the engines. Again, coal is at the present time cheap compared with former prices, and this is true also of steam engines of ordinary construction, which facts tend to maintain former conditions. On the contrary, steam machinery designed to secure economy, though lower than formerly, is still relatively high.

Principally to obtain uniformity of expression we may preliminarily state, on a somewhat elementary basis, that steam engines at the present time may be divided into two general classes, distinguished as high speed and low speed engines, and though most low speed engines are operated at higher speeds than were employed years ago, there is still a definite distinction, although in many cases the gradations not only appear to reach, but perhaps cross each other. The high speed engines are best distinguished by the fact that they are of comparatively short stroke and develop approximately the same piston speed as long stroke engines by an increased number of revolutions.

We have also simple, compound and triple compound engines of both the high and low speed types, and either of them may be horizontal or vertical. Most low speed engines of the power proposed are of the Corliss type, or at least have much the same general proportions and some means of automatically cutting off the steam by the action of the governor to produce regulation of speed.

Either of the above engines may also be operated with the steam escaping into the atmosphere or to a condenser, and in the latter case an air pump may or may not be used. The first class of engines can no longer be distinguished as "high pressure engines." They are referred to herein as "non-condensing engines." Those of the second class are called "high pressure condensing, without vacuum," while the term "condensing engines" is a general one applied to those in which the steam is condensed and a vacuum formed.

Table I, submitted herewith, shows in detail the cost of one horse power per year developed in engines of different kinds when operated for 10 hours per day for 308 days in the year and

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*Read at the Seventy-fifth Meeting of the American Institute of Electrical Engineers, New York, March 21, 1893.

TABLE I.—Showing the Comparative Cost of Steam Power Developed in Engines of Different Types.

BY CHAS. E. EMERY, PH. D., NEW YORK, 1893.

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p

$C_1 = .0405\,k + .06\,h + .075\,i$

a	b	G $G = q + E$	H $H = r + E$	I $I = s + E$	J $J = t + E$	K $K = u + F$	L $L = v + F$	M $M = w + F$	N $N = x + F$	O $O = q + y + A + \frac{1}{2}D + C_1$	P $P = r + y + A + \frac{1}{2}D + C_1$	Q $Q = s + y + A + \frac{1}{2}D + C_1$	R $R = t + y + A + \frac{1}{2}D + C_1$	S $S = u + z + B + \frac{1}{2}D + C_1$	T $T = v + z + B + \frac{1}{2}D + C_1$	U $U = w + z + B + \frac{1}{2}D + C_1$	V $V = x + z + B + \frac{1}{2}D + C_1$
DESIGNATION.	TYPE OF ENGINE.	TOTAL COST PER NET HORSE POWER PER YEAR ON BASIS OF								TOTAL COST PER NET HORSE POWER PER YEAR FOR ELECTRIC R. R. AND OTHER VARIABLE WORK REQUIRING 50 PER CENT. EXTRA PLANT TO OBTAIN ON THE AVERAGE 500 H. P. INSURANCE INCREASED TO 1¼ PER CENT., ENGINE RENEWALS TO 4 PER CENT. AND BOILER RENEWALS TO 5 PER CENT.							
	NAME.	308 DAYS OF 10 HOURS EACH AND COST OF COAL PER TON OF 2240 LBS. AS FOLLOWS:				365 DAYS OF 20 HOURS EACH AND COST OF COAL PER TON OF 2240 LBS. AS FOLLOWS:				FOR 308 DAYS OF 10 HOURS EACH AND COST OF COAL PER TON OF 2240 LBS. AS FOLLOWS:				FOR 365 DAYS OF 20 HOURS EACH AND COST OF COAL PER TON OF 2240 LBS. AS FOLLOWS;			
		$2.00	$3.00	$4.00	$5.00	$2.co	$3.00	$4.00	$5.00	$2.00	$3.00	$4.00	$5.00	$2.00	$3.00	$4.00	$5.00
		Dols.	Dols.	Dols.	Do's.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.
A	Simple High Speed, Non-Condensing...	29.81	36.17	42.54	48.90	56.49	70.89	85.29	99.69	35.45	41.82	48.19	54.55	62.14	76.54	90.94	105.34
B	" Low " " " ...	28.46	34.20	39.94	45.67	52.57	65.55	78.53	91.52	34.55	40.28	46.02	51.75	58.65	71.64	84.61	97.60
C	Compound High" " " ..	25.84	30.86	35.87	40.89	48.26	59.61	70.96	82.31	31.10	36.12	41.13	46.15	53.52	64.87	76.22	87.57
D	Special Triple Compound High Speed Non-Condensing	25.76	30.39	35.02	39.65	46.96	57.43	67.91	78.38	31.65	36.28	40.91	45.54	52.85	63.32	73.80	84.27
E	Simple High Speed Condensing......	23.25	27.49	31.73	35.98	43.22	52.82	62.42	72.02	28.08	32.32	36.56	40.81	48.05	57.65	67.25	76.85
F	" Low " "	22.82	26.77	30.73	34.69	41.30	50.25	59.20	68.16	28.12	32.07	36.03	39.99	46.60	55.55	64.50	73.46
G	Compound High" "	22.51	26.36	30.22	34.08	41.27	49.99	58.72	67.45	27.48	31.33	35.19	39.05	46.24	54.96	63.69	72.42
H	" Low " "	21.97	25.53	29.09	32.65	39.21	47.27	55.33	63.39	27.36	30.92	34.48	38.04	44.60	52.66	60.72	68.78
I	Special Triple Compound High Speed Condensing	21.57	24.85	28.13	31.41	38.51	45.93	53.35	60.77	26.92	30.20	33.48	36.76	43.86	51.28	58.70	66.12
J	Triple Compound Low Speed Condensing	22.10	25.27	28.43	31.60	38.09	45.25	52.42	59.58	28.27	31.44	34.60	37.77	44.26	51.42	58.59	65.75
K	do do	22.35	25.32	28.28	31.25	37.71	44.43	51.14	57.86	29.10	32.07	35.03	38.00	44.46	51.18	57.89	64.61
L	Do For Probable Maximum Results.....	21.71	24.19	26.67	29.15	36.56	42.17	47.77	53.38	28.33	30.81	33.29	35.77	43.18	48.79	54.39	60.00

for 20 hours per day for every day in the year, with columns showing the results in each case for coal costing $2, $3, $4 and $5 per ton. The results are at first presented on the basis that the power required is comparatively steady so that no surplus machinery is required. A second presentation shows the results for electric light and other plants in case 50 per cent. surplus machinery be provided to supply the maximum power during certain portions of the day, and the power for the remainder of the day is sufficiently low to maintain the average.

In column *b* of Table I will be found the designation of the several types of engines compared, arranged by the amount of fuel required to produce one horse power. Distinguishing letters are provided at the left in column *a* for convenience of reference. In general the kind of engine employed will be understood from the names at a glance. They are presented on different lines of the table, simple, high and low speed engines, both condensing and non-condensing, compound high and low speed engines, both condensing and non-condensing, high speed triple compound engines, condensing and non-condensing. There are also three lines devoted to low speed condensing triple compound engines. Of these line *J* shows the probable results with machinery designed to secure economy in construction rather than the highest economy of fuel. Line *K* refers to a low speed triple compound engine more expensively constructed, for which the economy is assumed lower than in the other case and for which the results are believed to be the best that can be secured under ordinary average practice even with the best machinery. There has, however, for comparison, been added another line, *L*, assumed to be operated at still lower economy by the use of boilers of unusual economy and careful attention to the details of operation, for which purpose $1 per day is added to the labor account. The results shown in this line are believed to be the maximum which can be obtained under the conditions of unusually good practice with the best care available.

Column *c* shows the indicated horse power required to produce 500 net horse power. As previously stated the net power is assumed as delivered to a shaft revolving at a speed of 250 to 350 revolutions per minute, such for instance as the main shaft of a so-called high speed engine, or the jack shaft of a low speed engine, consequently the indicated power of the latter must be increased sufficiently to overcome the frictional resistance developed in transmitting the power to the jack shaft. The total loss due to the friction of the engine and jack shaft of the slow speed engine is considered to be ten per cent., without reference to its distribution, which is substantially what has been obtained by experiment under average conditions. The friction of the high speed engines is fixed at 8 per cent, which may appear somewhat high for such large engines, but it is believed to be warranted by the short stroke, large bearings and high velocities necessarily employed, although it will undoubtedly show smaller in particular engines. In this way 542 is fixed as the indicated horse power of the high speed engines and 556 as the indicated horse power of the low speed engines.

Column *d* shows the assumed steam pressures as shown by gauge. The pressure regularly carried has been somewhat increased of late years, so that none of the engines are assumed to operate at a less pressure than 100 pounds, and for all the triple compound engines the pressure is assumed to be from 150 to 170 pounds.

Columns *e* and *f* relate to the feed water per indicated horse power per hour; column *e* showing the probable limits within which the feed water required will vary for engines of the types stated when constructed by different manufacturers or operated under different conditions. The lower limit is believed to have been fixed in each case at the minimum result which has been obtained by reliable experiments with the class of engines referred to; these figures are therefore too low for average practice. The larger figures in column *e* represent results which in the opinion of the writer may be obtained under less favorable but practical circumstances, and of course still larger costs would result from the use of apparatus imperfectly designed or improperly operated. Column *f* shows the feed water per indicated horse power per hour assumed for comparison. The figures in this column are not intended to be averages of those given in column *e*, but those which can be safely depended upon under conditions of practice, with the load varying between considerable limits, thereby affecting somewhat the economy. It should be stated that the desire to have these figures decrease progressively where possible has somewhat influenced the values selected as well as the above considerations, which should be borne in mind in making the comparisons. In cases where the conditions are especially favorable, the results for a type of engine written in one line may be taken from the line below or by an average of the results written opposite the name of such engine and those on the line below. It is believed, however, from a careful consideration of all the evidence available on the subject that the figures given are all that can be depended upon under average conditions of practice. Engines operating cotton mills or large numbers of small machines of any kind under conditions securing a substantially uniform load will necessarily give nearer the minimum results shown in column *e*, but engines generating electric current for electric railways or subject to variable loads of any kind will rarely show economies as low as has been assumed for comparison in column *f*.

Column *g* shows the commercial horse power of the boilers required to furnish steam to engines of the indicated power shown in column *c*. The power of a boiler is really represented by the quantity of water it will evaporate under normal conditions. Its rating should not be based on the maximum quantity it will evaporate, for in such case the steam pressure would fall during the operation of replenishing or cleaning the fires. There is really no such thing as an absolute boiler horse power, for the reason that the quantity of feed water evaporated required by different engines varies through such wide limits. It is, therefore, necessary to arbitrarily fix the rating for boilers based on the evaporation of a definite quantity of water under definite conditions. In the report of the judges of Group XX, Cent. Exh., the writer called attention to the fact that for economical engines the boilers were generally designed as part of the plant; that for portable engines the boiler and engine were generally attached together, and he suggested that the rated horse power of a boiler could properly be fixed by the quantity of water required for engines of a class then most largely in use, to wit, automatic cut-off high pressure engines of 80 to 100 horse power. He therefore based the calculation relating to the tests of boilers at the Exhibition on the basis that the commercial horse power of a boiler should be fixed at thirty pounds of water evaporated at seventy pounds pressure at a temperature of 100 degrees. This rating was adopted by the judges at the time and has since been adopted by a committee of the American Society of Mechanical Engineers. The increased duty required by the boiler to evaporate the water at an increased steam pressure is small and may ordinarily be neglected. The assumed temperature of feed water, to wit, 100 degs., can be readily obtained even with condensing engines, so the commercial horse power of boilers for the different engines has been found by simply taking the product of the several indicated horse powers in column *c* and of the water per indicated horse power in column *f* and dividing each by thirty, or the number of pounds of water per horse power assumed for the rating of boilers. It will be interesting to observe that the high speed non-condensing engines in line *A* require 596 boiler horse power to produce 500 net horse power, and that the power of the boilers continually diminishes with the reduction in feed water per horsepower, so that for the case last named, line *L*, only 250 boilers or commercial horse power is required.

While on the subject of boilers we proceed at once to the cost of the boilers given in column *i*. As shown by the heading, the prices stated not only include the original cost of the boilers proper but the erection and connection of the same, which may add a considerable sum to the original cost, particularly where the work is of such character that steam pressure must be maintained either on one boiler or another at all times during the hours of operation as is desirable in all kinds of manufacture and necessary where public interests are at stake as in electric work. All steam apparatus needs more or less repair. Stop valves will get off the stems occasionally or obstructions get upon the seats so that they cannot be shut; packing will blow out here and there, joints will become loosened and leaky; in fact there are numbers of petty difficulties that are likely to arise which will require a particular boiler to be shut off pending repairs, independent of the regular suspension of operations for the purposes of inspection and cleaning. To provide for such contingencies it is necessary to insert plenty of valves in the pipes so that one boiler may be shut off independently of another. As accidents are likely to arise at the valves themselves so as to require shutting off main steam pipes occasionally, the writer felt that it was warranted when building the plant for the New York Steam Company to provide duplicate connections to each boiler so that the main steam pipes themselves could be repaired without suspending operations. It was done in that case by the use of smaller pipes for the duplicates, and during the time they were used exclusively the steam pressure was carried higher. Very many electric light plants have, however, been made since that time, in which every connection has been duplicated of full size, and valves placed in every branch where it was possibly thought any difficulty would arise likely to cause a suspension of operation. In such case the water feed pipes are also duplicated in the same way. In the work of the writer above referred to, the duplication of the feed pipes was provided for by arranging blow-off valves which could also be used as check valves by leaving slack in the connection of the stems to the valves and then making connections from the pumps to the blow-off pipes. This arrangement answered the purpose perfectly and in fact proved of greater importance than the auxiliary system of steam pipes. It will be interesting to mention that the latter were kept in operation all the time and used like what is called the "donkey system" on board ship to supply the pumps and auxiliary connections.

There has been some embarrassment in selecting a type of boilers for this comparison on account of the very considerable difference in cost. It has been decided to use a price sufficiently high to cover the cost of the better class of what are termed "safety boilers," or those in which the water is contained in tubes, small chambers or comparatively small shells of unusual strength compared to the large shells of ordinary boilers. Tubular boilers, either of the horizontal or vertical type, are undoubtedly cheaper in the first place, and since, with equally good combustion in different cases, the economy obtainable is increased slightly by increasing the heating surface available for a given power, ordinary tubular boilers are selected when large ratios of heating surface to grate are desired or boilers of the sectional type employed with economizers at the base of the chimney. Increased surface in tubular boilers chokes the draft. It follows, therefore, that generally the tubular boilers do not have the surplus power of the better class of boilers of the sectional type and that therefore when the power varies greatly and the machinery is to be forced for several hours per day to its utmost, as in electric railway work, a greater H. P. of boilers of the tubular type must in general be provided than of the sectional type. Again, some forms of tubular boilers, although showing high economies under the special condition of steady work and careful attention, are not calculated from their construction to run for a considerable time without attention, and any emergency which prevents regular cleaning chokes them up so that their performance is very much reduced and inadequacy of boiler power soon becomes evident. This is particularly the case with the cheap, and, under certain conditions, very efficient vertical boilers with small tubes. In the earlier form of sectional boilers all parts of the boiler were composed of tubes of small sections which would leak at the joints and relieve the pressure much below the explosive limit of the sections. This kind involved difficulties in the way of disengagement of steam and were inconvenient to repair, so that in the more recent modified type, selected for comparison, all the water exposed to the direct heat of the fire is contained in tubes or small cells and disengagement of the steam takes place in drums at some distance from the fire. With this form of boiler, dangerous explosions are impossible, even when the water is low, and the cost of maintenance has proved to be very much less than for the ordinary types of boilers. It is thought, therefore, that though boiler explosions are rare, the small risk of an accident is sufficient, particularly when repairs are considered, to warrant the use of an apparatus with which a general disaster is impossible. A comparison is, however, made in Table II for cheaper boilers, which shows that the final result is not due to the price of the boilers selected. It has been assumed that sectional boilers for pressures not exceeding 125 pounds can be purchased and erected in place complete with necessary attachments, furnaces, brick walls, connections to chimney, steam and blow pipes and other connections, with fire tools and fire room fittings in place ready for regular use for $22 per commercial horse power; similarly the price for boilers erected and connected complete to carry regularly 150 pounds and upward has been fixed at $25 per commercial horse power.

In column *i* the above prices have been reduced to the prices per net horse power by multiplying the ratio of the commercial horse power given in column *g* to 500 net horse power by $22 or $25 in the several cases, when, as would be expected, it will be seen that the price per net horse power reduces as the economy increases in the same proportion as the commercial horse power of the boilers required.

We now return to column *h*, which shows the cost of engines erected and connected ready for operation. It has been somewhat difficult to obtain satisfactory information for this column. Circulars were issued to different engine manufacturers, and although all responded and some took special pains to furnish all the information in their power, the resulting data was nevertheless very incomplete, for the reason that few of the makers were prepared to manufacture high speed engines of 500 horse power, and none of them could give prices throughout the whole list. Again there appeared to be a difference of opinion among the manufacturers as to the *kind* of prices which should be given for such a purpose. Some undoubtedly added a percentage to those for which they regularly sell the same engines in the market, while others evidently stated prices lower than would be furnished under strict specifications. Few of the manufacturers replied to questions as to the cost of erection, stating that such cost would vary greatly with conditions at each location. In some cases, however, the costs of plants complete, including erection, have been obtained which checked well with estimates made up in detail in substantially the following manner: The costs of the engines at the shop, as furnished by manufacturers, were arranged in order, and the shop price adopted fixed not only by averaging different prices for engines of the same power, but by comparison with prices for engines of different sizes, and in some cases of different types, it being attempted to make a gradation in price from one type to another as nearly as the circumstances warranted. This method is the only practical one, for one manufacturer will quote prices for the same engine to develop either 400 or 500 horse power, and perhaps in another case at lower pressure or reduced speed even for 300 horse power. Several engines of different sizes are in some cases made by using the same frame and general details and simply changing the size of the cylinder so that the cost is not greatly modified for quite a range of power. In some cases it was necessary to consider double engines to produce 500 horse power. The price of engines at the shop had therefore to be derived by digesting all the data based on the several conditions. To these prices were added the cost of foundations as calculated from drawings in some of the circulars, and an allowance was made for pipes, felting and the numerous incidentals which are always required in erecting an engine. The final results, though more accurate on the average for different parts of the country than would be obtained by a less careful study of the subject, cannot be depended upon for special conditions. It would be the business of any engine manufacturer to claim that he would furnish machinery of a given kind for less than stated, and he could do it by using smaller engines or higher speeds than is customary, or in a variety of ways. The difference in price between an engine at the shop and one fully erected and in operation should in all cases be duly considered, and when a large number of engines are grouped on one system of piping for steam and another for exhaust, with condensing apparatus, air pumps and perhaps circulating pumps, the several items of cost mount up quite rapidly. There has been added to the cost of slow speed engines the cost of the main belt and a certain portion of the jack shaft, so as to put the high and low speed types on the same basis. The allowance will not, however, include the expensive clutches frequently employed. The prices for high speed non-condensing engines with boilers complete check very well with those collected by Mr. Wm. M. Schlesinger for a book he is preparing with Mr. T. C. Martin, of the *Electrical Engineer*, of which advance sheets have been kindly loaned me. Mr. Schlesinger gives the prices of six plants, varying from 250 to 1,200 H. P., with high speed engines of various kinds and tubular boilers of various sizes. The total cost varies from $50.40 to $61 per H. P., and averages $53.70 per H. P., which checks well with the $58.90 given in Table I for such engines with sectional boilers. A comparison for lower priced boilers is however given in Table II. The price given for triple compound engines with boilers, buildings and details complete, checks well with prices kindly furnished by F. S. Pearson, Esq., engineer of the West End Railway, Boston, for the large plant erected by that company. Mr. Pearson considers that $75.00 per H. P. will be sufficient to complete that work, which includes surface condensers not considered in the table.

TABLE II—SHOWING THE EFFECT ON THE COMPARISON IN TABLE I, DUE TO REDUCING THE COST OF THE BOILERS $5.00 PER COMMERCIAL HORSE POWER.

a	b	H	H_1	L	L_1	P	P_1	T	T_1
	TYPE OF ENGINE.	TOTAL COST PER NET HORSE POWER PER YEAR.							
		FIRST CASE. No surplus plant, Coal $8 per ton.				SECOND CASE. 50 per ct. surpl's plant, Coal $8 pr. ton.			
DESIGNATION.	NAME.	10 hours day.		20 hours day.		10 hours day.		20 hours day.	
		H From Table I.	H Reduced	L From Table I.	L Reduced	P From Table I.	P Reduced	T From Table I.	T Reduced
A	Simple high speed non-condensing	$36.17	$35 23	$70 89	$69 95	$41.82	$40 48	$76 54	$75 20
B	" low " " "	34.20	33 33	65 55	64.70	40 28	39 08	71 64	70.44
C	Compound high sp'd " "	30.86	30.12	59.61	58 87	36.12	35.06	64.87	63.81
D	Special triple compound high speed non-condensing	30.39	29.70	57.43	56 74	36 28	35 30	63 38	62.84
E	Simple high speed condensing	27 49	26 87	52 82	52 20	32 32	31 43	57 65	57.65
F	" low " "	26 77	26 19	50.25	49 67	32 07	31 24	55 55	54.72
G	Compound high speed condensing	26 36	25 79	49 99	49 42	31 33	30 52	54 96	54.15
H	" low " "	25.53	25.07	47.27	46.81	30.92	30.17	52.66	51.91
I	Special triple compound high speed condensing	24 85	24 37	45 93	45 45	30 20	29 51	51 28	50 59
J	Triple compound low speed condensing	25 27	24 80	45 25	44 78	31 44	30 78	51 42	50 76
K	" " " " "	25.32	24 88	44.43	43 99	32.07	31.44	51.18	50.55
L	Do. for probable maximum results	24.19	23.78	42.17	41.76	30.81	30.22	48.79	48.20

Column *j* shows the approximate cost per net horse power of the chimney and the buildings required for the steam machinery. These have been based upon the actual cost of various chimneys in actual practice and upon the cost of comparatively cheap buildings to cover the engines and boilers. The prices could be reduced by using very cheap wooden buildings, but are insufficient to provide for elaborate buildings designed to secure architectural effect.

(*To be continued.*)

Legal Notes.

The Edison Electric Light Company of New York have filed a bill of complaint in the United States Court at Hartford, Conn., against the Connecticut Glass Company of that city. The suit is brought for the alleged infringement of a patent in making glass bulbs for incandescent lights.

Augusta, Ga.—The Augusta Electric Railway Company will probably extend its lines to Aiken, the South Carolina health resort.

The Morality of the Patent System.

BY FREDERIC A. C. PERRINE, D. SC.

Of the various questions which have arisen in relation to the late decision of the courts on the Edison Lamp Patent and the use of that decision made by the General Electric Company, no one is of more importance to us and to our Government than the question of the moral status of the patent and the use which has been made of the decision.

As is well known at the present time the lamp in Edison's mind at the date of his application for a patent was rather an ideality than an actuality. The true carbon which was to revolutionize the whole world—not merely electric lighting, since the application of this lamp has effected a commercial revolution—had not yet been manufactured. However distinctly its requirements were in the mind of the inventor the practical carbon was not at that time a concrete fact; the carbon described in the specifications was not a commercial success, and it was only several years after the application that the bamboo filament, on which the immense fabric of this business has been erected, was developed as a commercial product.

The moral question, therefore, is the one of the right to individual property in an idea and is a question far wider than the right for use and abuse of a particular conception.

The grand effort of civilization has been toward defining rights and duties—the rights we may demand and the duties which are demanded of us. Barbarism held that the only right was the right of the strongest and that there were no duties one was bound to perform towards his fellow. His herds, his lands, his wife, his children, himself, we might each appropriate to our own use were we but the stronger and could we maintain our rights by force of arms. Egoism pure and simple was the moving principle of the savage, only gradually developed into altruism as the race has advanced towards civilization.

An advance made through the tribal and national consolidation which we have been taught to feel was the truest self-seeking. We attempt to elevate the poor in our cities, the downtrodden in all lands, from the feeling that the highest peace of mind, the easiest life together, is to be brought about by religiously performing our duties towards our fellows and raising them to the pitch of fellow-feeling when no one of us will fear robbery or oppression from another.

Personal slavery of mankind we have abolished, and on every side we see the moving forces which are tending to eliminate its last traces in oppression towards workers or peoples. Personally we are untouched by the oppression which exists in Russia, but that any people is downtrodden we feel is an injury to the race, and, as a common humanity, we protest against the last vestiges of oppression.

In the case before us does the right to property in an idea infringe the rights of our fellows which as correlative duties we are bound to respect?

As I have said, we are not from this standpoint discussing one patent or its manipulation, but that custom of granting monopolies in ideas which has been handed down from the Middle Ages in the form of the patent system. Nations in the past have granted monopolies of trade and processes, have given territorial rights to companies and persons, and it is only within the present century that these grants have been confined to the commercial development of special ideas already perfected. As late as 1798 the Legislature of New York granted to Chancellor Livingston the exclusive right to steam navigation on the waters of the State for a period of twenty years, provided that within a twelvemonth he should produce a boat capable of steaming four miles an hour, and on his failure to do so granted again in 1803 the same right to Livingston and Fulton. Such patents to-day are considered hostile to the best interests of the community.

At that time was beginning the age of mechanical development which has so vastly changed the characteristics of the civilized world, and it seemed to the statesmen of the period that such official encouragements were necessary to turn men's minds toward the development of their commercial and mechanical ideas. To-day we have found the fallacy of such a fancied necessity, but with true conservatism have yet held that by both expediency and right a man should be protected in the possession of the results of his ingenuity for a period of fourteen or seventeen years.

But has the history of the past hundred years proven to us the right or necessity of such protection?

Has the existence of the patent laws encouraged the discovery of new facts, and is the world further advanced in civilization than would have been the case without the existence of such laws?

Truly, it is as difficult to recall the past and, eliminating from it some important element, to say what would have been if this element had not existed as it is to-day to predict the far distant future; but we may at least pass in review the advance the world has made, and ascertain, within certain limits, the causes acting to produce these effects.

In our own science of electricity certain names—as indeed in all other sciences—both in discovery and application stand before the world as landmarks of progress. Ampere, Gramme, Faraday, Thomson, Henry, Morse, Edison and Bell represent each great steps in the wonderful development of the science and art.

All of these men leave behind them a world richer for their genius, some reaping in riches their rewards and others obtaining only honor and consideration. All have worked in the days of the patent monopoly and only some of them have sought its protection.

In January, 1832, at the end of his description of the discovery of the continuous production of electricity from magnetism, and after describing a machine which in 1884 created a furor as a new dynamo, Faraday adds: "I have rather, however, been desirous of discovering new facts and new relations dependent on magneto-electric induction than of exalting the force of those already obtained, being assured that the latter would find their full development hereafter," and turning again to his studies and his experiments, completed the great work of his life, carefully describing his successes and his failures in the three volumes from which Clerk Maxwell derived his great work, "Electricity and Magnetism," and toward which to the present day the inventor and investigator turn for inspiration.

Do we owe less to Faraday for his study of the law of ohm than to Edison for his application of its principles to his lamp?

Henry, working in his laboratory at the High School in Albany, and again at Princeton, studied this same law and explained to Morse its application to the magnet; taught him the necessary arrangement of his wires and batteries for long distance transmission, showing at the same time an actual signalling system in operation. Has Thomson derived the benefit of his studies and discoveries on the Atlantic cable which have been freely given to the world and have made the ocean telegraph a possibility, and has the work of Bell on the development of the telephone been grander and of more honor to him than his work upon the human ear and his development of a system by which the deaf and dumb both speak and hear?

And yet these, all alike, inventions and discoveries, are ideas and the work of a man's brain in which we would claim for some the right of property.

It is no reply to this reasoning to state that the common opportunity was open to all to obtain proprietary rights by application, for that these rights were not applied for and obtained makes the true force of the argument itself. Through the whole history of the world its great investigators have been engaged upon the discovery of nature's hidden secrets, and having once found them have gladly granted us the coveted knowledge of the world in which we live, and have so armed us to fight our battles against the elements that they have enabled us to turn the terrors of the unknown environment into friendly, familiar servants, while it has been the work of the inventors, using these truths so made free, to conquer some problem of living; and should we reward them beyond the measure of the advantage which their brains have already given them in the commercial competition?

The struggle in business life is to-day to win in the fight of competition; this makes riches and makes them honestly. If we are ahead and keep ahead, our fortune is made as easily as ought to be the case. But to reward a man for one step in advance by confirming to his use some share of the common property of the world's knowledge is to grant him a right of oppression over others to whom he is under no legal obligation to perform his social duties.

Thus reviewing the past, we cannot fail but see that the great discoveries have been made by men who, in the common fight against nature's oppression, have given us their services for the glory of winning for us all, without any thought of personal riches to be gained by a governmental monopoly in the truths they have made known.

We thus see that in the past the patent system has not produced the discoveries, and it remains for us to question whether it has encouraged all to do their best work for the cause of civilization, and on this point we may turn more profitably to the kindred system of the copyright, as in this field the character of growth in the past one hundred years is more noticeable. The writer from being a poor despised wretch, hardly better than a servant in some great family, has risen to dignity and consideration, and often even to riches. We have the system of copyright in different lands, but not until lately an international arrangement; besides this, a book may not be brought out anew as a plagiarism, but only as a pirated edition.

Now let us see what books have cost labor, and what books have brought riches, what books have been pirated and without the system would have yielded no profit, what books would have paid an author in any event.

Turning to the nearest bookstore, or recalling from memory the names of those seen and known, the answer is not far to seek.

The scientific, thoughtful books, costing a lifetime of labor, have often scarcely yielded the expense of their printing. The best of all kinds of books have won their way slowly, and yielded fair returns, but have offered no temptation to the greedy and unprincipled, while the great sales of froth and ephemeral, easy writing, have yielded the fortune which without a governmental protection would have been impossible; and can it be said, as one casts about amongst the writers of to-day, that such possible gains have not often turned men capable of better work in other fields into this for a livelihood?

While the results are not so apparent, it is nevertheless true that the same causes acting in the patent system have produced much the same effects, and so far from encouraging the investigator, these artificial rewards have turned men's minds from the great field of discovery towards that lower but more profitable one of invention and has filled our land, as all others of civilized society, with men striving for that illusive and undue reward of an artificial monopoly. Truly we have made great strides in the development of our resources, and have not neglected altogether the field of investigation, but this proves rather that no check or artificial bar can hinder the advancing tide of intellectual development and turn aside altogether the inquiring mind from its search for truth, a search destined to become more and more active as we advance in love for our fellow-man and as the grand altruistic tendency of humanity asserts itself more and more strongly.

Perhaps in the beginnings of the past such monopolies have tended to a development otherwise impossible, but to-day, in the full tide of advancing competition, nothing is necessary to turn the mind of the mechanical or commercial genius towards such improvements as will yield to it an advantage in the race for markets and earnings.

Nor is the reward by a monopoly longer necessary for the disclosure of a process since it cannot be said that our sciences are so far undeveloped as to allow the details of a process to remain long undiscovered by more than a single genius, and should it so remain concealed is proof enough that the inventor has made an advance entitling him to extraordinary gains.

For these reasons, then, it is my settled belief that the system of granting patents and copyrights is condemned by the grand definition of right, that which extends the length and breadth of life, and fits it better for its environment, and is accordingly to be classed amongst the erroneous legislation of the past which a more developed sense of the race's advancement calls immoral.

While the history of the electrical patents of the last twenty years lends to this argument much of its force, it is rather from the character of the field, with its hosts of investigator and its scientific methods, that the principles are apparent, than that in the electrical field there has been any dishonesty or undue shrewdness on the part of the various patentees; and while one may there feel most the sting of the injustice, we may not truly say that in this field alone has the world or the community been the sufferer from its own faulty system.

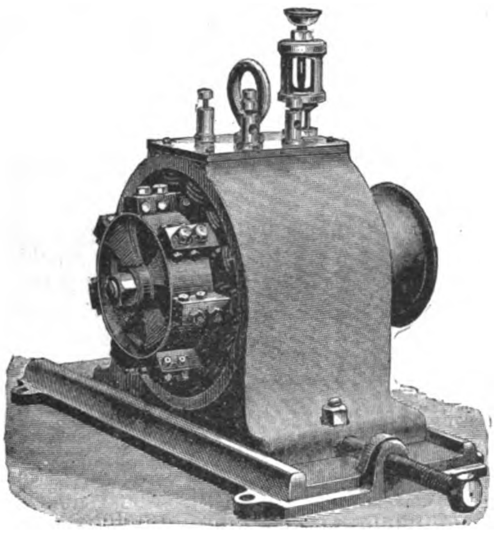
Ayer and Tesla Honored.

At the recent meeting of the National Electric Light Association at St. Louis, Nikola Tesla and James I. Ayer were elected to honorary membership. The name of Cornelius Herz was dropped by unanimous consent. The Association roll of honor now stands as follows:

Crompton, R. E., London, England.
Deprez, Marcel, Membre de l'Institut, Paris, France.
Forbes, George D., London, England.
Fujioka, Prof. I., Tokio, Japan.
Gramme, Z. T., Paris, France.
Hopkinson, Dr. John, London, England.
Hospitalier, Edouard, Paris, France.
Nichols, Dr. E. L., Cornell University, Ithaca, N. Y.
Rothschild, Baron Alphonse de, Paris, France.
Sprague, John T., Birmingham, England.
Swan, Joseph W., Lauriston, Bromley, Kent, England.
Thompson, Prof. Silvanus P., Technical College, Finsbury, London, England.
Yashima, Prof., Tokio, Japan.
Thomson, Sir William, Glasgow, Scotland.
Rowland, Prof. Henry A., Johns Hopkins University, Baltimore, Md.
Brush, Charles F., Cleveland, Ohio.
Edison, Thomas A., Orange, N. J.
Thomson, Prof. Elihu, Lynn, Mass.
Sprague, Frank J., New York.
Bowen, George S., New York.
Weston, Edward, Newark, N. J.
Dawson, Sir William, Montreal, Can.
Redpath, Frank R., Montreal Can.
Bevery, Prof. Henry T., McGill University, Montreal, Can.
Lockwood, Thomas D., Boston, Mass.
Ayer, James I., St. Louis, Mo.
Tesla, Nikola, New York City.

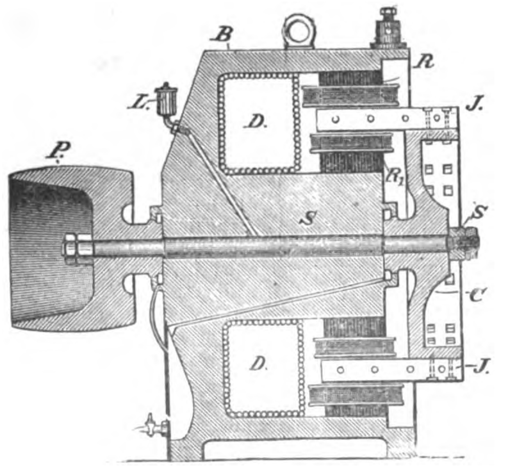
Lighting by Phosphorescent Tubes.[*]

High-tension work generally has developed with leaps and bounds, rotary current has stepped into the field, high-frequency currents have yielded results seemingly magical, and in all this those most antique pieces of apparatus, the Leyden jar and the Ruhmkorff coil, have played an important, and ever-increasingly important, part. The Geissler tubes, invented in the very early days at Bonn, having long served as the standing wonder of gaping crowds at popular lectures when whizzed around in circles and displayed in letters of phosphorescent light, or discoursed upon by scientists in lecture theatres in fascinatingly interesting considerations of molecular bombardment, these tubes now are receiving the earnest attention of electrical experimenters with the fond and not chimerical hope that in the illumination of the tubes lies the desired secret of practical lighting by glowworm or phosphorescent light--light without heat. 'Tis a consummation devoutly to be wished ; and the rich reward that is promised to the inventor of true "glow" lamps is certainly not less than awaits the inventor of "electricity direct from heat."



Pyke & Harris Inductor Dynamo.

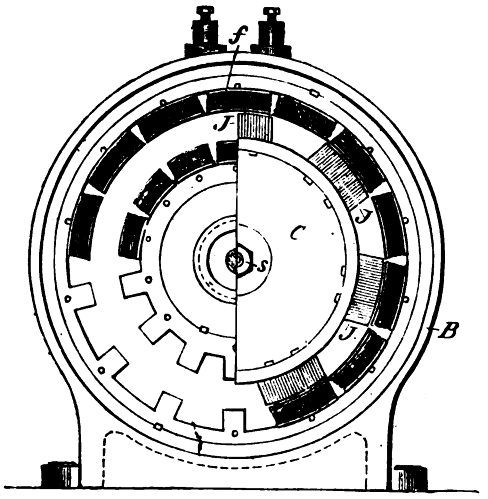
Amongst the experimenters who have done much in a quiet and persistent way in the domain of extreme high-tension and vacuum-tube research are Messrs. Pyke and Harris, who, together with Sir David Salomons, have carried out the practical utilization of phosphorescent tube lighting to a degree which, if it cannot be said to solve the long-discussed problem, is yet attended with very suggestive and satisfactory results. At various Royal Society and other *conversazioni* displays of phosphorescent tube lighting of some extent have been made, and it is with interest that we have learned particulars of vacuum-tube lighting for both theatres and private houses that have been carried out on the system thus brought forward. Mr. Pyke, in conjunction with Sir David Salomons, has been carrying out a number of experiments in this interesting and enticing field of research. Quite a large glass-blowing laboratory is kept going for the production of all kinds of vacuum tubes—a very favorite form now adopted being that of a closed coil, or spiral of thin glass tube, between two small bulbs. This coil, when made phosphorescent, gives out a fairly brilliant cool light, using, it is calculated, about one watt per foot of tube lighted.



Pyke & Harris Inductor Dynamo. Section.

The difficulty with these tubes is that when brilliantly phosphoresced they become heated, and there is trouble from melting of the glass after some interval of use. A further difficulty has been the necessity for the use of condensers to properly light the tubes, and condensers are both frail and cumbrous. In any case the light is never very brilliant—not sufficiently so, for instance, to take the place of ordinary incandescent lamps, though for the lighting of conservatories, where a soft and moonlight effect is desired, the groups of phosphorescent tubes produce an admirable effect, and many houses are now having such "glow" lamps added to the other lighting.

Before alluding to improvements that have recently been made in this class of lighting, it may be interesting to explain the principles upon which the lighting of these tubes has been carried out in experimental form.



Pyke & Harris Inductor Dynamo. Section.

An alternating current is, of course, necessary, and the inductor machine recently patented by Pyke and Harris is a very convenient form of dynamo to be used for private installations, being small, cheap and compact, though for town houses the alternate currents from the supply mains can be used. This inductor dynamo is herewith illustrated, and is worth the attention of engineers. The cut represents a machine, which will light 60 16-c. p. lamps, though but 20 in. by 15 in. by 21 in., and weighing 7 cwt. In the figure, B represents the magnetic mass forming an annular space for the inducing coil, D is the inducing coil, R and R are laminated rings with polar projections wound with armature coils, J J are laminated inductors which alone rotate, and the completion of the magnetic circuit causes the current. It will be noticed that the whole arrangement of the machine is far more solid than any other dynamo as yet in use, and for the same space occupied is the most energetic. The whole machine consists of two castings, some iron stampings and wire coils, and is thus very cheap to construct. Like machines worked on the inductor principle, it has the advantage of no rotating wire; and a further advantage is that, in case of the failure of one or several of the coils, there is a fuse arrangement attached to each connection which melts before the current from the active coils passes into the defective one.

To light the vacuum tubes, a tension of 50,000 or 100,000 volts is desired, and this is produced by a specially-wound transformer in oil, of the type that Messrs. Pyke and Harris patented and have produced for some years. This transformer is plunged in dehydrated oil, which is kept in circulation by an arrangement of tubes like those in hot-water heaters. These transformers are expensive, and have been lately replaced by a different arrangement.

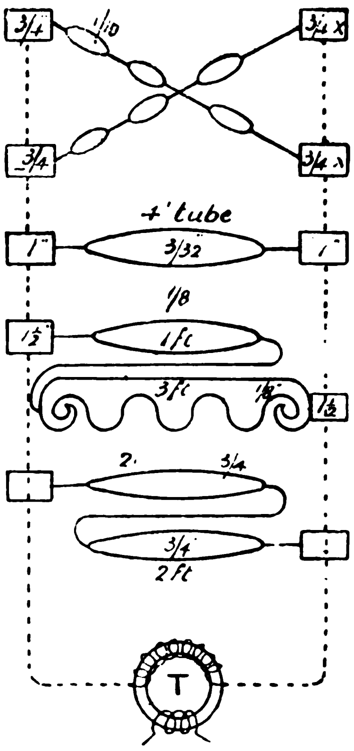
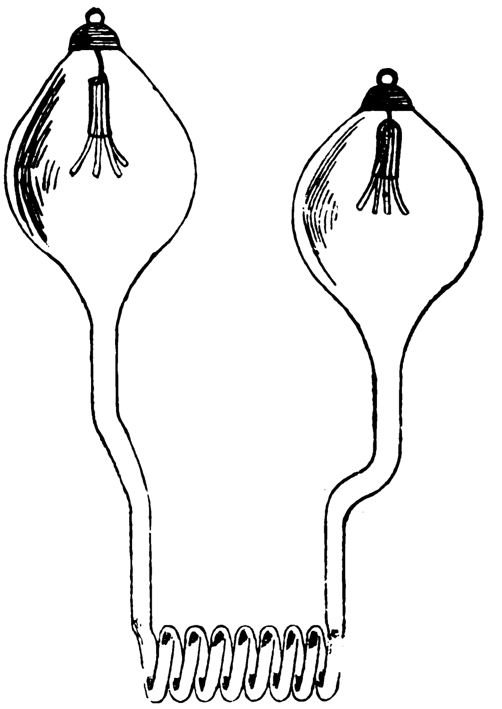


Diagram of Connections for Phosphorescent Tubes.

Having the current at high pressure, the next question is the arrangement most desirable in practice for connecting the tubes. The tubes are lighted by induction effects, and the peculiar arrangement of connecting the condensers in parallel and the tubes in series are here illustrated for the first time. Mr. Pyke has made careful experiments, and finds that to properly phosphoresce tubes of one inch internal diameter one square foot of tinfoil condenser is required. To light tubes of $\frac{1}{16}$ in. diameter, which have



Phosphorescent Tube Lamp.

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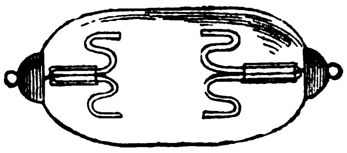
[*] *The Electrical Engineer*, London.

been generally employed, condenser sheets ¾ in. square are therefore required to give the desired effect.

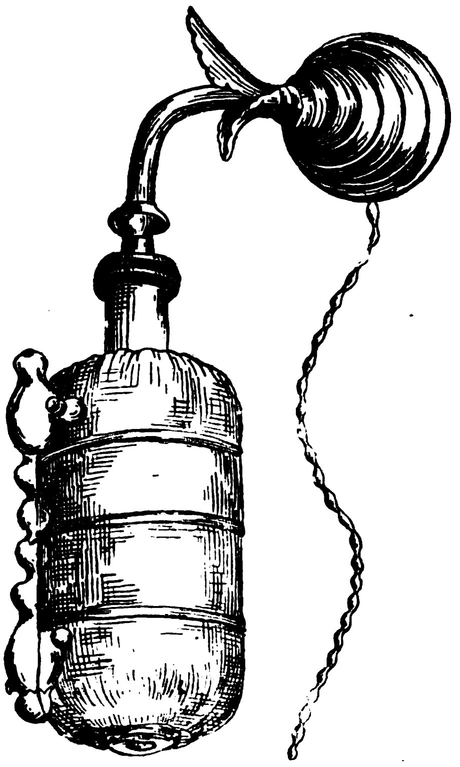
On one side of a glass plate a number of condenser sheets are arranged of the size desired, and these are all connected in parallel to the high-tension circuit, as shown by dotted lines on the figure, the dotted lines representing the under side of the sheet of glass. On the upper side the vacuum tubes are connected from one condenser plate to another, several in series, tubes of the same kind only on any wire, usually to make a total of one foot of tube. The whole of these tubes then light up on turning on the current, it being understood that they are lighted by induction condenser oscillations.



URANIUM SPRAY LAMP.

The following are the practical directions for vacuum-tube work of this kind:

Directions.—Class the tubes in average minimum internal diameter. Arrange that each tube or series of tubes in the various circuits have the same length. Tubes in each class only must be worked in series. Imagine the tubes electrically connected, then arrange the inductors with one square foot of foil ($\frac{1}{16}$ glass) to each square inch of diameter. Above one inch the current should be graduated more by the surface of the aluminium wire. Any difficulty may be overcome by cutting off one or adding to both inductors.



PYKE & SALOMONS' COMBINATION 5,000-VOLT TRANSFORMER.

So far with the methods hitherto used, now to be discarded. The difficulties are apparent—special dynamo, expensive transformer, cumbrous condensers. Experiments have been made to do without the condensers, and to construct a small but powerful transformer which can be used direct. A small closed-circuit transformer has been designed by Sir David Salomons and Mr. Pkye for use in conjunction with the supply companies' alternating-current circuits, intended to raise the potential from 100 to 5,000 volts. This is probably the smallest closed-circuit transformer yet made, and is very cheap to make, as it is capable of being sold for £1 for ordinary and experimental use. The illustration shows it attached to ordinary 100-volt mains.

The quantity of current which it furnishes at this potential is sufficient to very brilliantly illuminate vacuum tubes. Indeed, so bright are they that the photograph from which the above illustration is reproduced was taken solely by the light of the tubes suspended from the secondary terminals. The transformer, it will be seen, is provided with an attachment in the form of the usual "B. C." lampholder, the primary winding being connected to the brass contact-plates. This is a great convenience, as the connection is made, and the transformer securely held, in any conveniently placed lampholder.

We understand that Sir David Salomons intends proceeding further in the same direction, and will shortly introduce a combination similar to the above, but with the vacuum tubes permanently fixed thereon, and arranged to form an ornamental illuminating device which can be used in conservatories and other places where beauty is of more importance than a very brilliant illumination.

The curled phosphorescent-tube lamp used in these experiments is here illustrated. In practice the two bulbs are hidden, the glass spiral only being visible, and several of these lamps may be easily arranged to form letters or words. A newer form of uranium tube is also illustrated, in which the electrodes are in the form of a spray. A large number of these tubes can be connected in series, and lighted from the combination transformer.

The transformers are made by winding three primary circuits of No. 22 wire—one at each end and one in the middle—over boxwood bobbins, with the secondary of No. 40 wire in between. The whole is then wound longitudinally over and over with fine iron wire till the central core is filled, making a small and solid bundle which can be suitably covered with velvet or other material. The vacuum tubes can be mounted thereon. One very convenient point is that, as they are furnished with an ordinary lampholder bayonet joint, current at 5,000, or perhaps even 10,000, volts will be within the reach of ordinary experimentalists at a mere nominal cost. The current going into these transformers is only ½ ampere at 100 volts, and the current at the higher voltage is therefore infinitesimal—not sufficient, in fact, to give more than a slight shock.

It will be evident that high-tension currents are now within the reach of all, and we may expect further developments in this fascinating field of phosphorescent tube lighting.

The Telautograph.

Professor Elisha Gray, whose numerous inventions for communication by electricity are well known, has perfected the Telautograph, or long distance writing machine, illustrated below.

This consists of a transmitter and a receiver associated for use at one station. The structure of these instruments is remarkably simple and devoid of complication, and the mode of operation is in all respects direct and positive. The methods for transmitting the electric impulses to the line, and then converting them in the receiver into the corresponding movements of the automatic pen, are of a positive character, and are therefore not dependent upon accidental changes in conditions.

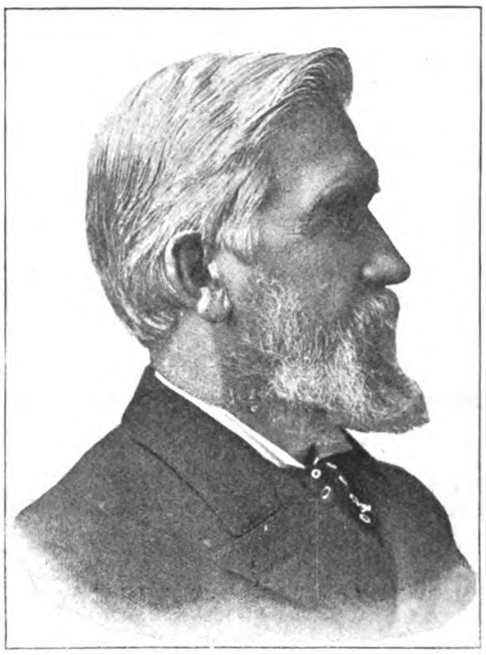
An ordinary lead pencil is used on the transmitter near the point of which two silk cords are fastened at right angles to each other. These cords connect with the instrument, and, following the motions of the pencil, regulate the current impulses which control the receiving pen at the distant station.

A lever at the left is so moved by the hand as to shift the paper forward mechanically at the transmitter and electrically at the receiver.

The receiving pen is a capillary glass tube placed at the junction of two aluminum arms. This glass pen is supplied with ink which flows from a reservoir through a small rubber tube placed in one of these arms.

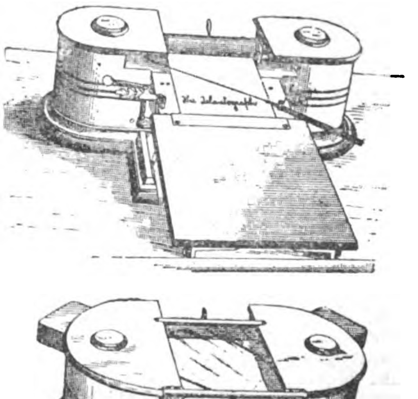
The electrical impulses coming over the wire move the pen of the receiver simultaneously with the movements of the pencil in the hand of the sender.

As the pen passes over the paper an ink tracing is left, which is always a fac-simile of the sender's motions, whether in the formation of words, figures or sketches.



PROF. ELISHA GRAY.

The Telautograph instruments are at present manufactured by the Gray Electric Company, who have erected a handsome and capacious brick building about one mile south of Highland Park, Ill., on the line of the Chicago and Northwestern Railway. This company was organized expressly to manufacture the apparatus for the Gray National Telautograph Company and has already invested $125,000 on its building and equipment. It owns a tract of fifty acres and has constructed a number of cottages for its employees. The machinery is the best procurable and the instruments turned out are samples of superior workmanship.



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R. H. WILLOUGHBY, - - ASSOCIATE EDITOR.

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Proposed Socialistic Legislation.

The comprehensive bill for the regulation of the prices for electrical current, just introduced in the Assembly by Mr. Finnegan, of Rockland County, seems to imply a necessity for additional facilities for the enlightenment of the population of that section in the field of electrical engineering. The plan proposed contemplates the establishment of uniform prices for electricity in cities of certain sizes throughout the State, without reference to the cost of production of the current, or any consideration of the conditions in various localities which affect the running expenses of a central station. It is satisfactory to note, however, that the bill contains one suggestion of common sense which evidently crept in through some oversight. The prices are fixed to apply to cities of a certain number of inhabitants.

The idea of the Legislature's fixing a uniform price for electric current is suggestive of the advantages which would ensue from a similar bill in regard to real estate, and possibly this principle might be extended to include fruits and vegetables. A consideration of fixed prices for the last-named articles might do more toward convincing our rural reformers of the fallacy of socialistic legislation than any experiments in the direction of electrical problems would, as they are undoubtedly more familiar with the former subjects.

For these legislators whose sense of duty compels them to grapple with the problem of the cost of electrical current, we earnestly commend a careful study of ELECTRICITY, which will reveal the fact that a station operating by water power where labor is cheap can sell its current for less than one requiring an expensive steam plant, and where coal and labor may be dear.

The following sample may be of interest:

> "In towns and cities of 15,000 population and under the rate of charge for electric energy for illuminating shall not be more than ten cents per 1,000 watts. The rate of charge for electric energy for power shall not be more than seven cents per 1,000 watts. In cities of over 15.000 population the rate of charge for electric energy for illuminating shall not be more than seven cents per 1,000 watts, and the rate of charge for electric energy for power shall not be more than four cents per 1.000 watts."

This certainly disposes of the matter in a very simple manner, but we fear these prices would discourage electrical progress in many localities. If a uniform price for illumination is desirable, we would suggest some amendments providing for the prices of gas, kerosene and candles.

* * *

Economic Steam Power Engineering.

It has been said, and not without reason, that the education of the electrical engineer should be nine parts mechanical and one part electrical in order to fit him to successfully cope with the engineering problems which he is called upon to solve, and this view of the case receives a strong indorsement in the valuable and suggestive paper read before the American Institute of Electrical Engineers by Dr. Emery at its last meeting. As suggested by its title, "The Cost of Steam Power Produced with Engines of Different Types under Practical Conditions," the paper treats exclusively of the mechanical engineering side of the subject, which nevertheless, is of paramount importance for the economic operation of electric central stations.

Some of the conclusions which Mr. Emery deduces are somewhat unexpected to the engineering fraternity, who have not followed this branch of the business closely, and the fact that in the most elaborately equipped stations the interest charges on the first cost of the equipment are liable to more than counterbalance the saving due to increased efficiency has escaped general notice.

Another important point is also made conspicuous in this connection. The paper shows the superior economy of operation when a plant is run continuously for the reason that the fixed charges such as interest, dividends, etc., are not proportional to the work done but are fixed for a certain definate time whether the plant runs all or only a fraction of the time.

The figures given in Table I show the compound triple expansion engines working at high pressure to be the best mode of operation for some cases, especially where coal is dear, but with coal at an ordinary price the compound condensing engine seems to show the best economy. A noticeable fact is that the high speed non-condensing engine, which has been developed through the demands of electrical central station requirements, makes the poorest showing of any of the different types of engines.

These results, however, cannot be considered as a criticism on any particular type of engine as Table I shows a decided variation in the maximum economy of different engines according to the cost of coal and the hours per day during which the plant is in operation. The value of engines of sufficient speed for direct coupling to the dynamos cannot in many cases be questioned.

The most important point which Dr. Emery's paper suggests is a careful study of the local conditions surrounding a station by the electrical engineer before prescribing any special design of steam plant, and it shows clearly the fact that no iron-clad rule can be adopted to cover every case.

* * *

"The Lamp Situation."

By methods of journalism known only to itself, the *Electrical World* has started a feeble discussion on the lamp situation in its columns. This discussion is of course not participated in by the *World* itself, but is carried on so far chiefly by anonymous writers, and by an able representative of the Bread and Butter Brigade over his own name.

The *Electrical World* has no opinions to offer on any subject except its own greatness; it is cocksure that it is the biggest freak known to trade journalism, and we agree with it.

But its opinions on the subject of the Electrical Trust, which has been recognized as of vital importance by every man in the trade for eight months, are as great a mystery to its readers as are the hieroglyphics on the Obelisk to the goats in Central Park.

The *Electrical World* long since forfeited all title to the respect of decent men. No one expected that at this late day it would begin to fulfil its obligations to the trade which has made it all that it is. It has played the coward and sneak successfully (according to its own ideas of success, which are strictly financial.) and cannot be looked to now for better things.

The numerous readers of ELECTRICITY, who number nine out of every ten men in the trade, arrived at definite conclusions on this subject some time ago.

We know of no reason, however, why it should not be discussed now in the columns of the *Electrical World*.

And when it has been thoroughly thrashed out a few times more, we suggest to our belated contemporary the following as other appropriate topics for discussion in its columns:

What was the foreign policy of Alexander the Great?

Has the monopoly of Russia in Poland been a beneficent thing for the Poles?

* * *

THE REFERENCE to the doings of the discredited Whiskey Trust by our Boston contemporary suggests the following questions: Did the Whiskey Trust take lessons in financiering from the Electric Trust? or did the Electric Trust take lessons in financiering from the Whiskey Trust? Further investigation must be awaited.

* * *

Was not Ferdinand Ward, *before his exposure*, looked upon as the shrewdest financier of his day?

* * *

Facts Cannot Be Longer Concealed. For years the stock gamblers who have controlled the fortunes of the Thomson-Houston Company have carried out their schemes in the dark. By methods known best to themselves they have muzzled the daily press of Boston, and their operations were of little interest outside of New England.

Many an entertaining story has been handed in by an unsophisticated newspaper hustler, only to be thrown in the waste-basket by the better-instructed city editor.

There is good ground for believing that this state of affairs is drawing to a close. We cite in evidence the article on "General Electric" which we reproduce in condensed form in another column.

At least one Boston newspaper has made a good start towards performing its duty. All honor to the Boston *Commercial Bulletin*; and if the *Herald*, *Traveler*, and *Advertiser* still decline to take the matter up, it will be for one reason and one reason only. We do not believe the management of these papers is for sale, but if they allow subordinates to smother this matter for a consideration, they themselves are almost equally culpable.

Passing over the matter of Mr. Edison's stock arrangements with the Lynn crowd, we come to something of wider interest—something which, probed to the bottom, reveals the rottenness of the whole Trust scheme.

That the banks of New England have been munificent backers of the Thomson-Houston and General Electric Companies is no news. An exposé of the METHODS, however, by which *bank officials* have been drawn in, and held tighter and tighter in the coils of the serpent until escape is impossible, would be news to the multitude.

The facility with which the Trust has raised immense sums of money has been looked upon as marvellous by electrical men. They know the "fishy" character of the reports given out from time to time; they know the business done, and can estimate the profits—or could if there were any. They know the value of the Trust plants is not above $12,000,000 to $14,000.000, and that the price of the stock and bonds in the market to-day is not affected at all by the actual value or *bona fide* assets. They know the problematical nature of the various stocks and bonds of local companies with which the Boston and New England banks are all but swamped, and with which the United Electric Securities Company was driven to a standstill. They do not need to be told why new financing companies are organized.

The investing public of New England, however, do not know all these things.

The daily press of Boston has a duty to perform. Its postponement will not only add to its unpleasantness, but will prove conclusively that the newspaper men of Boston are not free agents.

If these newspaper men are laboring under the delusion that the Trust can pull itself out, if let alone, and that the publication of facts will precipitate a disaster which may be avoided, they are mistaken. The disaster may be postponed; it cannot be averted.

The public has a right to know the facts, and to be its own judge as to whether it is safe to continue its investments. It has a right to know *what banks* are in beyond their depth.

The newspaper man who neglects to dig out the facts, or who withholds them from publication, has no place in the profession.

The annual statement of the General Electric Company is due on April 11. It will not be an honest statement. It will not be a statement that would satisfy any $100 stockholder in any respectable newspaper company in the country. It should be looked into.

It will show as assets the following items:

Local companies' stock.
Local companies' bonds.
Manufacturing companies' stock.
Construction companies' stock.
United Securities Company's stock.

These items should be analyzed. How many Syracuse bonds are there among the "local companies'" bonds? How much stock and bonds of local companies which are on the verge of bankruptcy? How much stock and bonds of the Brush Company, which will probably soon be closed up for good, or of the Short Company, already shelved?

All the financial arrangements of this concern may be beyond criticism. If so, why should they not be laid wide open to the public which is asked to invest its good money?

Why should an electric company more than a railroad company be allowed to conduct its business under a blanket?

There is good newspaper matter in all this.

The Boston press should also give us the names of the banks which are loaded almost to the sinking point with these "cats and dogs." They should give us the lists of the bonds of various local companies which are held as collateral by the United Securities Company against its several series of bonds. *What are they*, and what is the record and future lookout of the local companies? All humbug and "financiering" aside, this is where their values rest: on the plants themselves.

When the Boston newspaper men have gone to the bottom of this matter, and not till then, they can hold up their heads in the company of the honest and conscientious members of their profession.

General Electric.

Boston is Growing Suspicious, and Investigates.

When the consolidation of the Edison Thomson-Houston was brought about and Edison and his friends were rooted out of their soft places and fat salaries, Edison was left with 35,000 of stock. He offered it for sale at $90 per share, and on his being refused he threatened to throw it on the market. The Lynn contingent were given three days in which to arrange for its purchase.

After great pressure on the part of J. Pierpont Morgan, Edison agreed to hold his stock until April 1, 1893, upon the guarantee that it should be taken off his hands at par. The guarantee was signed by three of the prominent Lynn holders.

At the time the agreement was made, it was shown to Edison that before April, 1893, the stock would be put to 150 and he should have the benefit of the rise, and a pool was formed for that purpose. In the meantime Edison's ore concentrating scheme in New Jersey called for all the money he expected to receive for his stock. This he was enabled to borrow through the help of Villard and the guarantee of the Lynn magnates. In borrowing, Villard was careful to use only institutions, which by a strange coincidence, were largely controlled by those who were heavily interested in the Westinghouse Company.

In the middle of February, Edison through his friend and co-worker, Villard, was gently reminded that on April 1st the loans must be paid, and as they amounted to the tidy sum of $3,000,000 he had better be prepared.

In the meantime Wall Street began to be flooded with stories of bear raids, engineered by enemies who were to be punished when they began to buy back short stock; also stories of big earnings and surplus. At the same time there came a steady sale of stock which was explained on the ground of short sales; simultaneously bids were freely offered on Wall Street of 1-32 and 1-16 of 1 per cent. to borrow the stock one night, which was heralded over the country as evidence of large short interest. To show the genuineness of these bids, we are able to state that the parties who were so anxious to borrow it at a premium were at the same time offering 8 per cent. in Boston for loans on the same stock in lots of 1,000 to 5,000 shares. In fact, a certain wealthy estate not far from the Sears Building were paid 8½ per cent. for $220,000 for thirty days, secured by 3,000 shares.

The facts in regard to the short sales are these: One portion of the crowd, seeing that before April Edison stock must be sold and under circumstances that would prove disastrous to the price, began to fill all buying orders, and at the same time, by every device known to the sharpest manipulators of to-day, to keep a market upon which to sell. So well has this been accomplished that the rank and file of the old Lynn party have taken thousands of shares supposing they were buying the short stock of bad bears. To set at rest the story of the rise which is coming when the bears begin to buy back the stock they have sold, we will state that we can produce a party high up in the affairs of this big Trust who will pay a big commission to any one who will pay $100 a share for 25,000 shares.

We are also able to state, and this is of the greatest importance to the business public outside of stocks, that there are certain banking institutions in Boston that are loaning in the aggregate over $6,000,000 upon this stock.

There are outside of Boston, and inside of New England, other banks that are loaning over $2,500,000 to practically the same people, although through dummy names, or over seven times, and in one case, over thirteen times the legal limit.

To show the desperation of the people who are handling this gigantic stock-jobbing scheme, the company itself is loaning to the brokerage houses who are buying the stock and carrying it on margin enormous sums upon collateral that cannot be used in any bank in Boston at twenty cents on the dollar of the figure at which it is pledged, and the same money which they are loaning is what stockholders suppose has been used in paying merchandise bills which remain unpaid.

The case of the Whiskey Trust in using its rebate voucher cash is as nothing compared with it.

We can also state that the latest scheme for getting money out of the investing public (The $5,000.000 Electric Corporation) has been used to buy General Electric stock, but even that concern are getting so anxious to find some one to help them out of the hole they will be in when the Edison loans become due that they are trying to form a pool to buy the stock, which they are pledged to take but do not want.—*Boston Cowmercial Bulletin.*

The Brush Works.

An Order to Close Them Which Was Countermanded.

Private advices from Cleveland state that an order was recently received there to close up the Brush Works for good, but that the order was subsequently countermanded by wire.

It is understood that the reconsideration of this order was brought about in short order by Charles F. Brush who threatened if it was carried out to at once go into the manufacture of incandescent lamps on a large scale.

The inevitable must come, however, and Mr. Brush will not be able ultimately to protect the plant which bears his name.

This order explains some previous orders to the Brush Company and its various local agencies.

Not long ago it was directed that all the old machines at the Brush works be overhauled and put into salable condition; agents were commanded to *sell them*, and were for the time being given a preference over the other sub-companies' agents. It is understood that the new Illinois Central depot in Chicago got one of these bargains.

ELECTRICITY predicted some time ago that the closing of the Brush works was only a matter of a few months, and is not at all surprised.

THIS is the slogan: No man should buy one dollar's worth of supplies from the Trust which can be purchased elsewhere. Independent concerns should be aided in every practical way, and there is no more practical way than this.

"Will the Closed Conduit Supercede the Trolley in Large Cities?"

BY F. C. PERKINS.[*]

It would be folly for any one to assert that the trolley system for operating electric railways will be thrown out of use in small cities, villages and rural districts; and until some efficient, practical and reliable closed conduit system is brought before the public, the trolley will still continue to be used in the large cities as well.

A conduit system, however simple, could not compete with the trolley in the country, where long lines are necessary, and where wooden poles and a comparatively cheap line construction gives good satisfaction to the railway company and is not seriously objected to by the public.

In large cities, however, where the trolley system is so greatly objected to on account of the so-called "unsightly overhead wires," the conduit system, when perfected, will find many advocates, and be readily adopted by street railway companies interested. After looking at a street crossing in Boston with its network of wires as used in the trolley system, and then noticing the entire absence of overhead conductors in the city of Buda-Pesth, Hungary, one is impressed with the advantages of the conduit system, as well as the great difficulties under which our firemen have to work.

Regarding the cost of construction, a conduit system would compare very favorably with the trolley in cities where the authorities insist on the feeder wires being placed in underground conduits, and where an expensive line construction with iron poles, guard wires, etc., is required.

The systems now in use for operating electric railways are, first, the trolley, and second, the open slot conduit. Every one is so familiar with the trolley system that to go into details regarding its operation would be a waste of time; but we are not so familiar with the open slot conduit as it not in general use at present.

The Siemens & Halske system has been in use for some time in Buda-Pesth, Hungary. The Love system is now in operation in Chicago, and the Bentley-Knight system was operated a short time in Boston, but has not been in use for several years.

The greatest difficulty the companies using the open slot conduits have to contend with is maintaining a good insulation for the main conductors, the loss of current through leakage in wet weather being sometimes very great.

Many methods have been proposed whereby closed conduits might be used, thus avoiding the misuse of the conduit for a sewer, as is often the case with open conduits.

The Closed Conduit System is the one we wish to discuss this evening. Many patents have been granted in this line of work, and it will be interesting to study some of them.

The conduits may be divided into two groups: first, those operated electrically, such as the Lineff, Smith, Harding, Heron, Dewey and others; second, those operated mechanically, such as those of Van Depoele, Thomson, Brain and others.

The objects of the closed conduit are to do away with slotted channels, and to shut in the conductor so that neither dirt nor water can reach it and form a source of leakage.

An English patent was granted Alexander Lineff, of London, July 11, 1888. The characteristic feature of his invention is that a magnet on the car as it travels keeps attracting or drawing up fresh portions of an iron band, and thus puts the conductor proper in electrical connection with one or two sections of an upper rail, from which the current can be collected by a trolley wheel in the usual manner for driving the car. In case the connection is broken, a battery must be kept on the car to energize the magnet, in order to again pick up the iron band or conductor within the conduit.

Mr. H. W. Smith, of Newark, New Jersey, was granted United States patents March 5, 1889, for a system using a closed sectional conduit, in which the connection was made from the main bare conductor inside the conduit to the surface sections by means of small armatures mounted on bearings within the conduit. These armatures were attracted and drawn up by permanent and electro magnets mounted on the frame of the car. The permanent magnets were undoubtedly used to avoid carrying storage batteries on the car in case the connections were broken between the main conductor and the sections of the conduit. The current is conveyed to the car by means of brushes.

(*To be continued.*)

The Most Economical Age of Incandescent Lamps.[*]

COMMUNICATIONS.

Prof. Benjamin F. Thomas—I am indebted to Mr. Hering for the copy of his very interesting and valuable paper and for the opportunity to contribute a little to its discussion. All who are interested in any way in incandescent lighting must, with me, feel under obligation to Mr. Hering for the application of the O'Keenan analysis to the data of the Ohio test, and for his skilful interpretation of the results. The original paper and its discussion at Chicago established the fact that lamps last altogether too long for economical results, and also the fact that the lamp of highest initial efficiency is not always the most economical. Mr. Hering's paper now turns the conclusions there expressed in general terms into a complete demonstration, and adds other facts which will doubtless prove quite surprising to many who have made lamp questions a study. If the results are properly understood and applied, they must prove to be of great value to the lamp manufacturer, the station manager and his customers, and all who have anything to do with incandescent lamps. To the owners of isolated plants, Mr. Hering has demonstrated the importance of renewing lamps when they reach the point of minimum cost. (Why not call it the O. K. point?) It hardly seems right, however, to advise any one to run the lamps until they "die a natural death" when the amount of light afforded is not important. Economy considered, it is better to use, in such place, lamps of the lowest allowable candle power, and to renew them as elsewhere. Central station managers who furnish lamps to their patrons without specific charge for lamp renews, and who charge by meter record, will, of course, find it pays best to run the lamps just as long as they can, without causing enough dissatisfaction to seriously affect the number of customers they have. A rough calculation shows that even this class may profit by the deductions of Mr. Hering. The manager who runs a lamp 1,200 hours, instead of renewing at 400 hours, loses 12 cents of profit which he would have made on the larger current which would have passed through the lamp and meter if he had renewed at the proper time. The strength of the current which flows through the lamp diminishes as the lamp grows old, and therefore the watt hours which will be recorded will be less during the last half of the natural life of the lamp than during the first half. This is, of course, equivalent to decreasing the station output when lamps are burned as long as they will last. If we ever have lamps produced and sold at about 15 cents it will then be best for station managers of the class supposed to renew at the 400 or 500 hour point.

It is interesting to note that the man who is a customer of such a centrel station will find it profitable to buy his own lamps, even though no deduction be made in the price charged by the station. The higher average candle power of the lamps when renewed each 400 hours will enable him to light his premises equally well with a smaller number of lamps, and the saving in his meter bill will more than pay for all the lamps used, and he will have a more uniform and more satisfactory light. It seems not improbable that the central station of the future will limit itself to supplying current through its mains, the one who buys current furnishing his own lamps, fixtures, wiring, etc., and the fact last considered ought to be helpful in bringing about that state of things.

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[*] Paper read before the Buffalo Electrical Society, March 6, 1893.

[*] Paper read before the American Institute of Electrical Engineers. See ELECTRICITY, March 15, 1893.

Mr. Hering's Fig. 8 furnishes a very striking view of the relative values of several lamps as money savers. At 400 hours, lamps A, K, F and M are very close together, the extreme difference in cost of 1,000 candle hours being only 1 cent. Where the difference in cost of light is so small, it matters little which lamp be chosen, unless the the user of the light is particular about uniformity of candle power during the 400 hours.

Referring to Table IV of the paper read at Chicago,† the percentages of original candle power were, at 400 hours, for A, 74 per cent.; for F, 77 per cent.; for K, 78 per cent., and for M, 90 per cent. The M lamp is therefore best when uniformity of candle power is deemed important.

It must be borne in mind, however, that the number of lamps of each make tested was too small to base a sound judgment of relative merit on, and the above comparison must be considered as an illustration only.

Prof. Elihu Thomson—I have received the advance proofs of Mr. Hering's paper on incandescent lamps. I have very little time at present to add anything to the discussion of the matter. I think his points are well taken, but I also think he is quite right in pointing out that they are theoretical rather than practical. I think his practical rule for the running of lamps, which, as stated by the paper, is to run them until the diminution of incandescence becomes noticeable and then discard them, is a very good one. Whether to break them or not is another question. They are of course still capable of being run at a high incandescence for a short time if the voltage be increased. In fact, looking at the matter again from a purely theoretical standpoint, it strikes me that the ideal condition for running is to start the lamp at the potential for which it is made and gradually increase the potential so as to keep up a fair or uniform light efficiency regardless of the life of the lamp, letting the lamp go when it will. Of course this is not practical in most systems, but can be approximated by putting the older lamps on parts of the system which have the highest potential where there exist differences of potential. It also strikes me that the calculations will need to be varied with every change in the time of running of a lamp; in other words, if out of a set of lamps there are some which only run a short time for each day while others run a much longer time, the time for discarding a lamp will vary, theoretically, in this case. The short time lamps demand, theoretically, a higher light efficiency throughout their use.

It still remains after the discussion that we should not relax our efforts to obtain a lamp with long life, and one having an economical efficiency during that life. Furthermore, it is evident that the longer the life of the lamp, if the economy of the light production is maintained, the less in proportion becomes the cost of renewal to the other expenses. There is something to be said also on the score of the convenience of use of the long life lamps as against a lamp which runs down rapidly, which in a discussion like this is liable to be left out of the question. Where lamps require to be renewed very frequently and are somewhat inaccessible in their placing, the long life lamps have an advantage in the saving of labor.

In my opinion, the development of the manufacture of incandescent lamps will give rise to the production of lamps of short and long life to suit the varying conditions in practice and the relative cost of power to cost of lamp renewals.

Prof. E. P. Roberts—It was my intention to attend the meeting of February 21st; having, however, changed my plans and being very much rushed, I only have time to drop you the following brief memoranda:

1st. An instructive line of investigation, following the method of Mr. Hering's valuable paper, would be to determine the comparative value of lamps "L" 3.8 watts at start, 5.5 at 500 hours and "M" 4.8 at start and 5.1 at 500 hours.

2d. Undoubtedly, blackened lamps should be either destroyed or used where amount of light is of little consequence, or used for resistance racks.

3d. That as long as lamps have a 90 per cent. probability of being operated anywhere from 2 per cent. below normal voltage to from 10 per cent. and upwards above that, the practical rule, "Smash blackened lamps," should be supplemented by, "Pay the interest on $75.00 for a first-class portable voltmeter; use same frequently and systematically all over circuits and give the medicine called for by the diagnosis," which might be further supplemented by, "If, after knowing the disease, you will not pay for the medicine necessary to make a cure, do not complain if patients die young."

DISCUSSION.

Mr. W. D. Weaver—The paper of Mr. Hering is one of unusual value, not only on account of the matter contained but also from the important practical bearing of the subject.

The graphical method which Mr. Hering adopts is very interesting, and the curves enable one to easily follow and thoroughly understand the steps that lead to results that at first sight are rather startling. In this respect the graphical method is superior to an analytical one, but it has the misfortune in this case of being extremely laborious in application, and lacking in accuracy unless the curves are laid down on a large scale.

An inspection of Prof. Thomas's table giving the variation of watts with the life of a lamp shows that the rate is remarkably uniform in the majority of the tests and numerically equal to an increment of .3 watts per candle power per hundred hours. The regularity in these cases enables an analytical method of remarkable simplicity to be applied to the solution of the various problems considered graphically by Mr. Hering, the development of which is as follows:

Let T=total cost of one-candle power of light for a given number of hours.
" Y = average hourly cost during the same period.
" a = cost of lamps per candle power.
" b = cost of one electrical horse power per hour delivered at the lamp.
" w = initial watts per candle power.
" k = increase of watts per candle power for each hour of the life of the lamp.
" x = hours that the lamp is used.

Assuming that the increase in watts per candle power is by equal increments for equal increments of the time the lamp is burning, the watts being used at the time x are $w - k\,x$, and the total watts used up to the time x are

$$\int (w + k\,x)\,d\,x = w\,x + \frac{k\,x^2}{2}$$

The total cost, including the lamp cost, is therefore

$$T = a + \frac{b\,w\,x}{764} + \frac{b\,k\,x^2}{2 \times 746}$$

The average cost is

$$y = \frac{T}{x} = \frac{a}{x} + \frac{b\,w}{746} + \frac{b\,k\,x}{2 \times 746}$$

which is a minimum when

$$x = \sqrt{\frac{2\,a \times 746}{b\,k}}$$

If A is the cost of a 16-candle power lamp and K the increase of watts per hour for a 16-candle lamp, the formula becomes

$$x = \sqrt{\frac{1492\,A}{b\,k}}$$

The value of k from Professor Thomas's experiments is .003 and consequently $K = .048$; substituting we have finally for the life, L, or the "smashing point,"

$$L = 176 \sqrt{\frac{A}{b}}$$

By substituting the corresponding values of a and b, the minimum values of the life measured from the final curves laid down in the graphical method are at once obtained from this formula, and it is remarkable that such a simple equation can replace a graphical method so unusually involved. The accuracy of the method of course depends upon the assumption in regard to the arithmetical increase of watts with the life of the lamp, but an inspection of Table I shows that in most cases an error in this respect is less likely to cause a serious error in the final result than the graphical method, unless the scale of the latter is large.

A singular deduction from the formula is that the "smashing point" does not vary with the watt efficiency of the lamp. Consideration, however, shows that the factors of the question of efficiency are merely the relation between the hourly lamp cost at a given time and the increment of lamp energy at the same time, and as this is independent of the watt efficiency of the lamp, the latter does not enter.

As the most economical life varies directly as the square root of the cost of the lamp and inversely as the square root of the cost of the power, considerable variations in these values will not introduce large ones in the value of L, as the following table shows:

VALUES OF L.

	$b=$ 10 cents.	$b=$ 4 cents.
A 35 cents..........................	383	510
A 45 "	370	590
A – 55 "	404	650

The formula just deduced is based upon a constant value of K. Where this value varies materially, the following arithmetical method enables the "smashing point" to be determined, and also gives the ordinates of the curve showing the variation of the average cost of the unit light, the same that Mr. Hering constructs graphically.

In the tables below, which are based on lamps A and M of Prof. Thomas's experiments, the hours the lamp has been used are in column A, and the watts at the end of each 100 hours in column B. The increase for each 100 hours is in column C, and the total increase at the end of a given period in column D. The cost of this increase at 15 cents per 1,000 watt hours is given in column E, and the average cost per 100 hours in column F, while column G gives the corresponding average cost of the lamp per C. P. per hundred hours, the cost of a 16 C. P. lamp being assumed 45 cents. Column *H* gives the gain per c. p. per hundred hours from the continued use of the lamp, and column *I* the loss, these quantities being the sums of the values in columns *F* and *G*, and corresponding to the ordinates of Mr. Hering's curve E.

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† Transactions, American Institute, Vol. IX., p. 271.

Referring to the first table, it will be seen that at 300 hours the average cost of the increased watts required to maintain the unit length is .8 cent per hundred hours, while an average of .94 cent is saved by continuing the use of the lamp; at the end of 400 hours, however, these quantities are 1.031 and .7 respectively, showing that the cost of the increased power has become greater than the saving from the continued use of the lamp. The exact time when the average increased power cost is equal to the average lamp cost is the "smashing point," and may be determined approximately by a proportion between the quantities for 300 and 400 hours.

The following formula enables the quantities in column *D* to be quickly calculated :

$$D=\left(na+(n-1)b+(n-2)c+d+\right)-\frac{a+b+c+d+}{2},$$

where n = the hours in hundreds and a, b, c, d, etc., the values for 100, 200, 300, 400, etc., hours from column *C*.

LAMP A.

A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*
0	3.9	0	0	0	0	0	....	....
100	4.3	.4	.2	.3	.3	2.81	2.51	....
200	4.6	.3	.75	1.125	.56	1.40	.84	....
300	4.9	.3	1.6	2.40	.80	.94	.14	....
400	5.2	.3	2.75	4.125	1.08	.70	....	.38
500	5.5	.3	4.2	6.30	1.26	.56	....	.70
600	5.8	.3	5.95	8.925	1.48	.46	....	1.02
700	6.1	.3	8.	12.	1.71	.40	....	1.31
800	6.4	.3	10.35	15.52	1.94	.35	....	1.59
900	6.7	.3	13.0	19.5	2.18	.31	....	1.87
1000	6.8	.1	15.85	23.77	2.37	.28	....	2.09
1100	7.0	.2	18.85	28.27	2.57	.25	....	2.32
1200	7.1	.1	22.50	33.75	2.82	.23	....	2.59

Minimum at 324 hours.

LAMP M.

A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*
0	4.8	0	0	0	0	....	....	....
100	4.7	—.1	—.05	—.075	—.075	2.81	2.88	....
200	4.7	.0	—.15	—.225	—.112	1.40	1.47	....
300	4.8	.1	.05	.075	.025	.94	.91	....
400	4.9	.1	.2	.3	.075	.70	.62	....
500	5.1	.2	.5	.75	.15	.56	.41	....
600	5.5	.4	1.1	1.65	.276	.46	.18	....
700	5.8	.3	2.05	3 075	.44	.40	....	.04
800	5.9	.1	3.1	4.65	.58	.35	....	.23
900	6.1	.2	4.5	6.75	.75	.31	....	.44
1000	6.1	.0	5.9	8.85	.88	.28	....	.60

Minimum at 680 hours.

Mr. Hering—The formula given by Mr. Weaver is certainly very interesting. I have not had an opportunity to examine it carefully, but if it is correct, which I do not doubt, it certainly is a valuable formula. But it seems to me that it is applicable only in a general way, that is, it might not show all the characteristics of the different lamps, because it is based on a uniform rate of variation in the efficiency of a lamp. It does not seem to be correct for the two ends of the curve, but that is perhaps of little importance as long as it is correct in the neighborhood of the minimum point and as long as its application is limited to that point only and not to any other parts of the curve. It seems to me that by using this formula the characteristics of the curves of different lamps, which are caused to a great extent by their different rates of increase of the watts per candle power, would be lost, or in other words, curves constructed for different lamps would probably be parallel; but as the important part is the minimum point, this objection may not be of much importance. I am very glad to see such a simple algebraic formula for determining this point, as it makes such deductions as these much more valuable. It should be remembered, however, that it is to be used only in the neighborhood of the minimum point. Before endorsing the formula, however, it would be well to see how closely the results for each of the different lamps agree with those in Fig. 3. The arithmetical calculations are not as tedious as might at first seem; a curve could probably be calculated in ten or fifteen minutes.

The method which I used for calculating the results is purely arithmetical and not graphical; it is merely the final result which is given graphically because it shows so much more than a column of figures would. Although Mr. Weaver's second method of calculation, shown in the tabulated matter, is interesting, it involves more calculations and more work than the simple arithmetical methods which I used; besides, curves appeal to one much more than a column of figures do, particularly when two sets of similar figures are compared with each other. As there is no need of great accuracy in determining the best age, it is not unlikely that the purely arithmetical method used in the paper might after all be the simplest, especially when the data is not given in as convenient a form as in Prof. Thomas's paper.

Mr. George Hill—We should all feel grateful to Mr. Hering for again calling attention to this important subject, and those of us who have to look after clients' interests predict probable results and the like should appreciate these simple curves that will enable us to reach approximate results with considerable accuracy, while the formula that it called forth in the discussion will enable us to come still closer.

Apart from the perhaps insufficient data on which the conclusions were based, which were insufficient for very exact results or broad generalizations as to costs, but were ample for the underlying truths, the matter of interest should have been considered as one easily introduced, and under certain conditions materially affecting the result.

For example, take the case of a factory running the lamps a few hours per day during nine months in the year—say the lamps cost $0.35, the power $0.04 per K. W. hour, 16 C. P. lamps, and life of 500 hours, current would cost $2.27 and interest $0.136, making the total $2.41; this is, of course, 6 per cent. per annum, which is too much to neglect. Or take an office building with some of the lights burning the same number of hours as those just noted, then with power costing $0.15 per K. W. we should have the total cost, including interest at 6 per cent., $8.00 for the 500 hour life, while in the same building there would be lamps burning 9 hours every day, and, as a consequence, being renewed every 55 days for a 500 hour life, the cost of which, taking interest into account, would be for the first $7.62; for the fifth, at the end of the year say, $7.90, and for the eleventh, or the second year, $8.35; a gain at the end of two years of $0.73, or 9½ per cent. The investigation could be carried along this line much farther with interest, but it is not the line from which the best results can be obtained.

No one who has kept posted has been willing to deny that there was an economical limit or "smashing point" in the life of the lamp, and many have thought that it was about 400 to 600 hours ; in fact, two years ago I wrote a specification for a plant that we were installing calling for an initial efficiency of three watts per candle and a life of 600 hours, which was hardly commercially possible then, although one manufacturer thought that he could comply with the conditions. This was done simply as the result of something that I heard or read and does not deserve any particular credit.

The point that is most desirable of solution in my mind is : How can we take advantage of this knowledge in a practical way in the operation of our plants ? How can the manager of the small central station replace the lamps that are not doing their full duty or are taking too much current? In my own house I have some lamps that have been unchanged for nearly five years, burning an average of two hours per day for 270 days in the year, which would be a life of about 2,700 hours. They have been satisfactory, as they are all hall lights and not easily reached and have never been changed.

There should be, first, a new curve plotted, or a new formula deduced, with the element of the wages of a lamp collector added so as to get a new economical life, and then, second, some form of apparatus devised that would make it easy to determine the efficiency of each lamp. Possibly the candle power test spoken of by Mr. Hering if applied as a photometric test by the station management would be the simplest, but if we wait until there are complaints about the light we shall certainly run the lamps far beyond the economic point. Under such conditions we could call for a testing apparatus in each installation and instruct those who were to run it in its use, so as to do the best that present knowledge permits of for our clients.

Prof. Thomas's conclusion from Mr. Hering's paper is that the development of the future will be in the line of the central station furnishing so many watts of energy to the consumer to do as he pleases with, and he may be right for central station cases, although I am disposed to think that it would be found to be economy to exercise an oversight in these matters, the station taking away the lamps every few months, replacing them with new ones, testing those taken away, rating them and using them on circuits of known duty, and instead of charging for the renewals, lumping it in the charge for current. For the isolated plant, especially in large office buildings, the owner as a matter of course supplies the tenant with light, and there he must look after the lamps himself or waste much energy, since he is only required to supply a certain amount of light, and if the lamps are dull there will be more turned on until finally all the lamps are in use and then when they are insufficient there will be a complaint and an increase in the output of current of about ten per cent. Keeping in mind then the lesson of the paper, it will be seen how necessary it is to have some way of watching the lamps that is quickly applied; then the engineer of the building would each month change all of the lamps, test them, put those that are nearly used up in the halls, and new ones in the offices, so keeping them always under supervision, and smashing them when the proper time comes.

Mr. Townsend Wolcott—Mr. Howell read a paper[†] before the Institute April 10th, 1888, in which it was assumed that the watts per candle power for a given lamp were constant during its life. Yet, notwithstanding this assumption, it was pointed out in the discussion that a lamp could live too long, its efficiency being impaired by blackening. Mr. Howell stated that the relation between cost of power and first cost determined the most economical life of lamps; that is, the greater the cost of power in relation to the first cost, the hotter we can afford to burn the lamps. The cost of lamp manufacture (or at all events the selling price of lamps) has been reduced since that time, while that of power has not, and it ought to pay to burn them hotter, and I should be glad to see that done. I do not consider that a bottled angleworm is a suitable light. The incandescent lamp lacks just a little of being a beautiful light : just when every one begins to admire the light we find that we are away above the voltage marked on the lamp. In some places where lamps are run from existing power, or where the cost of power is not considered, they think more of the cost of lamps than anything else. In one place I have in mind 112 volt lamps are run from a dynamo which does not give above 110 volts. Where a good light is required the tendency is to use them up quicker. Although Mr. Hering's paper starts from a very different basis from Mr. Howell's, it leads to the same conclusion so far as the most important point is considered, namely, that we can afford to have better light than we have been getting.

[†] TRANSACTIONS, Vol. V., p. 237.

The Present Status of the Storage Battery.

BY JAMES K. PUMPELLY AND C. SORLEY.*

In order to put before you in a concise form the status of the storage battery at this date, it is necessary to go somewhat into its past history. Planté in 1860 published to the world the fact that he had discovered a method of storing electricity by using certain metals immersed in certain solutions, and that he had obtained the best results from sheet lead immersed in dilute sulphuric acid and subjected to a long process of alternately charging, discharging and reversing for the purpose of forming a layer of active material upon the surface of said sheet lead; unfortunately this process of forming the active material was very costly, owing to the great length of time required.

In 1881 Faure brought out a battery in which he used the same material; namely, lead and dilute sulphuric acid, but instead of making the active material out of the plate itself as Planté did, he applied active materials or materials to become active to the plates, in the form of a paste, paint or cement. This was a great advance so far as cost of production is concerned, but not when viewed from other standpoints, as it introduced some very serious defects, the greatest of which was the liability of the active material to scale off, or in other words to become detached from the plate. This would only cause loss of capacity, due to loss of active material, but these scales were liable to lodge between the plates and short-circuit the battery. The aim therefore of all makers of storage batteries since the Faure battery came out has been to so construct a battery that it should be impossible for the active material to fall off the plates. This has been accomplished in various ways, but almost invariably the result has been the introduction of another serious defect, namely, greater internal resistance and therefore less efficiency, for if the internal resistance is increased it will necessarily take a greater E. M. F. to put a given quantity of current through the battery, while in discharging this internal resistance will be added to the external resistance of the circuit and cause a corresponding loss in the discharge.

One of the greatest stumbling-blocks in the way of inventors who have tried to find a means of keeping the active material from falling off the plates has been the universally accepted idea that it is absolutely necessary to have a free circulation of the solution. Mr. Sorley and I after a long series of experiments have found that this is not necessary, providing a porous and also absorbent substance (capable of absorbing the sulphuric acid as fast as it is made in charging) has been placed between the plates.

This is a very important discovery, for it not only makes it impossible for the active material to fall off or out of the plates, but it enables us to jam the plates up close together, and so make one solid compact mass of the element, without any free solution to spill over everything when the battery is used for traction and other analogous purposes, and it also adds a number of years to the lifetime of the battery, for when the positive plates have become peroxidized nearly through, and would not be able to support their own weight (if made in the old way where every plate stands alone) by this method, the negative plates which never wear out will support them, and it also enables us to lower the internal resistance by bringing the positive and negative plates much closer together.

We have also found that no matter how well a battery may be constructed it is not possible to get as good results from one constructed upon the Faure principle (that is to say, with a mechanically applied oxide) as can be obtained from one made on the Planté principle. This brings us down to the question, can a Planté battery be made a commercial success? that is to say, can the electro chemical process of forming the active materials out of the plates itself be shortened from several months to a few days or hours?

We are glad to be able to answer that question with an emphatic "yes." By a process discovered by Mr. Sorley, and which after seven long months of costly experimenting by Mr. Sorley and myself, we have succeeded in developing a Planté battery in which the active material is made electro-chemically in one hour and fifty minutes. We are glad to produce before you one of the batteries containing all the latest improvements as I have described them.

It has been said that storage batteries will never do for street-car work, owing to the fact that when a car is climbing a heavy grade the demand on the battery for current is so great that it will not maintain its E. M. F., and that consequently when you exceed a certain number of amperes the voltage falls in proportion and you do not get any more watts, or in other words, although you are discharging the battery at a greater rate you do not get any more energy. Now this is true to a certain extent of a battery made with a mechanically applied oxide, but not of one wherein the active material is electro-chemically made, as Mr. Sorley will illustrate to you with the battery before you, which contains an element that only measures 6" × 6" × 6½", but which has a capacity of 177.7 ampere hours at a discharge rate of twenty-three amperes. He will show you that it is possible to discharge it as high as 75 to 85 amperes for say twenty minutes, which is ample time to climb a grade, and that this discharge of say 80 amperes for twenty minutes will not lower the voltage more than one 5-100 of a volt, that is to say, the E. M. F. during this large discharge from so small a cell will remain constant at 1.95 volts.

Now this E. M. F., with the usual number of cells that are placed in a street-car series, would produce at the terminals of the motor (at the above discharge rate of 80 amperes) nearly 21 horse power, or accurately 20.9 H. P.

Allowing that the test is to a great extent convincing to you, you will naturally ask, how do you know that this form of Planté battery will be any more durable, or that the plates will remain firm and intact any longer than the pasted or mechanically applied oxide plate.

In answering such a question we have to judge by our experience and our knowledge of the chemical action on the plates. The constant tendency of this chemical action on the pasted plate is that of slow disintegration caused largely in our opinion by the impurities that are introduced into the plate in the oxides of lead which are mechanically applied, whereas all the impurities which may be in the lead plate itself are dissolved out, and remain in the first solution, and consequently the peroxide and spongy lead that are subsequently formed are made out of perfectly pure lead, and there are no longer any chances of disintegration arising from local action. While on the subject of rolled lead, it would be proper to mention that the plate in this cell before you is made from one integral sheet of lead ⅜ of an inch thick and prepared for treatment by a new method patented by us, which does away with all joints or soldering, thus avoiding any chance for local action.

And aside from this, the process greatly cheapens the cost of making the plate.

One fact we have learned to aid us to a further conclusion, and that is, that when pure rolled lead (such as this battery is made of) is used for the electrodes the plates are far more durable than when constructed of cast lead, even when the active material is mechanically applied, and we know of plates so constructed that have lasted for five years. In conclusion we wish to say, for lighting purposes where weight is not an objection there is no reason why a storage battery should not be made that would last for twenty years, and this being the case there is no reason why storage batteries should not take the place for electricity that the gasometer now takes for gas, that is, act as a reservoir from which to distribute current from central stations.

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* Read before the Chicago Electric Club.

Personal.

Mr. Robb Mackie, city electrician of Cincinnati, has resigned that office to accept the position of chief engineer of the C. & C. Electric Company's factory and construction works in New York.

Mr. Elliott O. Johnson, who enjoys a wide acquaintance throughout the electrical field, is now located in a cosy office, 620 Atlantic avenue, Boston, as agent of the Redding Electric Company, Boston; Heinze Electric Company, Lynn; Holmes, Booth & Hayden, Waterbury, Conn., and other leading firms.

Mr. Orlando W. Hart, whose electrical inventions have brought him into prominence, has been appointed New England agent of the Ford-Washburn Storelectro Company, Cleveland, Ohio, and is now located in Room 33, 620 Atlantic avenue, Boston.

Mr. J. H. Rothamel, President of the Columbia Lamp Company of St. Louis, was in town last week. Mr. Rothamel expressed great confidence in the favorable outcome of the suit against his company, which comes up for hearing on April 11.

Mr. George A. McKinlock, treasurer of the Central Electric Company of Chicago, was in New York last week on a business trip, and has returned to Chicago.

A San Francisco Man Has One.

Another incandescent lamp is about to be launched upon the market by a San Francisco man who sends us the following description but withholds the details of the device pending the issue of his patents therefor. Of this he says: "I can, however, state to you that in my lamp, which is an entirely different light from the two systems now in existence, the carbon pencils burn in direct contact with one another and feed by gravity. These carbon pencils are, however, smaller in diameter than the arc light carbon pencils. The lamp is much smaller than arc lamps and readily admits of lights from 100 C. P. to 1,500 C. P. per light. The light is absolutely steady, with a steady current, as you may readily conceive from the actual contact of the pencil points. This gives a perfectly white light and a light which is quite agreeable to the eyes, even more so than our present incandescent light. In fact the light in question is an electro-chemical light. It requires an E. M. F. of from 3 to 6 volts and from 5 to 50 amperes according to the C. P. required. For instance, I have attained as one of my best results a 300 C. P. light with 5 volts and 12 amperes (60 watts), or 5 C. P. per watt. This result was attained with the direct current."

"From all the tests so far made it is apparent that the above system of lights and lamps is much better adapted for the alternating current. With this we obtained a light of 500 c. p. with a current of 5 volts and 15 amperes (75 watts), or 6.6 c. p. per watt.

"The lamp run from the alternating current is perfectly noiseless and steady, exactly the same as from the direct current. One of the reasons why the alternating current gives better results is that both carbon points burn equally and give an equal amount of light, while in the direct current the upper or positive carbon burns more and gives the most light of the two."

Boston Notes.

It is a long time since those engaged in the electrical business in and around Boston had their curiosity so aroused by an announcement as was the case with the unique query on inside cover of ELECTRICITY this week, "Who said a New Lamp?" "There's a Hen on" tickled the boys' risibilities and made them titillate till their sides expanded to well nigh bursting point. Judging from the way our office was besieged by messenger boys with orders for copies of ELECTRICITY, the entire fraternity might have been notified by wire over night to look out for a startling announcement concerning a new lamp. They were not disappointed, and all stand at this moment ready to doff their hats and exclaim, "Hail to the new lamp!"

An electric device has been invented by a Lynn man for turning over the leaves of a piece of music during its performance. A company, largely composed of piano manufacturers, is being organized in Philadelphia for placing this device on the market.

Next to the excitement caused by our own *exclusive* intimation about a new lamp, the subject of overcharges in the price of gas by the Bay State Gas Company is agitating everybody's mind from the Mayor down. Vulgarly speaking, the City Fathers, including Mayor Matthews, have got their dander up and before their wrath abates the big Gas Trust may find itself compelled to take a tumble in price.

One of the councilmen in the City of Lynn, Mr. G. B. Grant, connected with the factories of the General Electric Company of Lynn, has been discussing the question of how to introduce electric fire engines into that city. He is of opinion that the city could supply itself with many powerful fire engines by making use of the street railway tracks and electric power. A suitable railway truck could be fitted with pumps of great capacity, propelled quickly to the scene of a fire, and throw streams far exceeding in efficiency those of the steam engines now in use. He suggests a Knowles, Blake, Worthington or other type of pump, which, operated by electric power, could be made to throw at least nine times the quantity of water an ordinary steam pump throws.

The Electrical Corporation, which was organized a few days ago in Boston, includes some of the wealthiest men in Massachusetts. Of course it is but another limb of the General Electric Company, as is proven by the names of Mr. C. A. Coffin and Mr. J. R. McKee, as well as several others being in the list of incorporators.

At the annual dinner of the Oxford Club, Lynn, on Tuesday evening, Professor Elihu Thomson was one of the speakers and on his name being announced it was received with loud applause, the toastmaster introducing him as a man whose genius was only exceeded by his accomplishments and modesty. Professor Thomson then briefly reviewed the early days of electrical science and works. Michael Faraday, he said, laid the basis of the achievements of the last fifteen years. Could Faraday come back to-day and see the dynamo machines now constructed and built on the principles he laid down, he would most likely say: "What a giant my infant has become." The day may come when it will be possible to produce the electric light with a fraction of the energy now expended. From the incandescent lamp there was now being obtained much less result from the power expended, and the same might be said of the arc light, than may be the case in the future. There were many wonders yet to be disclosed, many phenomena yet to be explained, but the greatest mystery man had yet to encounter was the mystery of our own thought and mind—the mystery that enabled him to say, I am here."

Chicago Notes.

Henry L. Walker, secretary and treasurer of the Detroit Dynamo Company, was in the city for a few days this week.

Lucius E. Marple has joined the official staff of the Chicago-St. Louis Electric Railroad.

Mr. B. F. Harris, Jr., president of the Urbana and Champaign Electric Street Railway, was in the city this week, and left a few orders among the supply houses.

Mr. Floyd Short, until recently with the Remington Typewriter Company, has accepted a position as advertising representative of *Electrical Industries.*

W. H. McIntyre, the leading spirit of the electric light plants at Garrett and Auburn, Ind., was among the week's visitors in Chicago.

The Chicago City Council has passed several ordinances granting charters for extensions and additions to the different electric railways located in the southern and western portions of the city.

Flattering reports are made on the Westinghouse stopper lamps which are now in use in this city. They are reported to be fully equal to the lamp formerly made by the Sawyer-Man Company.

General News.

What Is Going on in the Electrical World.

Peterboro, Can.—The Canadian General Electric Company has been granted the franchise for an electric street railway in this city.

Norfolk, Neb.—A new electric light company is being organized here which proposes to do cheaper lighting than the old company.

Spring Valley, Minn.—An electric light company has been organized here, with D. F. Farmer president and John Leuthold secretary.

Ottawa, Can.—An English syndicate, it is reported, are taking steps to buy up and amalgamate all the gas and electric light companies in Canada.

Nashville, Tenn.—Not a single bid was received by the Board of Public Works in response to their call for proposals for furnishing public lights for the city.

Manchester, Va.—The proposed electric road between Petersburg and Manchester will certainly be built if the Manchester council grants the franchise asked for.

Kingston, Jamaica.—A contract has been entered into with the local branch of the Thomson-Houston Electric Light Company to light the city with electricity.

Atlanta, Ga.—The Atlanta City Railroad Company and the East Lake and Decatur Street Railway Company have united and the name of the latter company is dropped.

Texarkana, Tex.—Judge B. T. Estes has been elected president of the Gas and Electric Light Company, Geo. Fouke vice-president and Wm. Enfield secretary and treasurer.

Garfield, Wash.—The population of this town is slightly over 1,000, but the people are spirited and are going to have a new water system, electric lights and other modern improvements.

Celina, Ohio.—P. C. Burns, of Peru, Ind., has leased the Lock Factory building, and will begin at once the manufacture of all kinds of electrical supplies. One hundred hands will be employed.

Staten Island, N. Y.—The State Railroad Commission has approved the application of the Staten Island Belt Line Railroad Company for a change of motive power from horses to electricity.

Albany, N. Y.—Mr. Cahill has introduced a bill in the House to reduce telegraph rates inside the State to 15 cents for ten-word messages during the day and the same price for twenty words at night.

Woonsocket, R. I.—The Blackstone Valley Electric Railway Company intend to construct an electric line through Northbridge to Whitins. The line will connect with the Millbury and Worcester road.

Jackson, Mich.—The Jackson Electric Light Company have begun the erection of new buildings and are making extensive additions to their plant to meet the demands for additional power for the new electric line, etc.

Oxford, Pa.—There is a strong demand for an electric railway line between Oxford and Newark, Del. The distance is sixteen miles, and the proposed line would unite several villages and would be of great advantage to farmers along the route.

Niagara Falls, N. Y.—A large party of students from Cornell University, accompanied by Prof. Carpenter, last week visited the plant of the Cataract Construction Company and inspected the wheel pits and tunnel for the electrical plant.

Homestead, Pa.—All of the old machinery in certain mills of the Homestead steel works is being torn out and new machinery to be operated by electricity is being substituted. The new system will do away with the services of many employees known as "hookers."

Hoboken, N. J.—The new power station of the Hudson Electric Company has been completed at a cost of $250,000. The opening of the station occurred on the 18th, and a feature of the celebration was the running of the first trolley cars over the Fifteenth street extension.

Trenton, N. J.—A Philadelphia dispatch states that a syndicate in which Colonel E. de V. Morrell is a leader is about to apply for a charter for an electrical trolley road to extend from Philadelphia to Trenton. The towns between the two cities will form links in the system.

Rome, Italy.—The streets of this city are shortly to be lighted throughout by electric lamps supplied with current from dynamos located at a cascade at Tibur, in the Alban hills, twenty miles from Rome. The plant is known as the Tivoli long-distance power transmission system.

Coatesville, Pa.—Coatesville has been selected as a site for the power plant for the new Philadelphia and Lancaster electric railway. The council in granting the company the right to operate a road through the town made this a provision of the ordinance. The works will cover several acres of ground and will cost over $400,000.

Cardington, Ohio.—B. F. Jackson, of Chesterville; Harry True, of Marion, and Henry Cassell, of Fredericktown, have in contemplation the building of an electric railway from Marion to Mt. Vernon, by way of Mt. Gilead, Chesterville and Fredericktown. Electrical engineers have been consulted in regard to the route and have reported favorably.

New Paltz, N. Y.—There is talk of building an electric railroad between New Paltz and the Hudson River this spring, with possibly an extension to Lake Mohonk. B. Van Steenburgh, of New York, who has bought the stock of the New Paltz Turnpike Company and has just completed an electric light plant in the town, is at the head of the movement.

Youngstown, Ohio.—The Youngstown Electric Street Railway Company have awarded contracts for the construction of a belt line of electric railway around the city.—The right of way has already been secured for a line from here to connect with the Niles and Mineral Ridge line, and stock is being raised for an electric road to run from Canfield to Youngstown. Citizens of Poland and Hubbard are also agitating the question of electric railway communication with Youngstown.

New Orleans.—Isaac N. Seligman, of the banking house of Seligman & Company, New York, on his arrival here a few days ago, was interviewed by a reporter who quotes him as saying that he came to New Orleans "for the purpose of looking after the large interest which our firm and friends control in the street railway system of New Orleans, as well as in its electric light system. . . . We expect to spend between five and six million dollars in this city the next two years, the greater part of which will be expended in the conversion of the present mule system to the electric system."

Glens Falls, N. Y.—Interest is aroused here in a project which will probably be carried into effect if the men reported to be concerned in it take hold. The scheme is to build a dam across the Hudson a few miles above this place, and use the water power thus obtained to operate an electric plant to be established there, to furnish Glens Falls, Sandy Hill, Fort Edward, Saratoga, Fort Ann and Lake George with electricity for street and house lighting and power for running small motors, etc. Among the men mentioned in connection with this scheme are H. R. Leavens, M. O. Brown, E. B. and O. S. Potter and T. S. Cooledge.

Boston, Mass.—The president of the Germania Electric Company, Leopold L. Schlegelmich, says that if the company's business had not been hampered by injunctions the assets would exceed the liabilities two dollars to one. The injunctions have for the present caused the company to cease the manufacture of lamps, and as this was an important part of the articles manufactured it has been a serious drawback to the company. The company had been running about three years, having been organized under the laws of Maine in 1890, with an authorized capital of $250,000. It succeeded the Schafer Electric Manufacturing Company of Cambridgeport and removed the plant to Marlboro.

New York.—At the annual meeting of the Commercial Cable Company on the 20th inst. the report of the president was presented showing gross earnings for the year 1892 of $1,890,377; the net revenue was $1,099,587, an increase of $14,263 over the preceding year. The board of directors were unanimously re-elected as follows: James Gordon Bennett, A. B. Chandler, George S. Coe, C. R. Hosmer, G. G. Howland, R. Irvin, Jr., J. W. Mackay, J. W. Mackay, Jr., E. C. Platt, T. Skinner, Sir D. A. Smith, W. C. Van Horne and George G. Ward.—The Commissioners of Charities and Correction advertise for bids for electric light plants for the insane asylums and other buildings on Ward's Island and Central Islip.

Cleveland, Ohio.—There is talk here of a plan to construct an elevated road, operated by electricity, from the Public Square to Lakeview Cemetery, five miles distant. The line would compete directly with two electric surface roads. New York capitalists are credited with the conception.—At the annual meeting of the Brush Electric Company the following officers were elected for the ensuing year: W. H. Lawrence, president; John S. Bartlett, first vice-president; C. A. Coffin, second vice-president; W. B. Bolton, general counsel; B. F. Miles, treasurer; A. H. Hough, assistant treasurer; S. M. Hamill, secretary; L. B. LeVake, assistant secretary; J. F. Hughes, auditor, and S. M. Hamill, general manager. The executive committee will be composed of W. H. Lawrence, C. A. Coffin and J. S. Bartlett.

Newark, N. J.—Boston and Cincinnati capitalists have completed the purchase of all the capital stock of the Orange Cross Town Railroad, and the line is to be extended to Montclair on the north and to near South Orange avenue on the south and equipped with electricity. A number of branch lines will eventually be built.—A fire at the United States Electric Light works on Wednesday last caused a loss of about $10,000.—The certificate of organization of the New Jersey Light and Heat Company says the business of the company is to manufacture, purchase and sell machinery, apparatus, devices and materials required to be used for making and using gas and electricity for light, heat, power and all other purposes, etc. In New Jersey the places of business given are Jersey City, Newark, Hoboken, Paterson, Orange, Elizabeth, Trenton, Camden and Harrison.

Detroit, Mich.—The Detroit electric lighting bill, recently passed by the Legislature, provides as follows: Detroit's public lighting shall be in the hands of six commissioners to be appointed by the mayor and confirmed by the common council. If the council so determines and the people concur, a plant may be bought for not over $800,000, the commission doing all the business of buying and running it. The commission shall not engage in commercial lighting. If the council determines to light the city by contract, or to buy a plant or part of a plant to be leased to the contractor, the commission shall have charge of the business. The commission shall have charge of all electric lighting wires in the city, and a penalty is imposed for cutting or tampering with them. The city may issue bonds to buy a lighting plant.—J. W. Johnston, of Colorado, has bought the controlling interest in the stock of the Standard Electric Company of Detroit.

Milwaukee, Wis.—The *Wisconsin* says the project to construct an electric road between Milwaukee and Chicago shows signs of activity. The right of way from Milwaukee to the State line has been secured, and the Chicago and Eastern parties interested have not only secured the right of way from and through Chicago to the State line, but have started on the work of construction, and it will be running as far as Evanston by June. The Milwaukee gentlemen most directly interested in the project are Henry C. Payne and C. C. Rogers. "A company," says the *Wisconsin*, "has been organized which stands ready to put $10,000,000 into the enterprise. One of the great objects of the gigantic enterprise is to secure positive rapid transit, at frequent intervals, between this city and Chicago. Trains of two or three cars each will run at intervals of every half hour or hour, and they will, it is claimed by those interested, make the through run in one hour and twenty minutes. The road will be as nearly a bee line as possible, and it will take in Cudahy, South Milwaukee, Racine, Kenosha, Waukesha, Evanston and South Evanston, and will land passengers in the heart of Chicago."

The Ries Improved Universal Base Regulating Socket.

BY ELIAS E. RIES.

The rapid extension of incandescent lighting service that has taken place within recent years, and especially since the advent of the alternating current system of electrical distribution, has not been wholly produced by the electric lamp itself, but is largely traceable to the various auxiliary devices that have from time to time been brought forth for the purpose of rendering the incandescent light more economical, safe and reliable, and for better adapting it to the practical requirements of popular everyday use.

Among the many valuable devices that have been recently produced is the well-known Ries Regulating Socket. Since this made its first public appearance at the Montreal Convention of the National Electric Light Association, in August, 1891, it has largely extended the sphere of the incandescent electric lamp.

The Ries Regulating Socket is so constructed as to permit the incandescent electric light to be turned up and down from a faint glow to the full candle power of the lamp, in the same way as has long been common with gas and oil lamps. This important result is effected without the introduction into the lamp circuit of a "resistance" or any other current-wasting medium, and is accomplished by means of a small and peculiarly constructed "reaction coil" placed within the lamp socket, which, when used on an alternating current circuit, sets up a *variable counter electromotive force* that cuts down the electromotive force supplied to the lamp, and consequently also the current flowing through the lamp, in accordance with the degree of light desired. In addition to the regulation of the light, the Ries Regulating Socket has the important advantage that it reduces the strain on the lamp filaments not only in the act of turning on and off the light, which in this socket is performed gradually instead of suddenly, but also in the regular use of the lamps at such times when less than the full candle power of the light is needed, thereby very materially prolonging the useful life of the lamps with which the regulating socket is used.

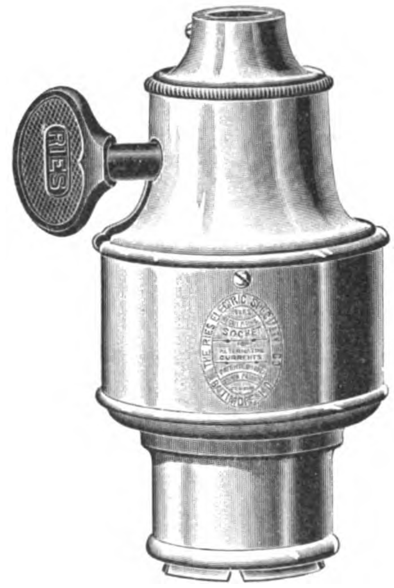

FIG. 1.

The Ries Regulating Socket has since its first introduction made rapid strides toward final perfection. As now manufactured by the Ries Electric Specialty Company, it embraces a number of important improvements that render it far superior in every way to those first placed upon the market.

By referring to Figs. 1 and 2, which illustrate an outside and inside view of the improved socket respectively, it will be seen that the socket comprises among other things the reaction coil, by means of which the opposing or regulating counter electromotive force is generated, the insulating block or support containing the contacts representing the coil terminals, the operating key, switch arm and binding screw connections for the leading-in wires, and the enclosing shell, the latter made in two separable parts.

The mechanical problem of providing an effective, permanent, and thoroughly safe and reliable supporting block that would permit of making the necessary frictional connections between the contact pins and the delicate terminal wires of the reaction coil was one that presented numerous difficulties. These contact blocks were originally made of wood, which although of a sufficiently yielding character to permit of making the required connections, had a number of objectionable features, and after numerous preliminary experiments with various moulded compositions and other insulating materials the writer finally succeeded in devising a porcelain block, together with a method of making the necessary contacts therein, so constructed as to fully meet every requirement.

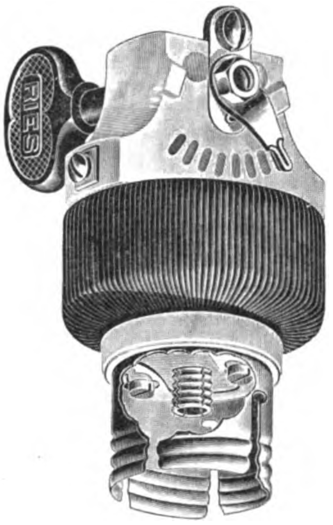

FIG. 2.

The reaction coil used in this socket consists of a small finely laminated annular iron core evenly wound with a silk insulated cable composed of seven separately insulated copper wires varying in size according to the maximum current that each is required to carry. The ends of this cable, after it is wound upon the core, are then bared, and the extremities of the individual wires, each with part of its insulation removed, are threaded through a double series of holes in the porcelain supporting block in such a manner that when the copper contact or terminal pins are driven home and clinched at the back of the block all of the several wires of the cable are connected in series the winding being divided by the contact pins into seven sections of equal length.

The operating key of the socket, which has its bearing in the porcelain block and projects through an opening in the enclosing shell, is provided with a contact arm that moves over the series of terminal pins on the working face of the block, and by including a fewer or greater number of the coil sections in the lamp filament circuit, diminishes or increases the counter electromotive force developed by the coil, and thus raises or lowers the light.

The operating key moves through an angle of 90 degrees, and its position indicates the extent to which the lamp is turned on. The contact pins are slightly depressed below the hardened glazed face of the porcelain block, so as to form a seat for the end of the contact arm and thus insure its proper electrical engagement with the pins and prevent accidental displacement. This arrangement also prevents all possibility of short-circuiting and consequent heating of a coil section that might otherwise be produced by the bridging of two adjacent terminal pins at the same time.

The advantages presented by this coil are: First, the magnetic circuit is very short, unbroken and of exceedingly low resistance. Second, the seven wires comprising the coil are wound upon the core simultaneously and in such a manner that each wire is distributed evenly around the core at the same uniform distance, so that the entire core is uniformly energized by each active section of the winding. Third, the winding is so proportioned with respect to the maximum current flowing through the same at the different stages of light, and with respect to the iron core, that a very low and practically uniform C^2R loss per unit length is obtained and a maximum induction produced in the iron core throughout nearly the whole range of regulation.

When the lamp is burning at lowest rate on an ordinary fifty volt alternating current circuit (the lamp being of standard 16 candle power), it will consume just one-fifth of an ampere at an electromotive force of ten volts, or a total energy of two watts, as against fifty watts when burning its normal candle power.

In the new universal base shown in Fig. 2 it will be observed that the centre contact is a hollow slotted stud provided with the standard Thomson-Houston lamp-thread upon its outer surface, its interior being of the proper diameter to receive the centre pin of the standard Sawyer-Man or Westinghouse base lamps, while its exposed end is arranged to bear against the centre disk of the standard Edison lamp base. The slots in the projecting portion of the centre stud give it sufficient elasticity to make good electrical contact and to accommodate itself readily to variations in the diameter of the contact pins or threads that are often found in lamps of different makes. It is also capable of a slight vertical movement to accommodate variations in lamp bases.

It may be well to state, in order to avoid misconception, that while the socket is designed for Edison or any other type of *lamp*, it is not adapted for such lamps on direct or continuous current circuits, but can only be used as a *regulating* socket on alternating circuits. The total ohmic resistance of the winding on the reaction coil is so low that it does not make an appreciable difference in the brilliancy of the lamp if used on the continuous current circuit. This fact in itself proves that the regulation of the light is not due to resistance as has been alleged by those unfamiliar with its construction.

Vulcanized Mud.

The Delaware Hard Fibre Company, of Wilmington, Del., has just issued a card calling the attention of electrical manufacturers to the fact that the low prices which prevail for fibre have tempted some manufacturers of that material to introduce impurities in their goods. They state that this can be done in the same way that rubber goods are adulterated.

In samples which they have recently examined they found large percentages of red clay and chloride of zinc and calcium. In one case nearly 50 per cent. by weight of the "fibre' was composed of these impurities.

The presence of such ingredients makes the fibre brittle, easily split and causes it to swell and shrink under atmospheric changes besides utterly destroying its insulating properties. Such material is wholly unfit for electrical work. This "mud fibre" can be sold for from one-half (depending upon the available supply of clay) to one-quarter of the price of the genuine article.

COMMERCIAL PARAGRAPHS.

The Mason Electric Company, 10 and 12 Vandewater street, New York, send out a neat and comprehensive catalogue of their specialties, which include surgical and dental outfits, reading lamps, fan motors, motors for sewing machines, etc., with the well known Mason battery for supplying current. The company will soon issue a valuable book, "Wonders of Primary Batteries; What Can be Done with Them, and How Best to Use and Care for Them."

The Simpson Electric Company of Chicago report an excellent business in their small electric motors. They are now manufacturing motors up to five horse power capacity. They are also getting a large stock of small fan motors ready for the summer trade.

The Chicago office of the National Electric Company has recently secured the contract for furnishing the complete electric plant for the Chicago Beach, one of the largest World's Fair hotels.

The Jenney Electric Motor Company have recently opened an office in the Monadnock Building, Chicago, and expect to carry a full line of electric motors and supplies. Mr. A. H. Goode, until recently with the General Electric Company, has been placed in charge.

Mr. Harry Bishop, Western agent for the Massachusetts Chemical Company, is continuing his remarkable success in introducing Insullac in the West.

The Calumet Electric Manufacturing and Engineering Company has recently been organized in Chicago by Messrs. L. A. Hine. L. J. Otis and G. E. Dorman, for the purpose of manufacturing a line of dynamos and motors invented by Mr. Dorman. The company expect to build a large number of small fan motors for the summer trade, and will make a specialty of 500 volt motors. Mr. G. E. Dorman, the electrician of the company, is well known through his numerous electrical patents, and also through his connection with the Standard Electric Company of Chicago.

The Atwood Electric and Manufacturing Company of Chicago have been receiving a large number of orders since they placed their new incandescent arc lamp on the market. Their new lamp for alternating circuits is also in good demand.

The Knapp Electric Company of Chicago report the sale of a large amount of house supplies to the contractors for the new World's Fair hotels that are being built in the neighborhood of the Exposition grounds. The orders for Knapp Annunciators have been exceptionally large.

The Intramural Railway Company at Chicag, has decided to use Simplex Wire for feeders. George Cutter is the recipient of the order.

INCORPORATIONS.

Alexandria Electric Light and Power Company, Alexandria, Ind. Capital stock, $30,000. Directors: James M. Barton, Cassius Greenlee, J. E. Jeffries, S. E. Young and A. E. Harlan. The company has been empowered by the Alexandria City Council to build a street railway, and will probably extend it to Anderson.

A certificate of consolidation of the Greenwich Electric Light and Power Company and the Cambridge Electric Light and Power Company, forming the Consolidated Electric Company of Greenwich, Washington County, New York, has been filed at Albany. The capital of the new company is $35,000 and the directors are: Henry Gray, Le Roy Thompson, James Lavake, John Brooks, Mortimer R. Teffts, Harry C. Gray, Greenwich, and Jerome B. Rice, Andrew B. McNish and John L. Agan, of Cambridge. The company's operations will be carried on in the towns of White Creek, Cambridge, Jackson, Easton and Greenwich, Washington County, and the town of Schuylerville, Saratoga County.

The Hudson and Bergen Traction Company has filed a certificate of organization in the Secretary of State's office at Trenton, N. J. Myles Tierney, of New York. Theophilus Butts, of Hoboken, and Albert C. Wall, of East Orange, are the incorporators. The capital stock is $5,000,000. The company proposes to operate electric roads in Bergen and Hudson Counties and through the Oranges.

The Consolidated Traction Company of New Jersey, having filed its certificate of incorporation, has elected the following officers: Edward F. C. Young, president of the First National Bank of Jersey City, president; Thomas J. George, of Newark, secretary and treasurer; David Young, of Newark, chief engineer.

The Rahway Electric Street Railway Company, Rahway, N. J. Incorporators: C. W. Boynton, Henry Mauerer, Henry G. Wolcott, William Howard, N. E. Mead, Jr., D. K. Ryno and Jackson Jaques. The route of the proposed road is through the principal streets of Rahway, and to Wood Bridge and Boynton Beach on Staten Island Sound.

The Peoria and Pekin Electric Railway Company. Peoria, Ill. Capital stock, $200,000, equally divided between John J. Patterson and E. A. Demange. The articles provide for the construction and maintenance of an electric railway between Peoria and Pekin, and the construction of a bridge over the Illinois River at Pekin.

The Mt. Vernon Electric Light and Street Railway Company, Mt. Vernon, Ohio. Capital stock, $400,000. This company, it is understood, will absorb the Mt. Vernon Electric Light Company, and begin the construction of electric railways in Mt. Vernon, and thence to towns in the neighborhood.

Articles of incorporation of the Stockton Power Transmission Company have been filed by San Francisco and Stockton men, with a capital of $1,000,000. The company will generate electricity with water power on the Mokelumne River, forty-two miles from Stockton, and transmit it for sale to manufactories. The company will also supply electricity for a railroad between Stockton and Lodi.

The Consolidated Street Railway Company, Bay City, Mich. Capital stock, $1,000,000. Officers: President, W. B. McKinley, Chicago; vice-president, R. S. Hunter, Philadelphia; secretary, H. H. Norrington, West Bay City; treasurer, D. W. Slack, Philadelphia. assistant treasurer, H. Norrington.

The Norwalk, Fairfield and Southern Railroad Company, Norwalk, N. Y. Capital stock, $50,000. Incorporators: Charles P. Wickham, T. F. Hildreth, Jay F. Laning, Harry H. Hoyt, S. E. Crawford, Frank H. Evans and John A. Williams. Organized to build a line to be operated by steam or electricity between Norwalk and North Fairfield in Hudson County.

Articles of incorporation have been filed in the Camden County Clerk's office by the Treichler Water and Light Company. The objects of the corporation are to supply water, water power and electricity. The capital stock of the company is $100,000. The incorporators are M. K. Treichler, of Philadelphia; B. Smith, of Wenonah, and Isaac Moffett, of Glassboro, N. J.

The Spring Valley Electric Light Company, Peoria, Ill. Capital stock, $25,000. Incorporators E. B. Hillman, H. T. Hays and L. B. Bradley.

The Wyoming Electric Light and Power Company. Peoria, Ill. Capital stock, $15,000. Incorporators: E. B. Hillman, H. T. Mays and L. B. Bradley.

The Citizens' Street Railroad Company of Indianapolis has been reorganized, and the new officers chosen are: President, Augustus L. Mason; vice-president, William L. Elder; directors, Murray A. Verner, E. Sellers McKee and Richard W. Clay, Chicago; H. C. Clay, New York; Augustus L. Mason, William Lines Elder, W. J. Holliday and Dr. Henry Jameson.

The New Jersey Light and Heat Company, Newark, N. J. Capital stock, $2,000,000. It is understood that the object is to consolidate the Newark and Citizens' Gas Companies and the Newark Electric Light Company under one management.

The Peru Street Railway Company, Peru, Ind. Capital stock. $50,000. President, R. A. Edwards; vice-president, W. S. Mercer; secretary, R. H. Bonsteog; treasurer, C. H. Brownell. The company has been granted a franchise for an electric street railway in Peru.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED MARCH 21, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

493.695. Conduit Electric Railway. Henry P. Feltrow, Columbus, Ohio, assignor of one-half to Richmond R. Brown, same place. Filed March 4, 1891.

493,713. Insulator for Trolley-Wires. Merrill H. Hathaway, Springfield, Mass., and John Kellener, Manchester, N. H.; Adele L. Hathaway administratrix of said Merrill H. Hathaway, deceased. Filed April 2, 1892.

493,716 Conduit System for Electric Railways. Elias Hazelton, Lansing, Mich., assignor of one-half to Harley Ingersoll, same place. Filed Feb. 15, 1892.

493,789. Trolley for Electric Railways. John F. Saltz, Baldwin, Allegheny County, assignor of two-thirds to Thomas A. Noble, Pittsburg, and Frederick G. Kay, Allegheny, Pa. Filed June 18, 1891.

493,914. Converter System for Railways. Alard du Bois-Reymond, Charlottenburg, assignor to Siemens & Halske, Berlin, Germany. Filed Feb. 3, 1892.

493,948. Closed Conduit for Electric Railways. George W. von Siemens, Berlin, Germany, assignor to Siemens & Halske, same place. Filed June 24, 1892.

493,969. Electric Car. Charles Brown, Basle, Switzerland, assignor to the Maschinenbau Gesellschaft, same place. Filed March 8, 1892.

ELECTRIC LIGHTS AND APPLIANCES.

493,629. Thermal Cut-Out for Electric Lamps. Hermann Lemp and Merle J. Wightman, Hartford, Conn., assignors to the Schuyler Electric Company of Connecticut. Filed Aug. 27, 1886.

493,739. Electric-Arc Lamp. Elihu Thomson, Lynn, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed June 30, 1886.

493,842. Electric-Lighting System. Samuel W. Rushmore, Brooklyn, N. Y. Filed Feb. 7, 1891.

493,868. Switch for Electric-Light Fixtures. Joseph Hutchinson, New York, N. Y. Filed April 8, 1892.

DYNAMOS AND MOTORS.

493,679. Dynamo-Electric Machine and Motor. Harold P. Brown, New York, N. Y. Filed Dec. 10, 1891.

493,718. Dynamo-Electric Machine. Santa Hellebrandt, Przemysl, Austria-Hungary. Filed May 25, 1892.

493,745. Dynamo-Electric Machine. Foree Bain, Chicago, Ill. Filed Dec. 21, 1891.

493,942. Electric Locomotive. Alexander Philipsborn, Berlin, Germany, assignor to Siemens & Halske, same place. Filed April 21, 1892.

493,943. Electric Locomotive. Alexander Philipsborn, Berlin, Germany, assignor to Siemens & Halske, same place. Filed May 17, 1892.

494,042. System of Winding Armatures for Dynamo-Electric Machines. William M. Thomas, Grand Rapids, assignor to Louis Warfield, Detroit, Mich. Filed Jan. 29, 1892.

BATTERIES.

493,817. Secondary Battery. Lars Bristol, London, England. Filed Aug. 28, 1890. Renewed Feb. 13, 1892.

494,062. Secondary-Battery Electrode. William W. Donaldson and Roderick Macrae, Baltimore, Md. Filed March 4, 1892.

TELEPHONE AND TELEGRAPH APPARATUS.

493,704. Listening and Ringing Key for Telephone Switchboards. William M. Goodridge, Highland Park, assignor to the Western Electric Company, Chicago, Ill. Filed July 19, 1890.

493,907. Telephone. Charles T. Bloomer, New York, N. Y. Filed Nov. 28, 1892.

MISCELLANEOUS.

493,672. Automatic Electric Cut-Out. Francis B. Badt, Chicago, Ill., assignor to the Western Electric Company, same place. Filed June 6, 1889.

493,673. System for Transmitting Electric Current. Edward Baines, Brooklyn, N. Y., assignor to himself and Edward J. Mitchell, same place, and Adolph L. Mitchell, Rockville, N. Y. Filed March 21, 1892.

493,678. Electric Railway-Signal. Jefferson Bradford and James P. Williams, Boston Station, Ky. Filed June 23, 1892.

493,754. Electric Connector and Cut-Out. Charles H. Crockett and Chancellor C. Allen, Boston. Filed April 8, 1892.

493,755. Electric Cut-Out. Charles H. Crockett and Chancellor C. Allen, Boston, Mass. Filed April 8, 1892.

493,777. Electric Clock Striking Mechanism. William Kaisling, Allegheny, Pa. Filed April 4, 1892.

493,809. Apparatus for Purifying Liquors by Electrolysis. John Becker, Kymulga, Ala. Filed March 12, 1892.

493,883. Insulating-Coupling. Ernest Ballett, Bordeaux, France. Filed Oct. 31, 1892.

493,918. Electrically-Operated Railway Switch. Powell Evans, Philadelphia, Pa. Filed Dec. 7, 1891.

493,926. Lightning-Arrester. Hermann O. Henneberg, Berlin, Germany, assignor to Siemens & Halske, same place. Filed Dec. 9, 1892.

493,935. Electric Railway-Signal. Henry V. Miller, Bloomington, and Alexander C. Miller, Aurora, Ill. Filed Nov. 8, 1892.

493,881. Rosette Cut-Out. Charles E. Barry, New York, N. Y. Filed Aug. 16, 1892

493,997 Electrical Attachment for Rocking-Chairs. Charles E. Hartellus, Bay Ridge, N. Y. Filed Nov. 22, 1892.

494,007. Block-Signal System. John La Burt, New York, N. Y., assignor, by direct and mesne assignments, to the La Burt Automatic Electric Block Signal System and Car Coupler Company, same place. Filed June 16, 1892.

494,043. Theatrical Stage Appliance. David I. Towers, New York, N. Y., assignor to Neilson Burgess, Highlands, N. J. Filed Feb 5, 1891.

494,053. Reciprocating Electric Drill. William A. G. Birkin, Nottingham, England. Filed April 23, 1892.

494.966. Marine Railway. Edward Kaye, Phillipsburg, Pa. Filed Dec. 9, 1892.

494,077. Railway Block-Signal. Robert D. Peters, Winamac, Ind., assignor of one-half to Charles L. Wait, same place. Filed July 11, 1892.

494,080. Sanding Device for Cars. Edward H. Pinkham, Haverhill, Mass. Filed July 12, 1892.

494,091. Electric Cigar-Lighter. William M. Thomas, Chicago, Ill., assignor to Louis Warfield, Detroit, Mich. Filed Oct. 26, 1892.

494,098. Electrical Appliance. Charles H. Folger, Cincinnati, Ohio, assignor, by direct and mesne assignments, to the Cincinnati Novelty Company, same place. Filed Sept. 5, 1892.

494,111. Electrical Railway-Signal. Samuel W. Miller and Alexander C. Miller, Aurora, and Henry V. Miller, Bloomington, Ill.; said Samuel W. Miller assignor to said Alexander C. Miller and Henry V. Miller. Filed April 4, 1892.

ELECTRICITY.

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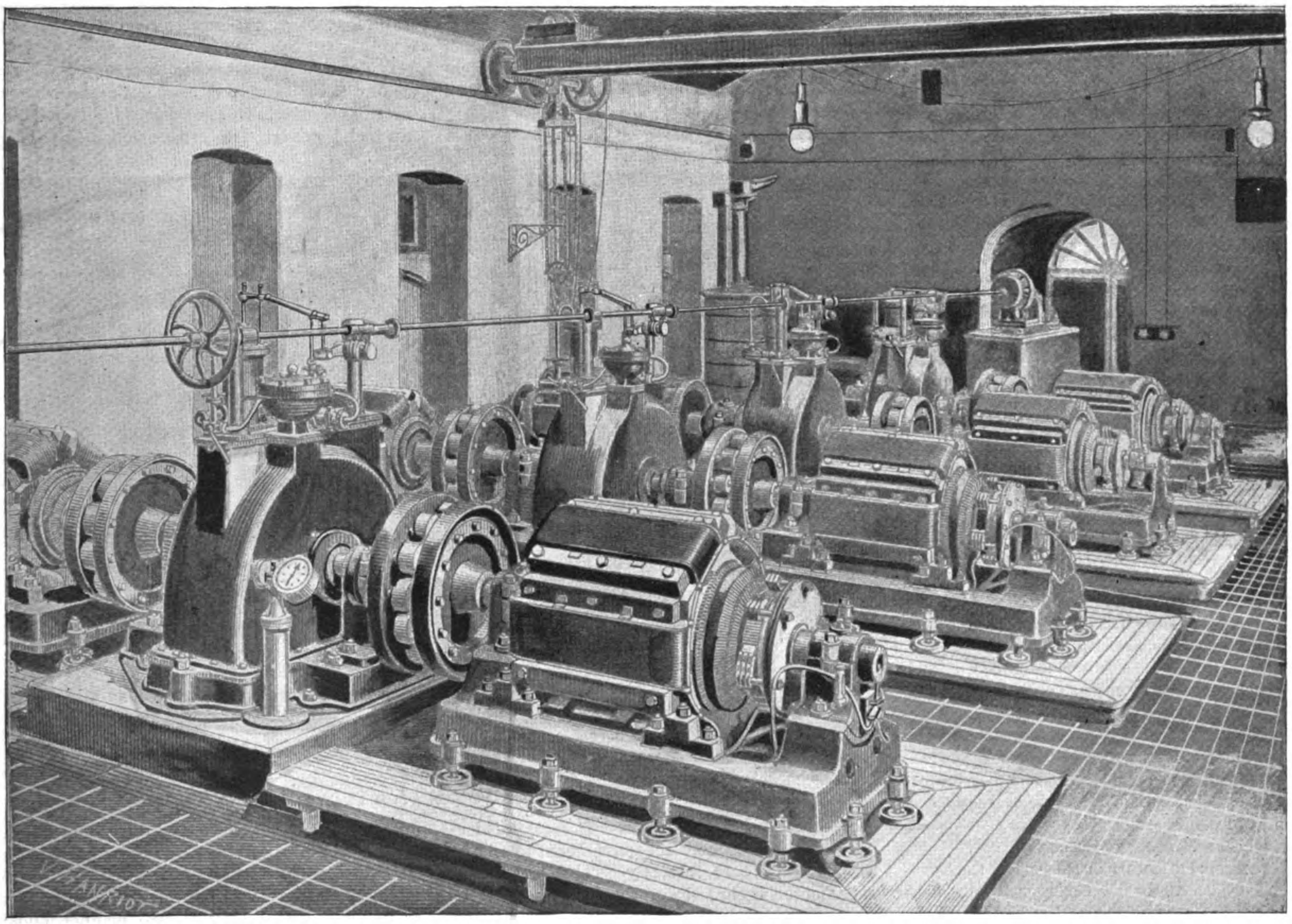
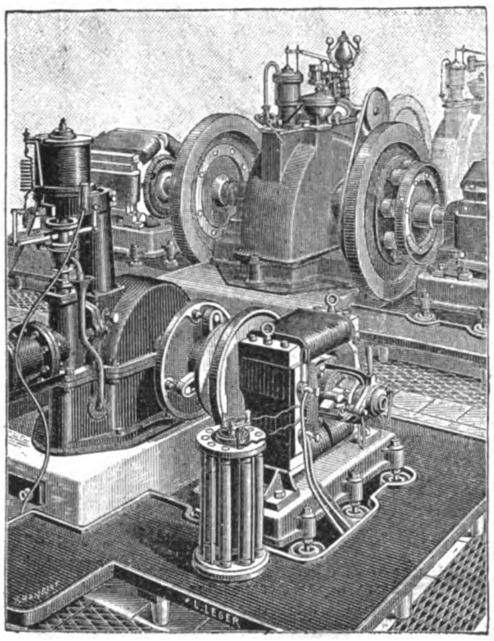


GENERAL VIEW OF THE STATION "PACINOTTI." (SEE PAGE 154.)

The Distribution of Electrical Energy.

An interesting description of several French central stations has appeared in *Électricité* from the pen of M. Anney. The station Volta, shown in part in Fig. 1, has been in operation since December, 1891, and notwithstanding several novel elements which it contains has from the start given entire satisfaction. It comprises four groups of machines, each having a turbine of 140 H. P., and eight dynamos giving 47 amperes at 1,000 volts. These were installed by the Compagnie de l'Industrie Électrique, and are of the Thury type, although they contain some novel points which were imposed by the special conditions in this plant.



PARTIAL VIEW OF THE STATION "VOLTA." (FIG. 1.)

The generators run at a constant speed and the regulation of the voltage is accomplished by means of an automatic regulator which varies the exciting current. This is done by changing the speed of the turbine which drives the exciter, both of which are independent machines without mechanical connection to the main generators. This arrangement has the advantage of regulating the pressure of the entire station with but one regulator, no matter how many machines may be in use, and in this respect is a very desirable feature and is entirely automatic. On the other hand it introduced some serious difficulties, as it was found necessary to change the construction and winding of the generators and to provide turbines of excellent regulation without which its successful operation would be impossible.

These turbines were supplied by MM. Faesch & Piccard, of Geneva, and have been found to amply fulfil every requirement in the line of automatic regulation. They have a horizontal axis and the water enters at the centre of the wheel and escapes at its periphery. The distributor, which is supplied with orifices which vary their amount of opening, regulates the supply of water to the wheel according to the speed.

The principal difficulty on the part of the dynamos relates to their insulation. As the field windings are all connected in the circuit of the separate exciter, these windings must be insulated so as to stand the total voltage furnished by the machines without damage, that is to say, from 6,000 to 8,000 volts or more.

This result is effected by placing a supplementary insulation between the magnets and the frame, and as it was feared that a spark might pass from the windings to the pole pieces the entire magnet was covered with a heavy, compact insulation in the form of a screen.

There is but a slight heating of the magnets and this insulation has given no trouble on that score.

The frames of the dynamos are mounted on bolts imbedded in strong porcelain insulators provided with a circular shelf which is filled with oil in order to avoid surface leakage, which was feared on account of the moisture in that locality.

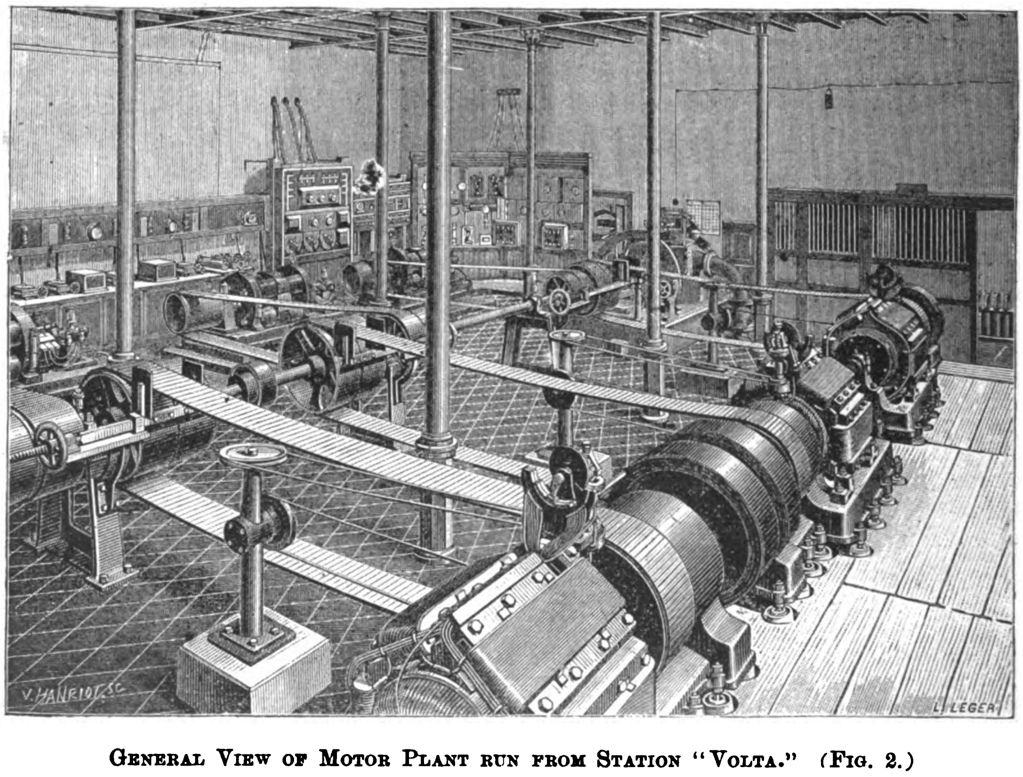
The total insulation is so high that it cannot be determined by the ordinary measuring instruments.

These precautions, though simple, have been entirely sufficient for the pressure of 5,000 volts, and not a single mishap has so far occurred. This points to the suggestion that this pressure can be increased considerably without danger. Another feature inherent in separately excited machines is the tendency to sparking at the brushes when working under full load, owing to the reduction of the magnetic density.

To avoid this a very strong field is employed which contains a section adapted to be easily wound, and further, special carbon brushes of unusual density are used in which, however, the conductivity is sufficiently low to reduce the tendency to sparking.

Practically, the dynamos may be run on short circuit at their maximum current and speed with an inappreciable exciting current without any trace of sparking at the commutators or any necessity for repairing the contacts. The carbon brushes last indefinitely and show no appreciable wear after many months of use, during which time they have required no special attention. The commutators are also highly polished and have never been repaired or oiled.

The precise regulation of the voltage was a most difficult matter to adjust. In fact, the electromotive force varies at each moment to a large extent, and almost instantly. Thus when a 60 H. P. motor is shut down, the brushes must be suddenly short-circuited by the movement of a switch, and the 1,200 volts which it consumes must be dissipated or the pressure throughout the system will be greatly increased, especially if the motor forms a large part of the load. This makes it essential for the regulator to instantly correct wide variations which would be impossible if the turbine driving the exciter did not respond instantly to the action of the regulator.



GENERAL VIEW OF MOTOR PLANT RUN FROM STATION "VOLTA." (FIG. 2.)

The single exciter common to all the generators is coupled directly to a 12 H. P. turbine which has no fly-wheel, and whose moment of inertia is reduced to a minimum. The exciter has a field of high magnetic density and the armature is extremely light, being but 180 millimetres in diameter. For this reason the weight of the moving parts is but little, and their inertia is practically negligible. In order to secure a sufficiently stable magnetic field under all conditions the exciter is also separately excited by a small machine from which the lights in the station are run.

The station "Pacinotti," shown in our Frontispiece, was started on the 23d of November last. It is designed to contain six groups of machines, of which at present four are in full operation. These groups are of the same character as those of the former station, having a Piccard turbine of 140 H. P. which drives two Thury dynamos of 1,000 volts and 45 amperes at 475 revolutions per minute. All the dynamos are connected in series and are self-excited. The method of speed regulation differs from that of the former station and is much simpler. Only one regulator is used for the whole station.

The fly-wheels of the turbines have been discarded, and the armatures of the generators have as little inertia as possible. By this arrangement the regulation is partly effected, as when the current diminishes the generators absorb less power and the turbines increase their speed, thus partially correcting the error. The field magnets work at low magnetic density, which facilitates this automatic regulation considerably.

The current regulator has then only to correct small differences, and it need not necessarily act instantaneously. This consists of a Thury motor in which there are two armature windings, permitting it to work in either direction without reversal. This drives an arrangement that regulates the supply of water to the turbines. The motor is started in either direction by an iron armature moved by an electro magnet, and a relay carries the current to either armature winding according as the current increases or diminishes in the main circuit. In this way the speed of the turbines is varied as required.

General Electric's Dividend.

The Directors of the General Electric Company met on Friday, March 31, and declared a quarterly dividend of 2 per cent. payable May 1.

The Cost of Steam Power Produced With Engines of Different Types Under Practical Conditions; with Supplement Relating to Water Power.

BY CHAS. E. EMERY, PH. D.[*]

[Concluded.]

Column *k*[†] shows the aggregate cost per net horse power of the engines, boilers, buildings and chimney as given in the three previous columns.

Column *l* shows the amount in column *k* augmented 2½ per cent for inspection and 6 per cent. for loss of interest during construction, a total of 8½ per cent., which is designed to cover the expenses of the kind indicated and other contingencies incidental to the construction of a large steam plant or other important work. In starting a company there must be an organization formed in connection with raising the money, procuring the charter and initiating the construction, involving the salaries of several individuals. The engineers to take charge of the work must also be selected before the work is completed and in general very much of the expense must be incurred a considerable time before the plant is put in operation; and even after operation commences a long time intervenes before everything is working on a sufficiently large scale to secure economy in operation and a return therefrom. Frequently these items are not considered in making estimates. Some of them are of a kind which are not necessarily included in those made by an engineer. Eventually, however, all these expenses must be charged in some way on the books and will usually be placed in the construction account, and it is, therefore, proper to make this charge of 8½ per cent in excess of the ordinary preliminary charges for designs naturally included in construction, with the belief that it will in rare instances be sufficient to provide for the several contingencies referred to.

An inspection of column *l* shows unexpectedly small differences in the total cost of steam machinery of different types when everything is considered. It is a curious fact that the machinery which as a whole costs least originally is that of fairly good economy. The total cost of non-condensing steam machinery is, on the basis of performance assumed, higher than for more economical condensing engines, on account of the increased cost of the additional boilers, buildings and chimney made necessary by such reduced economy. If it be considered that the feed water per indicated horse power per hour for the non-condensing engines is higher than would be obtained in particular cases, a comparison with the minimum quantities in column *e* shows that an assumption of the best possible results will not equalize the total cost of non-condensing and condensing engines of similar construction. The more economical engines near the bottom of the table are comparatively so high priced that even when the reduced cost of boilers is considered the total price is greater than for the steam machinery of reasonable economy shown near the middle of the table.

In column *m* is shown the weight of water which it is assumed will be evaporated per pound of coal. The assumption is 8½ pounds, except in the last case where it has been fixed at 9½ pounds. Although 9 and 9½ pounds evaporated can be obtained under actual conditions readily with boilers of good proportion and construction, it is thought that 8½ pounds is as much as can be depended upon in average practice. It is in fact greater than is obtained in most cases, though less than is claimed in exceptional ones. This rate must be considered somewhat in relation to the price of coal. If cheap coal is to be used which will not give 8½ pounds evaporation, the results must be sought in the column of the table applying to coal of a higher price.

Column *n* shows the coal per indicated horse power per hour, which is simply deduced by dividing the feed water per horse power, column *f*, by the feed water evaporated per pound of coal, column *m*. We notice that the coal per indicated horse power per hour decreases from 3.88 to 1.47 lbs., which is about what should be expected for the various conditions heretofore discussed.

We next have in columns *o* and *p* the number of tons of coal, of 2,240 pounds, required under the conditions stated; column *o* referring to a working day of 10 hours, and column *p* to a working day of 20 hours, with coal for one hour added in each case for starting and stopping fires.

We have next in columns *q* to *x* inclusive the cost of coal per horse power per year at the rates of $2, $3, $4 and $5 per ton; first on the basis of 308 days of 10 hours each, and second on the basis of 365 days of 20 hours each.

We have next in columns *y* and *z* the cost per net horse power per year of supplies and average repairs. There has been allowed 12 cents per day of 10 hours for supplies and 29 cents for repairs, or 41 cents total for a 500 H. P. slow speed engine. These costs are based on testimony in the Fall River suit mentioned in the paper previously referred to. This amount has been increased to 48 cents for the high speed engines, which will probably be insufficient in many cases but has been assumed correct for the better types.

We next have in columns *A* and *B* the cost per net horse power per year for wages based on $3 per day of 10 hours for an engineer and $4 per day for 500 commercial or boiler horse power for fireman and the labor incidental to passing the coal and disposing of the ashes. The latter amount has been entered fractionally, for although this would be impossible for a single unit it is the only way to obtain a correct progression when considering each unit as a part of a much larger plant. The cost amounts to $4.77 per day for simple engine in line *A* and $2.22 for compound engine in line *K*.

In column *C* is given the cost of insurance, taxes and renewals per horse power per year. This is obtained on a basis of ½ of 1 per cent for insurance, which is too low for an electric light plant, and in fact too low for other manufacturing operations except those insured on a mutual plan. Taxes have been assumed at $15 per thousand on three-fourths of the total cost, equivalent to 1.2 per cent. The renewals for engines, boilers and buildings all averaged together have been assumed at 3.3 per cent., making a total of 5 per cent. The several percentages are believed to be low for general practice, but have been used in the first part of Table I so as to keep within bounds the influence which quantities proportioned to cost have on the result.

We have in column *D* the amount per horse power per year to be provided for interest and dividends which has been fixed at the moderate rate of ten per cent. on the capital invested. It should be realized that the interest account should not simply cover the interest on money borrowed or invested to do the work, but a percentage sufficient to pay expected dividends on the capital; in fact, interest and dividends must be considered together. In this country at least, active business men demand at least 10 per cent. on their investments. It may be that they will borrow the money actually required to do the greater part of the work at a comparatively low rate of interest, say 5 per cent to 6 per cent., which the business is expected to pay in addition to a dividend of an equal or greater amount to recompense the promoters for their trouble and responsibility in the matter, so that 10 per cent. allowance for interest and dividends is none too much in a growing country. Indeed, it is altogether too small for operations in which the actual value of the plant is represented by a greatly increased face value of securities. Evidently the payment of 5 per cent. interest on a bonded issue equal to the cost of construction and 5 per cent. dividends on an equal amount of stock to control the company, or any similar financial scheme based on the same total, is equivalent to an allowance of 10 per cent for interest and dividends, which is the basis assumed for comparison, and this percentage must of course be paid on all expenditures, including everything relating not only to the purchase but the erection of the various details of the steam machinery.

Columns *E* and *F* merely sum up the cost per horse power per year of all operating, current and interest expenditures, except coal, and include therefore the cost of wages, columns *A* and *B*; cost of insurance, taxes and renewals, column *C*; and the interest or dividends, column *D*.

We next have in columns *G* to *N* inclusive the *total* cost per net horse power per year on the basis shown in the previous columns, for coal at $2, $3, $4 and $5 per ton, first for 308 days of 10 hours each, and second for 365 days of 20 hours each. An examination of the several columns shows clearly that for cheap fuel and short hours the engines of fair economy and least cost give the most economical results when both the cost of fuel and collateral and interest charges are considered. Such a result would be anticipated in comparison with non-condensing engines, but *it is somewhat surprising to find that the compound engines of comparatively moderate price show better economy, everything considered, than the higher priced triple compound engines*, if we reject the results shown in the last line, which, as already stated, it is believed cannot be obtained in average practice. For the 10 hours day, with coal at $2 per ton, the lowest result is, for the assumed conditions, shown on line *I*, referring to special triple compound high speed condensing engines. Unfortunately more conditions have had to be assumed in relation to this type of engine than for any of the others. They are being made specially for electrical purposes of extra weight and with extra length of bearings, and the prices available would with proper allowance for erection give prices higher than stated. However, the result is very little different from that shown in lines *G* and *H* for compound engines high and low speed, or even for the simple low speed condensing engine, line *F*, on the one hand, or the triple compound, lines *J* and *K*, on the other hand. This similarity in final cost is certainly very interesting, and examining columns *H*, *I* and *J*, referring to coal at $3, $4 and $5 per ton, we find that although the total cost per year increases, the relative cost for engines of different kinds varies but little. At the $5 rate the high speed compound engine, line *G*, has fallen $1.43 per horse power per year behind the low speed compound engine, line *H*, and $2.67 behind the high speed triple compound, line *I*, on basis assumed, but the latter with its lower assumed original price and higher coal consumption is holding its own substantially with the higher priced compound engine, line *J*. The same relations practically hold for 20 hours per day with cheap coal, and it is not until we reach column *N* for 20 hours per day and coal at $5 per ton that the higher priced engines (rejecting as before line *L*) show any decided superiority, and even under these circumstances the difference is comparatively not great.

We next examine columns *O* and *V* inclusive, which show the total cost per net horse power per year for electric railroad and other variable work requiring 50 per cent. extra plant to obtain on the average 500 horse power. That is, it must be supposed that a 750 horse power plant, or the larger portion of the same, leaving one unit, perhaps, for emergencies, is employed during the times of heavy traffic, and that at other times the power is less than 500 horse power, so as to maintain the average. In making this comparison the cost of fuel and labor per average horse power has not been increased. Very great variations of load would certainly change these items, but as all conditions cannot be provided for in one table it may be assumed that the charge for fuel in the first part of the table is rather high for uniform loads and that charges for both fuel and labor have not been exceeded for the conditions involving surplus plant in the second part of table. The insurance in the latter case has, however, been increased to 1½ per cent. as an average on engines, boilers and buildings. The engine renewals have also been increased to 4 per cent. and the boiler renewals to 5 per cent. These latter allowances are believed to be more nearly correct than those first assumed for many kinds of work. There are individual cases of boilers and engines lasting a long time, but in many cases the necessary changes in the character of the work done requires a change of steam plant, so it is safer to charge off for renewals a sufficient sum to provide for conditions other than the actual wearing out of the apparatus. In any case we think it will be granted that these allowances are none too large for electric light plants. The comparisons are as before on the basis of coal costing $2, $3, $4 and $5 per ton, first for 308 days of 10 hours each and second for 365 days of 20 hours each.

Examining columns *O* to *V*, we are surprised at once to find that, although the costs have necessarily all been raised, the general relations for the different engines have been very little modified. For short hours and low priced coal the medium priced engines show, if anything, still better results than on the previous basis, and the higher priced engines only show to advantage for long hours and high priced coal, as shown in column *V*. The results even in this column for the engines referred to in the last four lines (excluding *L* as before) are remarkably near uniformity.

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[*] Read at the Seventy-fifth Meeting of the American Institute of Electrical Engineers, New York, March 21, 1893.

[†] For Tables see ELECTRICITY for March 29, 1893, Vol. IV., No. 11.

Before drawing further conclusions, it is desirable to ascertain the effect that will be had on the results by the use of cheap boilers. As has been stated, it is well known that boilers are to be had in the market at a cheaper rate per horse power than the safety boilers which have been assumed. A mere examination of quoted prices would make it appear that such boilers can be purchased for $10 less per horse power than the safety boilers, but the better types of the latter have much more surplus power than ordinary types of boilers, so much so in fact that no allowance has been made in previous calculations for a greater boiler power than is required to supply engines with steam, as it is believed that the better class of safety boilers have so much surplus power that in large plants one or two can be laid off for cleaning purposes and the others take up the load. Even less than the rated power can be purchased in starting a plant and no injury followed from forcing such boilers so as to obtain the power desired. When, however, boilers with small tubes, which furnish heating surface very rapidly at reduced cost, are employed, in general a higher rated horse power must be furnished for a particular case, either originally or soon after operations are started. Moreover, the cost of extra steam and water connections and valves will be as high as in the previous case, and in general higher, for the reason that the units for such boilers are customarily smaller. It has been decided to make the comparison shown in Table II on the basis that boilers will be employed costing $5 per horse power less than those referred to in Table I and from the modification thus shown the effect of a further reduction if found possible can be estimated.

Table II shows in columns *H*, *L*, *P* and *T* the total costs per horse power per year shown in columns of corresponding numbers in Table I, all being on the basis of coal at $3 per ton; the first two named being for the 10 hours and 20 hours day without surplus power, and the last two named being for the 10 hours and 20 hours day with surplus power. In connection with these columns and distinguished by the same letters marked sub-1 are corresponding columns showing the costs per net horse power per year with the interest and other charges affected by the first cost reduced proportionally to a reduction of $5 per commercial horse power on the original cost of the boilers. An examination of the parallel columns shows at once that the effect has been to favor the engines requiring the use of most fuel, for the evident reason that, as they require more boiler power for a given net power, the reduction for them is proportionally greater than for the higher priced engines. The differences are comparatively not great, but sufficient to show the effect of reduction in this direction. The same effect would result from reducing not only the cost of coal as previously stated, but the cost of handling and firing the same.

Evidently, however, any decrease found possible in the cost of engines or of the numerous attachments and appurtenances necessary or claimed to be necessary in connection with a steam plant, and which do not increase in cost proportionally to the commercial horse power, will decrease the interest charges in a higher proportion for the more economical engines and thus secure economy both by saving of fuel and by saving of interest. These considerations, though not governing ones, since interest is only one item of expense, show the desirability of exercising careful judgment in the details of a steam plant. There will be no economy in selecting poor material or in hurrying matters so as to secure cheap work. Everything must be of the best in the sense of being the best adapted for the purpose. The tendency to put in numerous details, each by itself of small cost, needs, however, to be checked, as such items amount in the aggregate to a large sum. It is recommended that the purchase of the various devices which are being urged upon the owners of steam plants should not be consummated unless they will surely save say 25 per cent. of their cost annually. It will be observed that the columns of the table foot up a percentage proportioned to more than two-thirds of this, and as the attention and repairs of miscellaneous apparatus are great the additional percentage is not only thought to be warranted but to be perhaps insufficient in some cases.

The rules adopted for calculating the various columns of Table I are shown by algebraic formulæ, the notation being in terms of the letters designating the several columns.

The comparison shows the non-condensing engines inferior at every point to condensing engines, and even if better results be obtained for the former in certain cases, still, as has been referred to before, the principal difference will be found by causing the quantities in column *f*, Table I, to approximate more nearly to the minimum quantities in column *e*. Some forms of engines undoubtedly accomplish this, but it is believed that the quantities stated are nearly correct for average good practice, with variable loads. Non-condensing engines are wasteful of fuel when heavily loaded on account of low expansion and at light loads the back pressure forms a large proportion of the total resistance, whereas condensing engines will maintain their economy through a wider range on account of the reduction of the back pressure. The back pressure must particularly affect the economy of the new triple compound engines when used non-condensing. It does not seem possible that such engines used non-condensing can for irregular loads show any economy over well designed compound engines operated non-condensing, unless the steam pressure is carried to 200 pounds or upward and the size of the cylinders carefully proportioned to the average load.

It may be claimed that it is unnecessary to add 10 per cent. for interest and dividends, for the reason that nearly every large owner of steam machinery can borrow a large proportion of the money required to construct the plant at a much lower rate of interest. This reasoning is good in some cases and not in others. If the manufacturer can in his regular business pay 10 per cent. or more on the capital invested, it is more economical for him to use his credit and borrow money to extend his business than to put such money into a steam plant at a lower rate. For such conditions there is no question but that every expenditure should be charged at 10 per cent. or upward. The case is different with municipalities which can borrow money at 3 per cent. and 4 per cent., but this after all will not make a great difference in the results, as interest is only one of several items of cost independent of coal. If instead of adding 10 per cent. for interest and dividends in column *D* we add only 5 per cent., the difference between the amounts so added for different engines is very small; for instance, it would make only 42 cents per horse power per year difference in engines in lines *I* and *J*, which is exactly the difference between the total cost per horse power per year for these engines with coal at $3 per ton as shown by column *H*. That is, for this particular comparison the cheaper of the two engines is 42 cents per horse power per year more economical when 10 per cent. is added and of the same economy when only 5 per cent. is added. If we compare the engines referred to on lines *I* and *K* in column *H*, we find that the cost per horse power per year is 47 cents less for the former with 10 per cent. added for interest and dividends, and that the latter is 20 cents per horse power per year more economical if only 5 per cent. be added for interest and dividends.

It is true also that the 8½ per cent. added for inspection and loss of interest during construction, in column *l*, would probably not be expended in making additions to a whole plant, though rather insufficient than otherwise for original construction. The rejection of this item will not, however, make a great difference. It has not been included in ascertaining the cost of insurance, taxes and renewals shown in column *C*, and if 10 per cent. of the increase be charged in column *D* it is only 10 per cent. of 8½ per cent. or .85 of 1 per cent., and so would affect the result only about one-sixth as much as the former presentation.

A little more careful examination of the table shows, as was substantially stated at the outset, that it is not the interest charges which principally cause equalization of total costs in the operation of engines of different kinds. The principal difference is due to the fact that all the other expenses except coal and interest are very nearly constant and the interest intensifies the difference by directly neutralizing, so far as it goes, the economy due to decreased coal consumption. This is made more clear by the following tabular presentation. (See next column.)

The table shows that the collateral charges, line (2), excepting interest, are substantially the same, and about equal to cost of coal, Col. (1), for the economical engines, and that the slight increase of interest, line (4), for the more economical engines tends to neutralize the slight increase of economy of coal shown on line 1, so that, though the costs for engine *I* still remain less than those for engine *G*, they are also less than for the more economical engine *K*.

In conclusion we will say that when this investigation was instituted it was believed, as had indeed been hinted by others and proved for extreme cases, that under some conditions as to the relative prices of economical types of steam machinery compared to price of coal and number of hours operation, the saving in fuel would not warrant the increase of first cost, but it was not known that this would occur within the limits of ordinary practice as the comparison shows. It is hoped that the conclusions and the facts upon which they are based will be very closely examined by engineers and manufacturers, and any facts or reasons confirming or varying such conclusions be fully presented and discussed.

This paper should not be considered a criticism of the practice or views of others or serve to discourage the higher development of the steam engine. On the contrary, an investigation of this kind, whatever the result, is calculated to broaden the view by taking into consideration more of the conditions of the problem, and thereby enabling the engineer to secure the best results for each particular case. The tables do show for short hours or low priced coal, or both, that types of steam machinery to secure the greatest economy of fuel are not warranted, but by the same tables it is found that for longer hours and the higher prices of coal considered, the more expensive machinery begins to show a commercial advantage which evidently increases as the price of fuel increases. In some cases other conditions must be included for a complete solution of the problem. For instance, in large steamers making long voyages economical machinery secures in addition to the saving in the cost of fuel a saving in the space required to carry the machinery and fuel, and thus increases almost in a geometrical ratio the efficiency of the ships. This may not be true for vessels making very short trips or stopping a large proportion of the time in port. The very large expenditures made by some mining companies to save fuel by the use of expensive steam machinery of special design has been fully warranted by the long hours and the high price of coal. The enormous mechanical operations at the Calumet & Hecla mines gave the profession unequalled opportunities, which have been grasped in the most creditable manner by our distinguished co-laborer in the engineering field, Mr. E. D. Leavitt, who has reared there a series of remarkable monuments of engineering skill with an expense warranted, doubtless, by the conditions. The development of the great West is, however, now so modifying the conditions that a change of policy may be initiated even at the Calumet & Hecla mines in the near future. During a recent business investigation with an electrical outlook, the writer ascertained that the prices of coal in Duluth and Superior, beyond the Calumet & Hecla peninsula, are even now reduced nearly to those ruling on the seaboard, which result has been brought about by the construction and operation of large whaleback steamers which take wheat eastward and coal on their return trips.

	Simple High Speed Non-Condensing.	Compound High Speed Condensing.	Special Triple Compound High Speed Condensing.	Triple Compound Slow Speed Condensing.
LINES OF TABLE I.	*A*	*G*	*I*	*K*
(1) The costs of coal at $3.00 per ton, Col. *r*, for a ten hours day are for engines stated in the headings at the right...	$19.09	$11.57	$9.84	$8.91
(2) The collateral operating expenses, excluding interest, are (Line *E*—Line *D*).....	10.69	9.18	9.06	9.11
(3) The interest charges, Col. *D*, are...............	6.39	5.61	5.95	7.30
(4) The total costs, Col. *H*, are....................	36.17	26.36	24.85	25.32

Until quite recently the construction of pumping engines of special design and expensive construction was warranted, even for locations near lines of communication with coal fields. At present, however, pumping engines of good economy are being manufactured regularly, as a business, at a comparative cost that will make the still more economical but much more expensive machinery less in demand than formerly. The further perfection of the steam engine will not be hindered by these facts, for with the development of our mining industries at great distances from the coal fields, the closest economy in the use of fuel will secure the best commercial results. In order, however, to secure such results for our growing enterprises, electrical and otherwise, in the cities and towns along lines of communication already established, it is believed that the field will be occupied by cheaper engines of simple construction, which, though not securing the maximum economy of fuel, will so reduce the capital upon which interest and dividends are to be paid as on the whole to represent not only better commercial policy but better engineering, because based on more complete conditions.

SUPPLEMENT RELATING TO WATER POWER.

It will be impossible in this connection to make a satisfactory comparison of the relative advantages of steam and water power under different conditions. The cost of steam power has, however, in the previous pages, been considered on a somewhat different basis than has heretofore been customary, particularly by including the interest and certain miscellaneous charges in the operating expenses, making the minimum practicable cost per horse power per year appear higher than has been stated by others, so if the cost of water power calculated on the ordinary basis were compared with this increased cost of steam power it would cause the water power to show an unwarranted advantage. It therefore appears necessary to make a brief examination in the form of an inquiry as to what amount can be paid for the development of a water power in competition with steam power. To do this we cannot select examples where Nature has specially favored the development of water powers at a nominal cost, as may be found at various sites throughout the country, nor can we consider a case like that at the Falls of St. Anthony, where an enormous water power was developed at a minimum expense amid surroundings apparently permanent to those who had not studied former recessions. In due time, however, the water undermined the hard limestone cap defining the falls, which had already been worn through above, and started a new channel through the underlying sandstone, thereby threatening to change the falls into a series of rapids extending miles up stream, when by the intervention of the General Government and the use of large appropriations, on the plea of preserving navigation, with some private contributions, a concrete dike or dam was built in a cross tunnel in the sand rock back of the falls, from a firm foundation up to the limestone cap, and the falls and incidentally the water power saved. Ordinarily such disasters must be provided for from the accumulations of an ample depreciation account. We must rather deal, therefore, with more general conditions, such as have been developed on the Merrimac.

Prof. Swain has stated in the Census Reports the costs of several of the principal structures at Lawrence and Lowell, aggregating $650,000 at the former place and $752,000 at the latter place. There are wing dams and probably other improvements apparently not included at Lawrence, and the costs of the greater portion of the canals at Lowell are not mentioned. In addition to the above items must be added the original cost of the land and large expenditures which have been made by the several mill owners jointly for works to control and regulate the flow from several large lakes on the watershed and thereby help the low water flow of the stream. The testimony of the mill owners in various suits relative to water power shows that the original costs of development on the Merrimac were so high that it has been customary to gradually "charge off" from year to year a portion of the cost so that the final results would show better interest on the apparent capital invested. It is believed to be safe to assume that the original costs in connection with the Lawrence water power have been about $1,000,000, which is less than the amount stated to have been originally paid in, and that those for Lowell have been considerably more. The original costs at Manchester could not have varied greatly from those at Lawrence. Additional hydraulic plant has, however, been put in all these places to utilize "surplus water" or that flowing in excess of the assumed low water capacity of the stream, and steam plants are also employed to keep up the power when the stream is low. The work is principally of a kind that requires steam for manufacturing purposes, independent of power, the year around for slashing, dyeing, etc., and steam also is necessarily required in the winter to heat the buildings. These other uses somewhat offset the cost of a steam plant, while the expenditures for surplus power by raising the average power developed on the stream really lower the average cost per horse power of the general expenditures which have been made to utilize it. There were originally sold at Lawrence 128 mill powers aggregating 8,700 net horse power and a little more power at Lowell where the fall is higher. The leases permitted the use of the water for 15 or 16 hours per day. In practice, however, but little water is used during more than 60 hours per week and the dams are so large that during low water little water is wasted and a larger power on a 10-hour basis is utilized, which fact together with the use of surplus water when available probably brings the net power available at Lawrence up to 13,000 horse power on a 10-hour basis throughout the year and somewhat more at Lowell.

On the basis of a cost of $1,000,000 the general plant at Lawrence has therefore cost about $77 per horse power and somewhat more at Lowell. Independent of this the mill owners have incurred large expenses in erecting turbines and hydraulic connections from the head canals to the lower levels. These costs have been estimated by Mr. Main at $45 per horse power, including provision for surplus water on an average of $65 per horse power for the average power utilized.† Adding this to $77, the general cost stated above, we find that the total cost of developing the water power on the Merrimac has been about $142 per horse power, which it will be shown is about the limit of cost at which water power can be developed in competition with steam. The Merrimac owners are, however, obliged to add to this cost the greater part of the cost of a steam plant for use when there is no surplus water, which still further increases the capital account.

It has long been known that the water power on the Merrimac had cost so much for development that could the expenditures be recalled it would be more economical to locate where coal can be obtained at cheaper rates and steam power used exclusively. This was true before mill engines were constructed as economically as at present. Now the preponderance is so great that unavoidable errors of fact as to the details of the original costs will not change the illustrative value of the presentation. It is true, notwithstanding these facts, that a new water power is being developed at Sewall Falls, near Concord, N. H., but it appears to be limited to the low water flow of the stream and it is not known whether it will assume part of the original cost of the reservoir systems.

The highest allowable cost for the complete development of water power from the dam to the jack shaft appears to be about $140 per horse power utilized on a 10 hour basis. If we consider that accidents are liable to happen to the best constructed hydraulic work, we should charge at least 2½ per cent. of the original cost for depreciation, say 1¼ per cent. for repairs and about 1¼ per cent. for taxes, or about 5 per cent. independent of interest account. If then on the principles above developed we charge 10 per cent. to an account for interest and dividends and allow 2 per cent. for operating expenses, the total annual charge becomes 17 per cent. of the original expenditure. At an original cost of $140 per horse power, 17 per cent. represents an annual cost of $23.80 per horse power per year, or about the same as shown in the tables with economical engines and coal between $2 and $3 per ton. Generally, however, there will be one company to furnish water power and others to utilize it, which will have the effect of increasing this 17 per cent. so as to make the balance in favor of steam somewhat greater. This statement of course only applies to conditions where simply power is required and no large quantity of water is necessary for purposes other than for power. When the power is used for 24 hours per day instead of 10 hours, a much greater original cost is permissible.

When the power of a waterfall is to be delivered at a distance, the allowable cost of actually developing the power must be decreased by that necessary to transmit the power and actually deliver it to a jack shaft at a given distance. An electric transmission is undoubtedly the most economical for such a purpose. If we add to the cost of the electric dynamos that of the buildings, of the hydraulic connections to the canals, of the turbines, of the line and of the installation, and finally add the cost of the motors, so that the power is according to the assumption delivered to a jack shaft, the total cost of what may be called the "electrical transmission plant" cannot probably at present prices be put in for $140 for each net horse power delivered, so on a 10 hour basis no expenditure could be allowed for the general development of the water power, but only for the simplest hydraulic connections to existing canals, etc. If, however, power can be sold throughout the whole 24 hours, more than double the price can be obtained for the same, and this will warrant doubling the total cost of development unless a greater percentage of income is desired. As the cost of the electrical plant remains the same, the whole allowable increase may be applied to the development of the hydraulic plant, thereby entirely changing the conditions.

The writer has not hesitated to recommend an original expenditure of $200 per horse power for a combined hydraulic and electric plant near large cities, where not only the customary income due to incandescent and arc lighting and the use of small motors at high rates would be available for comparatively short hours, but where the industries were such that large units of power could be sold at remunerative prices on a 24 hour basis. Even higher costs for development would appear to be warranted in some locations, but there is no general rule on the subject. The allowable expenditure in a particular case can only be determined from calculations based on the actual conditions.

Storage Batteries for Propelling Vehicles.

In the discussion of the paper on "The Present Status of the Storage Battery," read before the Chicago Electric Club (see ELECTRICITY, Vol. IV, No. 11), Mr. Deganhart gave some interesting facts in connection with the electrically propelled vehicle with which he has been experimenting for some time in Chicago. Speaking of the batteries he said: "During the past two years Mr. Keller and myself have conducted experiments with the view of perfecting a vehicle for carrying passengers about the city for pleasure and also for profit. Our experiments led us in a slightly different direction from that of the work ordinarily carried on in traction methods as applied to street cars. The work as applied to street cars calls for unusual conditions; the loads are varying, the tax on the battery is very great at intervals, the frequent stops necessitating hard usage of the battery; so that the use of a storage battery on a vehicle is peculiar in the respect that you must have small space and large capacity, which you are liable to be called on for at unusual intervals. I mean by that that in traversing a city like Chicago we encounter grades, as at the bridges. While it was our aim in our experimental work to confine the voltage to as low a point as possible, that is about 12 volts, we found it necessary to use a battery which would come to the rescue when we were climbing grades and propel the vehicle up those grades without the loss of horse power. The pasted batteries, that is, the batteries in which the plates have received the oxides by pasting, were found to be very weak as a rule. Without going into particulars as to manufacturers, or giving the names of them, I would say that generally the pasted batteries were weak. We discovered early in our work that there was a shortness of the fibres. By that I mean where the paste was applied it was evident that the molecules were finally broken up in pasting; while there was an adhesiveness in the method of pasting, still the molecules were so fine that when subjected to rough usage, such as going over cobblestones and uneven surfaces, the paste was gradually jarred loose. Consequently we were introducing an element not fitted for that kind of a battery. We also found that in hard usage the plates would buckle. Later on in our experimental work we were brought in contact with a battery made much on the lines of this cell, I gather from the explanations by Mr. Pompelly, as it was made electrolitically; that is, the plates were formed quickly by a secret process under a current.

"An examination of the plates of the battery which we use, manufactured 'practically' on the lines that Mr. Pompelly has adopted, disclosed the fact that there was a flocculent condition of the lead which the pasted battery did not possess. A close observation of this led me to the conclusion that it was due to the fibres of the lead interlacing, as it were, instead of being broken up into small particles, as in the paste. This flocculent condition was brought about by an interlacing of the particles as the oxide was formed, consequently giving a tenacity which the paste itself did not possess. It was our pleasure to find that there was practically no falling off of the oxide; that is, we did not find any to speak of at the bottom of the cell, nothing that would injure the life of the cell.

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† "The Value of a Water Power," by Chas. T. Main, Vol. XIII Trans. Am. Soc. M. E. The price stated seems high, but should be known to Mr. Main, who resided at Lawrence when the paper was written. He has, however, overlooked the items of cost of development referred to above, not mentioned by Prof. Swain, and therefore gives $130 as the total cost, instead of $142 as stated in the text.

"Another very important fact brought out in our research by the use of that cell was that there was no buckling of the plates. A very necessary quality in such a cell, as you all know, is the ability of retaining its voltage. A reading taken from a large number of pasted cells showed us that the voltage at first fell away very slightly, a trifle less than the voltage of this type of cells of which I now speak. However, as we progressed with our work the line of reading fell away gradually, and finally it dropped right off. While the readings taken from the cell, which was manufactured, as I think, much on these lines, that is, by this peculiar process, the reading extended almost in a direct line until the final moment, when the cell collapsed altogther; that is, the electrical energy had given out, and it dropped abruptly. That of course is a very desirable thing in all traction work; that is, the maintenance of a high voltage; for without that high pressure it is an absolute impossibility, in my judgment, to climb grades and get the efficiency from the battery that you must naturally expect if you intend to do the work of moving vehicles.

"A curious feature enters into the propulsion of vehicles which is not unlike the severe test that a car subjects the battery to. In the case of a car you move along on a plane surface, but you stop frequently, and there are varying loads on the car; that is, there are more or less passengers getting on and off. Sometimes you may carry fifty passengers and then again you will only carry ten; and it is the logical conclusion that in overcoming the inertia of a mass representing fifty passengers you call for more energy than you do in overcoming the inertia represented by ten passengers. However, in the case of a vehicle for street use we early discovered a very peculiar circumstance: that the road over which we traveled had much to do with taxing the energy of the battery. Without a rubber tired vehicle we learned that an ordinary dirt road, a macadamized road, was the most desirable for the propulsion of the vehicle, the economy of the battery, and the best all-around condition for vehicular travel. When we got on to the asphalt pavement we naturally supposed that we had a perfect condition. We were mistaken. A series of experiments demonstrated to us in a very short time that it required no less than 21 per cent. additional energy to move the vehicle over the asphaltum pavement. That seems almost preposterous at first glance; but when you recall the fact that the pavement is of a spongy character, and your wheels, four of them, indent themselves into the asphaltum, you find that you are continually climbing a grade, imperceptible perhaps to the eye, but nevertheless you are climbing a grade with four wheels all the time. Now wood pavements have objections, because they present varying conditions of surface. The same thing applies to the Belgium block pavement out here. Now when you introduce the rubber tire of course a great percentage of that is reduced. You move along freely over the asphaltum road. And therein again comes the desirability of having a battery which will maintain its high voltage until the battery is really unfit for service by the discharge, and moreover the desirability of having a battery which will retain its oxide in position. I mean by that that it must hold itself up; there must be no breaking down of the structural portion of the battery; the oxide must not fall to the bottom, because it is self-apparent that in handling the vehicles you must have your battery so constructed that if you have relay batteries, that is, if you propose to run your vehicle for five hours at its maximum capacity of speed, then you must perforce have some place where you can renew the battery quickly, where it will be subjected to the rough usage that the ordinary man about some stations will put it to. It is not to be supposed that he is going to handle it like a piece of china. He yanks it out of the wagon, slaps it on the ground and puts in the other cell, connects it up and you start off, over the rubble pavement perhaps, and you can clearly see that you want a battery which will hold up, which is strong and won't buckle and won't drop its oxide to the bottom of the cell. Our experience over those two years has brought us to the conclusion and the firm conviction that this type of battery, this form preferably of rolled lead, is the best for the propulsion of vehicles; and I do not think I am claiming too much when I say that if this cell holds up as the demonstrations have shown us would lead me to suppose it would at that voltage, then we have the ideal battery in that type. I imagine that the difference between the use of cast lead and rolled lead comes in again much in the way that I have explained—the use of the oxides. There is a broken-up condition in a cast lead, there is not a homogeneous condition of affairs from which the molecules by melting have become separated to a certain extent; but in the rolled lead there is a sort of interlacing of the molecules, and consequently when the oxide is formed there is an original interlacing of the molecules through the rolling process, and by that means the oxide is held firmly in place.

"I may say in experience in the last two years that various batteries were tried, and that it has never been my pleasure to meet with a cell before of this character; while it is true that the cells, multiple series cells, that we used on our vehicle exhibited much the same characteristics; that is, the voltage held up well. In starting your load the voltage is taxed, of course. You start in with a high rate of discharge in amperes, and almost at once, as you get under motion, the ampere current descends to the average, and your voltage is kept up all the time. You tax your voltage—that is, on this apparatus that we have used, simply because we required fully twelve volts, enough to provide for any excess demand, and consequently we had a good opportunity to judge whether we needed any extra pressure for it; and I am free to say that you do need a reserve force of pressure. It is the pressure that maintains your speed after you have got under way.

"I just recall a test made on that vehicle. In starting up we required as high as 39 amperes. We were carrying about 1,250 pounds dead weight. When we got under way on a dirt road we used 27 amperes at 12 volts. When we struck the asphaltum we used 32.4 amperes and required that amount of current at 12 volts to move us along that road at four and a half miles an hour. We had plain iron tired wheels."

The Trust was Not In It.

The Westinghouse Company have closed a contract with the Atlantic Avenue line in Brooklyn for one hundred car equipments. The total value of the contract is over $1,000,000. Westinghouse business for the month of March was the largest in the history of the company.

The Present and Future Competition Between Gas and Electricity.

BY JOSEPH GWYNN.*

The above subject was assigned me by the Executive Committee of the Ohio Gas Light Association, and at the urgent request of our worthy secretary I consented against my own judgment to prepare a paper on the subject. My reasons for objecting were that I did not consider it a proper subject to come before a strictly gas association, and last, but not least, my grave doubts as to my ability to add anything to what has already been written in papers read before this Association some years ago. I feel confident that the subject treated will not please what is termed strictly a gas man, as his whole heart, soul and energy, if he is a wide-awake gas manager, are bent upon his gas business; and as most of you are aware, everything in the illuminating line is inferior, unreliable and impracticable as compared with gas; that is, looking at it from his standpoint. But none the less, electricity is in our midst and with its rapid strides is advancing with unparalleled rapidity in all directions. Never in the history of the civilized world has any one invention or discovery made the rapid strides and advancement that has electricity. It has been and is being daily pushed by unlimited capital and energy. As I stated at our Dayton meeting several years ago, electricity has come to stay and my advice to all live gas managers is not to follow in the footsteps of Rip Van Winkle, but to wake up and take hold at the helm and be at your posts ready to meet all emergencies as they come and be in shape to give the public whatever kind of light they demand. That electricity is a full-fledged competitor of gas in all that the word implies I think there can be no doubt. It has, practically speaking, an unlimited field to fill and more opportunity for rapid strides and advancement than has gas; and while it has some disadvantages to gas, looking at it from an illuminating standpoint, yet on the other hand it has some advantages over gas.

In order to get at the inwardness of both branches of the industry and to treat them fairly from an unbiased standpoint and produce a paper based on actual facts and figures, and not one written from my own views on the subject, I communicated with upwards of two hundred gas and electric companies in different parts of the United States, in order to obtain as reliable data as possible on the subject to be treated. In order to give each one opportunity to consider the subject for himself and to rely on his own judgment as to the best course to pursue in the future. I append a few figures in order to fully show the advancement of both branches of the business. To show the rapid advancement of one branch of the electric business, which is arc lighting, I append the following figures, showing the growth of the carbon business. Upon the introduction of the arc lighting business from the year 1879 to the year 1881 only a small amount of carbons were manufactured, and from what data I can obtain the total sales of carbons would not exceed one million per annum, with prices ranging from $120 to $150 per thousand. From 1881 to January 1, 1892, the amount of carbons manufactured and sold in the United States has gradually increased until to-day there are upwards of 145,000,000 of carbons being manufactured and sold annually, with prices ranging from $9 to $10 per thousand. From the above figures it will be seen that the arc lighting business has shown an average advancement of over twelve per cent. per annum for the past twelve years. While the arc lighting business has shown a rapid advancement for mainly public lighting, what effect do we find this has had upon public lighting by gas companies. To-day out of over 928 gas companies in the United States we find of that number only 435 have contracts for street lighting and 493 have lost the street lighting business entirely which has been displaced by arc and some few incandescent lights, while on the other hand a great many of the gas companies who still do street lighting do only a limited business in this line as street lighting by gas is being gradually displaced by electricity and will eventually be a thing of the past. Let us again consider the two great competitors from a commercial lighting standpoint and what are the results? The aggregate gain in output of twenty-seven gas companies for the year 1891 is 6.56 per cent. and for the year 1892 6.61 per cent., or a net gain of 13.17 per cent. for the output of 1892 over that of 1890. For comparison, I will now show the aggregate gain of the commercial electric lighting business. In 1891 the aggregate number of incandescent lamps then installed by fourteen electric companies was 16,475 and in 1892 the aggregate number of lamps then installed had reached 33,238, showing a net gain of over one hundred per cent. in the past year. From the above figures it will be plainly seen that the net increase of commercial incandescent lighting for the past year over gas is ninety-three per cent. In addition to the incandescent lighting business of the above electric companies, I find that in 1890 they had then installed 1,047 commercial arc lights and in 1891 they had increased to 1,149 and in 1892 to a total of 1,620 lights, showing a net gain in the past two years of over fifty-four per cent.

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* Read before the Ohio Gas Light Association, March 15.

Again, let us look at the lighting question. It has been claimed by most gas managers that electricity could not compete against gas for day lighting as the business was not sufficient to justify an electric company to operate day circuits only in large cities. In this respect, I wish to say they have been mistaken, for I find that quite a number of electric companies in cities of 20,000 population and under are operating day circuits, or, in other words, are operating their plant for the full twenty-four hours. I am asked how they can afford to operate a day circuit without continual loss. I wish to reply to this question by saying that in addition to what lights are required the constant demand for ventilating fan motors, from which a good revenue is derived, enables an electric company to operate a day circuit at a small profit. To give you an idea of the growth and prosperity of the ventilating fan motor business, which is being rapidly introduced by electric companies, I append a few figures obtained from the manufacturers as to the sale of fan motors for the years 1891 and 1892. In 1891 the sale of fan motors by four of the principal electric companies was 2,012. In 1892 the sale of fan motors by the same companies was 5,093 and the companies above referred to stated in their report to me that from the present outlook the sales of fan motors for the year 1893 will be fifty per cent. greater than for the previous year. In order to further enlighten you on the possibilities of electric companies operating day circuits, I wish to call your attention to the following figures showing the enormous increase in the sales of motors used for isolated purposes and independent of street-car use. In the year 1889 the sales were, practically speaking, nothing, as the reports obtained show an aggregate sale of 175 horse power. In 1890 the aggregate sales of motors of five of the principal electric companies show 6,584 horse power. In 1891 the aggregate sales of motors by six of the principal electric companies were 9,657 horse power and for the year 1892 the aggregate sales of seven of the principal electric companies were 19.216 horse power, or, in other words, the total sales of motors for the past three years by seven of the leading electric companies show an aggregate of 35,457 horse power. This branch of the business, if you will stop to think, comes in competition with the gas engine business, and while I have no figures to show the aggregate horse power of gas engines sold for the same period, yet at the same time I venture the assertion that twenty-five per cent. of the sales of motors would be a fair estimate for the sales of gas engines. This branch of the motor business, looking at it from an electric standpoint, is not as easy to handle, and possibly not as profitable as is the gas engine business to gas companies. While the gas company can furnish the gas required for gas engines through the same line that is used for illuminating purposes and without increased expense, it is impossible for electric companies to furnish current for motor use from the same circuit used for lighting. As I stated above, fan motors can be operated on the electric lighting circuits, but when an electric company undertakes to operate anything larger than fan motors from a lighting circuit, the continual stopping and starting of the motor will cause a variance in the lights.

There is no doubt but that electricity has made rapid advancement over gas in the past, and while it will continue to advance possibly more rapidly than will gas, yet at the same time, in the future, the advancement will be somewhat checked as the novelty has worn off. Yet, on the other hand, the continued improvements, which are many and great, in electrical appliances will continue to make the electric business more simple and reliable, and will still hasten its progress rapidly on for some years to come. In conclusion I wish to make mention of a few facts that may be of interest to gas companies. My advice to all is to stand firm and push your business with all the vitality you have. Strive to make a good quality of gas as is possible at a minimum cost and sell at the lowest price possible to give a fair return on the capital invested. Again, let me urge upon you the necessity of pushing your gas heating and cooking business as rapidly as possible, as this is an almost unlimited field for gas companies, and one that is not likely to be disturbed in the near future by your co-competitor, the electric light company.

The Edison Feeder Patent Sustained.

Full Text of Judge Green's Decision Not Yet Given Out.

The Associated Press on Monday, March 27, reported that Judge Green, in the United States Circuit Court at Trenton, had decided for the plaintiff in the suit of the Edison Electric Light Company vs. Westinghouse, Church, Kerr & Company for infringement of the Edison feeder patent.

An air of mystery has surrounded the matter since the first announcement, and no one, so far as we can learn, knows just what points the decision covered. The statement, however, from General Electric officials, that the sustainment was broad enough to cover a majority of the incandescent light and street-railway plants in the country has been used industriously in the financial papers, and has had a favorable effect on the stock market. Whether the decision, when published, will prove these claims remains to be seen.

The feeder and main system to which this patent refers provides for keeping the voltage as nearly equal as possible at every point on the distributing system. This is effected by running mains throughout the system of distribution and taking off the branch lines for service from them.

These mains form a network over the whole system and are calculated to carry the current from the centres of distribution, or feeder ends, to the service wires.

The feeders connecting this system with the station are led to different points on the mains, and each feeder supplies current for a certain territory which is distributed by the mains.

The mains are generally calculated for a very small drop in potential—about two per cent.—and the principal loss is in the feeders. By keeping the voltage at the different feeder ends equal, the pressure on the mains is kept practically even throughout the whole system.

The Trenton station involved in the suit was one of those originally installed by Westinghouse, Church, Kerr & Company to use the Byllesby three-wire system. The Edison Company brought eight suits, based on various patent claims, against the local company and Westinghouse, Church, Kerr & Company. Some of the points covered were the three-wire system proper, the feeder system, the use of a bank of lamps in throwing in dynamos, the connection of the field circuits with a switch, and several minor ones. The system was taken out when the alternating system was introduced. It was the original intention of the Edison Company to get a verdict on the three-wire patent to use against the Thomson-Houston Company, who have been the chief infringers of that patent.

The present case will naturally be carried to a higher court, and it will probably require a year or so to get another decision. It is admitted by every one except the General Electric Company that the patent has only one more year to run.

A broad sustainment of the patent would cover practically all central stations and isolated plants for direct-current incandescent lighting, and every electric railroad in the country of any consequence. Of course the Westinghouse lighting plants using the alternating current would not be affected.

The present case has been strenuously contested by the Westinghouse Company. Able counsel were employed, and eminent electricians were examined as experts on both sides of the case. In support of Mr. Edison's claims, Sir William Thomson, Prof. Chandler, Mr. Henry L. Brevoort, and William J. Jenks were examined as experts, and on behalf of the Westinghouse Company Prof. Morton of the Stevens Institute of Technology, Mr. Franklin L. Pope, Mr. Edward Weston and others. The taking of testimony occupied nearly five years, and involved an expense of probably not less than $100,000.

All the numerous contributions to electric science by such well known writers and patentees as Lane-Fox, Werdemann, Khotinsky, Sawyer and Man, and others, were cited and relied upon.

The case was argued in May, 1892, by Frederic H. Betts on behalf of the Edison Company (Betts, Atterbury, Hyde & Betts and Eaton & Lewis representing the Edison Company), and Messrs. Kerr & Curtis, William Bakewell, and Edmund Wetmore appearing for the Westinghouse Company.

The Bird is Now in Training.

The mystery surrounding the new lamp the forthcoming appearance of which was announced exclusively in Electricity is no nearer solution by our esteemed contemporaries, or by the public generally, than it was when our announcement first appeared. Nevertheless, most satisfactory progress is being made with the arrangements for placing it on the market in large quantities, and we hope to be in a position in our next issue to finally allay the anxiety of everybody whose nervous system is at present on the rack because of inability to find out just where and when the new light is going to break on the horizon of the doubters and sceptics. The representatives of our electrical contemporaries are assuming knowing airs, and professing familiarity with every detail, and just as soon as we come out with a full story—illustrated of course—of the new lamp, why, of course, our journalist friends will exclaim, as they always do when they want everybody to believe they haven't been left—"We told you so."

An Innovation in Street Cars.

The street railway syndicate that have obtained control of the street car lines in Hudson and Essex Counties, N. J., intend, it is understood, to introduce a novel feature in their new electric cars, somewhat similar to the English system. The new cars are to be much longer than the present horse cars and will be divided into two compartments, one of which will be reserved for women and children, though men may be admitted. The fare in the reserved compartment will be six cents, in the other five cents. It is thought that this arrangement will have the effect of secluding the cleaner and better dressed passengers from contact with the unsavory and unkempt travelers of unacclimated habits, who it is expected will prefer the cheaper compartment not only to save the extra cent but to avoid mortifying comparisons between their own coarse and dirty garments and those of their better groomed fellow passengers.

Personal.

John Cabot, lately in the employ of the Edison Company of New York, has been elected city electrician of Cincinnati to succeed Robert Mackie, whose resignation we have chronicled.

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New York Telephone Rates.

The long standing struggle of the Business Men's Protective Association against the extortionate rates for telephone service in New York City has again been revived and is being conducted in the manner which has proved so entirely ineffective in former years. The list of bills which have been defeated, smothered in committees or left unconsidered by previous Legislatures is too great to give much encouragement for the passage of the latest one, that recently introduced by Senator Walker, which fixes the prices for telephones at rates proportional to the sizes of the cities in which they are used. The mileage charges are limited to ten cents and are only to apply to distances over five miles.

While there is no question that the rates in this city are exorbitant—being considerably higher than those of any other city in the United States—and admitting the propriety of the Walker bill, the chances of its becoming a law are very doubtful. Moreover, the matter can be adjusted by the subscribers themselves, and quite effectively, without recourse to legislation. A few years ago the same conditions existed in the city of Rochester and at the third attempt to advance the rentals for telephones the citizens made a strong protest, which, however, was unheeded by the telephone company. Finding remonstrance to be unavailing in reducing the prices, every telephone subscriber ordered his instrument out on a certain day, and for over six months not a single telephone was in use in that city. At the end of this time, however, the telephone company was glad to meet the demands of the public, and the telephones were replaced at the rates for which the subscribers had contended.

This same remedy is open to New York or any other city, and if thoroughly carried out is impossible of failure. While the telephone has grown to be an important adjunct of most business offices, there are comparatively few places where it is absolutely indispensable, and the inconvenience caused by such a course of action would be pretty sure to be but temporary.

In Buffalo a telephone subscribers' association has just been organized to effect a reduction in the rates in that city, and the question of following Rochester's example is under consideration. Although enjoying lower rates than New York City, the profits of this Buffalo company, as shown by the report of a recent legislative committee appointed to make an investigation into the affairs of the company, were shown to be about 50 per cent. on the actual investment for the year 1886.

The large variation in rates for cities of equal population show conclusively that there has been considerable extortion practised in many cases, but there is also no question but that the subscribers have a remedy if they care to use it, as the business of the telephone companies depends entirely upon the patronage of the public.

* * *

THE sustainment of the Edison lamp patent sinks into insignificance when compared with the effects of a full establishment of the Trust's claims to the feeder system.

A Common Source.

The exchange reader on a metropolitan daily paper, who is expected to glean from perhaps a hundred publications every day, has often been impressed with the similarity, not only in ideas but in the language itself, of editorials appearing the same morning in publications so widely separated as to preclude the possibility of a discussion of the particular subject by the various supposed writers. During national political campaigns this similarity is particularly striking, and often goes so far that scores of editorials appearing in cities hundreds of miles apart, on a given day, are exactly the same, word for word.

The novice might marvel at this, but not the old timer. He knows the reason, the common source of this outflow of wisdom.

Hence when we counted recently upwards of forty editorials on the marvellous progress made by the promoters of the Chicago-St. Louis electric road—the possibilities of the new era which the completion of this road would mark—clipped from as many different journals from all parts of the country, identical in ideas, in diction, even in punctuation, we did not marvel—except at the childish faith of the editors.

We knew that the boomers of the through-by-lightning fake were making another spurt in the sale of stock, and that the Press Bureau had another bill to charge to Promoting Account.

* * *

The Telephone Patents.

A decision of considerable importance as affecting the telephone patents in this country was rendered on March 27 by the United States Supreme Court. The law upon which this decision is based reads: "Every patent granted for an invention which has previously been patented in a foreign country shall be so limited as to expire at the same time with the foreign patent."

In this connection the question has been raised whether a foreign patent limiting the duration of an American patent should be prior to the date of issue or prior to the date of application for the latter. The former is in accordance with a strict interpretation of the law, but the question still remains to be settled in the courts. If this view is upheld the Telephone Company will have only the Berliner patent left, and as the validity of the latter is in question there is a reasonable prospect that the entire telephone system may at no distant date be thrown open to the public.

* * *

THE General Electric Company, when it recently sent a $1,000 contribution to the New York Press Club, wasted its money. The desired object will not be accomplished. One thousand dollars is not enough to smother even the most disreputable of the New York dailies. And as for the best papers, they cannot be bought for any price. It may not be amiss to remind Mr. Coffin that George Jones once declined a million dollars in currency which could have been his in consideration of his withholding the facts which his young men had gathered in regard to the Tweed ring. Furthermore, the New York Press Club is not composed of the men who direct the policy of the daily press.

Tightening Their Grip. In the absence of definite information on the subject, it is impossible to discuss intelligently the effects of the sustainment of the Edison feeder and main patent by Judge Green, of the United States Circuit Court. The withholding of the facts in the case for so many days gives some ground for the belief that the decision was not so broad as is claimed by officials of the General Electric Company.

The possibilities involved, however, in a final broad decision in favor of this patent are worthy of thoughtful consideration.

The advantage gained by the Trust in the establishment of the validity of the lamp patent would be as nothing compared to a like final decision in this case, provided the decision comes before the patent expires.

However plausible may be the statements of Mr. Fish as to the future policy of the Trust, the trade knows what has been the policy in the past few months, and that it has little to expect in the way of justice or fair treatment. And while non-infringing lamps will soon be on the market in sufficient quantities to meet all requirements, it is difficult to conceive of any method by which to avoid the claims of the feeder patent.

It behooves every man who has the best interests of the trade at heart to put forth his best efforts. The fight now on is one for existence.

ELECTRICITY has already suggested one means of redress which independent concerns can bring about, and which could not fail of success. A thorough Congressional investigation would riddle the common enemy, and leave him without a legal leg to stand on. This, however, cannot be accomplished for several months to come. Meantime ELECTRICITY will not be idle. We shall endeavor before the summer is over to lay before our readers a fair idea of the actual financial condition of the Trust—and we shall not rely on the annual statement of the company.

* * *

"The Lamp Situation." In its last issue the *Electrical World* publishes another instalment of "discussion" of a subject which is as dead as Kelsey's cat.

No one believes that the Electric Trust *can* do what it started out to do; no one, except the members of the Bread and Butter Brigade (represented this week by Mr. Wilmerding and Mr. Fish), believes that the success of the Trust, if possible, means aught else than ruin to scores of independent concerns, and a standstill in the development of the art.

The methods adopted by the *Electrical World* to start this discussion are on record. When it seems advisable to do so, we shall print documentary proof that this paper has violated all journalistic courtesy, decency and common honesty.

Meantime, the only point brought out which is worthy of notice in these columns is the sickly whine of the *Electrical World* itself, that it has not been able to induce others to do the work which it should have long ago undertaken on its own responsibility.

"How exceedingly non-committal those are who have thus far given their views on this subject must be generally remarked. Several who thought their business would be injured as a result of the lamp decisions gave it as their opinion that electrical journals should speak very frankly to the General Electric Company, and point out to it the course it was expected to pursue in this matter. When the suggestion of discussing the subject in the *Electrical World* was made, each of these was invited by letter to give his views, either over his own signature or otherwise, and, strange as it may seem, *not one of them responded, except to the effect that he had nothing to say for publication.*"

Following this is an humble apology for its friend and patron, the General Electric Company, and a little gratuitous advice to the trade, which it has insulted regularly in every issue for eight months.

The concern that sits down now to "let matters take their own course" may sit there till doomsday. There will never be any occasion for it to arise.

* * *

Alternating Current Arc Lighting. We print elsewhere an estimate furnished by Mr. Frank B. Rae for an arc lighting plant for the city of Detroit which is based on a system entirely novel in this country. Although there have been a few arc lamps used here on alternating currents, they have not been entirely satisfactory. Within the last few months, however, a lamp of German design has been introduced by a Philadelphia company which promises thorough success.

American arc lighting practice has, in fact, been considerably outstripped by European engineers, and alternating current arc lighting has been developed abroad with excellent results. Besides being more flexible in permitting the use of incandescent lighting from the same circuit, the alternating current can be used at its highest efficiency for arc lighting as the load is practically constant during the entire run. The efficiency of the converters is well known to fall off considerably as the load decreases, but by having a constant load, as in this case, they may be run at their maximum capacity with a loss of not more than three or four per cent.

By running the high pressure lines to the converters underground, which is proposed in this case, the element of danger is greatly reduced as all the wires within possible reach are no more dangerous than those of the ordinary incandescent lighting systems. While the type of plant suggested in this estimate would undoubtedly be an economical one to operate, the cost per lamp per year would be pretty sure to exceed the figure given. The cost of coal is figured at $2.00 per ton, and if this price is correct Detroit has considerable advantage over the majority of cities owning municipal plants. The item of repairs and depreciation, which is put at four per cent., is likely to be considerably exceeded in practice. There should also be included the items of taxes and water rates, as these would accrue to the city if such a plant were to be operated by a private company. There are, however, some excellent suggestions in this estimate which would enable a central station company to furnish arc lights at a still more economical figure, as the production of a satisfactory alternating current arc lamp makes it feasible to run the street lamps on an ordinary incandescent house lighting system of the alternating type and further increase the economy of operation by using still larger station units, avoiding the running of extra lines and decreasing proportionally the cost of labor and attendance.

* * *

WE recommend to the consideration of the New York *Sun* the leading article in the *Electrical World* of last week, copied verbatim from the *Sun* of Tuesday, March 28. Not only was the news matter stolen, but the Edison interview with a *Sun* reporter was made to appear as if secured by the *Electrical World* itself. The printing of 22 or even 220 pages of this kind of matter is no cause for "self-gratulation," no proof of enterprise. The only requisites are industry with the shears, a total lack of conscience, and enough money wheedled out of the trade under false pretenses to pay the printer's bill.

* * *

A PROMINENT electrical man in the West writes as follows:

"I was very much amused at your article on the Man from Oshkosh visiting New York. I was ground through this mill myself about a year ago, and all I have to show for it up to the present writing is a notice of interference in the Patent Office upon an invention which they were surprised 'so young a man' should have had brains enough to perfect."

This mill is not so well supplied with grist as it was a month ago.

* * *

A SUBSTANTIAL increase in salary was awarded to the Controller of the General Electric Company recently—just about the time, in fact, that work was begun on the preparation of the annual statement.

* * *

IF THE *Electrical Engineer* had made the request, we would have cheerfully loaned it the illustration to accompany the item "An Electric Safety Curtain," the text of which it borrowed from our issue of February 22 without permission and without acknowledgment.

* * *

WE HAVE strong assurances that our argument for the admission of supply men to full voting privileges in the National Electric Light Association has borne fruit, and that at the next session they will be admitted. They will have a vote simultaneously with the twenty-five or thirty gentlemen whose dues were paid by the Trust's lobby at the St. Louis meeting. The money was wasted.

* * *

BY reference to our advertising pages it will be noticed that the Buckeye Electric Company have discontinued manufacturing incandescent lamps, and have ceased to take orders or make shipments.

"Self-Gratulation."

Uriah Heep Enjoys His Seat on the Fence, and Shakes Hands With Himself.

(*From the Electrical World.*)

We have in recent numbers taken occasion to felicitate ourselves and our friends upon the prosperous condition of the *Electrical World* as evidenced by its large and rapidly increasing circulation, the extensive use made by our patrons of its advertising columns, and the DIGNIFIED COURSE which we have been able to maintain under slanderous attacks from envious contemporaries and under more trying conditions of trade than the electrical interests have ever before been called upon to meet.

Detroit Lighting Matters.

Estimates For a City Plant.

Mayor Pingree has succeeded in getting a bill through the Michigan Legislature authorizing the city of Detroit to build a municipal plant. Mr. Pingree wisely called on Mr. Frank B. Rae to prepare estimates of the cost of a new plant equipped with modern apparatus. The city is now in shape to demand its rights, but is not compelled to build a plant unless it seems best.

The high standing of Mr. Rae in his profession renders his estimates on the cost of a plant of general interest.

The following is a summary of estimate No. 1, which is of the greatest interest owing to the novelty of the design proposed:

FOR 2,000 ARC-LIGHT PLANT COMPLETE WITH FIRE PROOF BUILDING, DIRECT COUPLED ENGINES AND DYNAMOS.

TOTAL COST OF STATION.

Real estate and buildings including chimney...	$35,000
Boilers and appurtenances at $22 per horse power...	44.000
Engines and connections at $28 per horse power.	58,800
Dynamos and station electrical appliances at $33.25 per horse power...	70,000
Contingent, 5 per cent...	10,090
	$217,890
Lamps, lines, etc...	$320,000

TOTAL INVESTMENT.

Station and power plant...	$217,890
Lamps, lines, etc...	320,000
	$537,890

COST OF OPERATION AND MAINTENANCE PER YEAR, STATION TO RUN TWELVE HOURS PER DAY AT 2,000 HORSE POWER.

Expenses of Commissioner's office, including City Electrician, secretary, clerks, etc...	$6.000
Employees' salaries...	11 540
Fuel, maintenance, etc...	55,942

Cost per H. P. per year delivered to line:
55,942 ÷ 2,000 = $27.97.

Cost of maintaining lamps and lights per year, 2,000 lights...	$62,250
Cost per lamp per year for line and lamp maintenance...	31.12

TOTAL COST PER YEAR.

Expense of Commissioners' office per year...	$6.000
Cost of 2,000 horse power...	55,924
Cost of maintaining lamps and lines...	62.250
	$124,174

TOTAL COST PER LAMP PER YEAR.

Expense of Commissioners' office per lamp per year...	$3 00
Cost of power delivered to line per year...	27.97
Cost of lamp and line maintenance per year...	31.12
	$62.09

This estimate provides for dynamos of the alternating current type, having a potential of about 2,000 volts, arranged to be operated together upon one set of mains. A system of distribution from the main station either to large converters at convenient centres of distribution or individual converters for each lamp or group of lamps.

The engine room to contain three vertical, compound condensing engines of about 700 H. P. each, or four of 500 H. P. each, with dynamo machines of like capacity, having the armature mounted directly upon the engine shafts.

The total output of the station may be carried upon a single set of main conductors, and the conduit system thus reduced to two ducts and a single pair of wires. When it shall become necessary to increase the capacity of the station for added lights, such increase can be made without altering the underground mains by raising the pressure upon them with converters.

The First Direct-Connected Machines for Isolated Plants.

The electric light plant in the Havemeyer Building, recently described in ELECTRICITY, was, we are advised, incorrectly credited with the first use of direct-connected engines and bipolar dynamos for an isolated plant.

Mr. Newton L. Schloss has called our attention to a similar plant previously erected by him for the New York Biscuit Company while manager Thos. H. Dallett & Company, of Philadelphia.

CORRESPONDENCE.

Photograph of "Ribbon" Lightning.

To the Editor of ELECTRICITY.

DEAR SIR: Referring to the letter of Prof. Elihu Thomson which appears in your issue of March 15, explaining the cause of the "so-called ribbon lightning," a photograph of which was produced in ELECTRICITY of March 1st, instant, I do not agree with Prof. Thomson that the broadening of the band is due to camera movement, as I have obtained photographs of "ribbon" lightning when the camera has been firmly anchored and there could be no possible movement of the lens tube.*

I distinctly *saw* this identical flash in all its details as a broad wavy ribbon; at the same time I caught a clear, instantaneous view of the railroad ties close up to the end of the moving train.

Neither do I think a part of the photograph represents the effect of "the gradual cooling of the hot stream of air particles," for in such a case the line of light would be shaded from one side to the other, owing to the gradual loss of actinic power, which effect my picture does not show.

I saw hundreds of lightning flashes that night, blazing up on all sides, but with a single exception they consisted of sinuous *lines*, not ribbons.

This broad band looked to me more like a vivid section of the "Northern Lights" than an ordinary lightning flash.

Very truly yours,
W. N. JENNINGS.

Historical Exhibits at the Official Headquarters of the American Institute of Electrical Engineers at the World's Fair.

To the Editor of ELECTRICITY.

DEAR SIR: At the last meeting of the Council of the American Institute of Electrical Engineers, the Committee on Ways and Means, who have charge of matters pertaining to the official headquarters of that body at the World's Fair, presented a report and the committee was instructed to insert a notice in the technical papers calling attention to the fact that the Institute had secured through the co-operation of the authorities at the World's Fair two rooms adjoining the offices of the Electrical Department in the Electricity Building. These headquarters are now being furnished and the secretary of the Institute, Mr. Ralph W. Pope, will be in general charge of the headquarters during the Exhibition, and the committee, on behalf of the council, wish to extend an invitation, not only to the members of the American Institute of Electrical Engineers, but to any and all of our foreign friends of the electrical profession who may visit our shores during the coming World's Fair, to use these rooms as their headquarters. Letters may be addressed in the care of the secretary at the headquarters. In the furnishing of the rooms, facilities will be given for writing letters, meeting friends, reading technical papers, which will be placed on file, leaving their parcels and securing general information upon the Electrical Congress and other meetings and World's Fair matters generally. The rooms will be equipped with a long-distance telephone and telegraph service, fire protection, and the authorities have promised to place one or more members of the Columbian Guard at the headquarters. The Institute has decided to place in these rooms various objects of great scientific and historical interest, such as photographs, pictures, autograph letters, rare electrical books, models, instruments, etc. These things will be properly classified and arranged, and the committee request that all persons having objects which would prove of interest or value in this connection to communicate with the secretary, Mr. Pope, at the headquarters of the Institute, No. 12 West Thirty-first street, New York City, or with the chairman of the committee, Mr. William J. Hammer, 527 Temple Court, New York City. As we are somewhat limited for space, the committee will be compelled to select only objects which are not too bulky and which are of great interest and value, and they propose to make the headquarters of the Institute one of the most interesting features of the Electrical Department of the World's Fair. As the time is very limited, the committee trust that a prompt response will be given to this call, and that all the members of the Institute will feel a personal interest in seeing that the exhibit made shall be as full and as valuable as possible. The secretary was instructed by the council at the last meeting to extend an official invitation to the foreign electrical societies to avail themselves of the privileges of the Institute.

WM. J. HAMMER, }
FRANCIS R. UPTON, } Committee.
W. A. KRIEDLER, }
New York, March 29, 1893.

BOOK NOTICES.

Two Trade Directories.

THE "ELECTRICIAN" ELECTRICAL TRADES DIRECTORY AND HANDBOOK FOR 1893. (Eleventh Year.) THE "ELECTRICIAN" PRINTING AND PUBLISHING COMPANY, LTD., London. Price 7s. 6d.

JOHNSTON'S ELECTRICAL AND STREET RAILWAY DIRECTORY. THE W. J. JOHNSTON PUBLISHING COMPANY, New York. Price $5.

The "Electrician" Directory for 1893 shows the same painstaking care which has been evident in the previous volumes. It has long since become the standard directory of the electrical trade throughout the world. It is a directory, and more than a directory—it is practically an encyclopædia of general information. The table of contents would itself fill one of our columns, and there are no useless departments—no padding. The work comprises about 600 pages of directorial matter and 400 pages of handbook information.

For concerns doing foreign business it is well nigh invaluable, and working electricians will find it a great time-saver as a work of reference on many subjects.

We regret that equally high praise cannot be given to "Johnston's Electrical and Street Railway Directory." This latter work is, of course, not intended to fill the same field as the one just mentioned, but is a directory only. It, however, contains so many errors and inaccuracies that it falls far short of perfection. It is valuable inasmuch as it is the only directory we have; and it may be forgiven many faults in this its first issue. But we recommend in this case direct copying of English custom, and trust that the W. J. Johnston Publishing Company will not be eleven years in giving us a directory and handbook which will be at least on a par with the "Electrician's."

ALTERNATING CURRENTS. BY DRS. FREDERICK BEDELL AND ALBERT C. CREHORE. THE W. J. JOHNSTON COMPANY, LTD., New York. 325 pp., 112 illustrations. Price $2.50.

Notwithstanding the prominent position which the alternating current has attained in the solution of a large class of modern electrical engineering problems, most of the literature on this now important branch of the industry has been of a desultory character, generally treating of special applications and ignoring the fundamental principles from which the results are deduced.

The present work is the first book that treats the subject in a connected, logical and complete manner. The principles are gradually and logically developed from the elementary experiments upon which they are based, and in a manner so clear and simple as to make the book easily read by any one having even a limited knowledge of the mathematics involved. By this method the student becomes familiar with every step of the process of development, and the mysteries usually associated with the theory of alternating currents are found to be rather the result of unsatisfactory treatment than due to any inherent difficulty.

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* *Photographic Times*, New York, May 16, 1890, and *Journal Franklin Institute*, January, 1892.

The first fourteen chapters contain the analytical development, commencing with circuits containing resistance and self-induction only, resistance and capacity only, and proceeding to more complex circuits containing resistance, self-induction and capacity, and resistance and distributed capacity. A feature is the numerical calculations given as illustrations.

The remaining chapters are devoted to the graphical consideration of the same subjects, enabling a reader with a little mathematical knowledge to follow the authors, with extensions to cases that are better treated by the graphical than the analytical method.

Electric Welding.

There is at present building at the General Electric Company's factory, Lynn, a machine for electrically welding together either street or steam railway rails. The machine can be used either at one particular point or can be mounted on a flat car and moved from place to place. The current can be taken from the trolley wire overhead; the joints can be made after the rails are laid, and it has been proved that in about eight minutes welds can be made which are the strongest parts of the rails.

"Will the Closed Conduit Supercede the Trolley in Large Cities?"

BY F. C. PERKINS.*

(*Concluded.*)

Mr. Chas. Harding, of Atlantic, Iowa, was granted English patents April 15, 1891, for a sectional closed conduit system in which each section of the conduit was connected to the main conductor within, automatically as the car passed, by means of electro magnetic switches or contact devices placed in sealed boxes, one for each section.

Mr. Wm. B. Heron, of Brooklyn, was granted American patents August 18, 1891. His plan is to use a magnet on the car and a " traveling armature " on wheels within the sectional conduit. As the car moves along, the traveling armature is attracted or drawn along by the magnet on the car.

It is not stated how the traveling armature is picked up again should it wander away from the car.

An American patent was issued to Mr. Mark W. Dewey recently on an induction system using alternating currents, the arrangement of the transformers being such that the primary circuit is underneath the road-bed while the secondary is carried upon the car, so that there is no metallic connection between the car and the main circuit from which the current is derived.

Mr. Dewey's plan is to place the primary coils wound upon U-shaped iron cores in the roadbed between the rails, at equal distances apart and at intervals corresponding to the length of the car. The apparatus carried on the car constitutes the other half of the transformer. Each motor has an inverted U-shaped or straight iron core, upon which one or more secondary coils are wound. When a good alternating current motor is placed on the market, this system will undoubtedly receive greater attention than it has heretofore.

Mr. C. J. Van Depoele has invented a system which works mechanically, and is in reality an open slot conduit with a rubber or other flexible guard, which is pressed open as the plow moves along and closes the conduit after the car has passed.

Mr. Elihu Thomson invented a similar closed conduit, using a brush or broom as a guard, instead of rubber, to close the slot.

February 7th, 1893, the writer was granted a United States patent for a closed conduit system for electric railways, consisting of a bare conductor mounted on an insulating support in a conduit, the top of which is rendered elastic by being formed of sheet metal adapted to be pressed into contact with the supply conductor by a motor car.

It may be well to consider the surface leakage from sectional conduit systems operating say fifty cars. The only data obtainable at once is from experiments made by Mr. Gisbert Kapp, author of " Electrical Transmission of Energy." In a paper read by him before the British Association, September, 1890, in reference to the loss from leakage of sections of the Lineff system, he says: "To ascertain the surface leakage I applied the voltmeter test, and found the following insulation resistances of three charged sections of the magnetic rail of the closed conduit: With the line clear and moist, 4,183 ohms; with the line very wet and covered with mud and water, 980 ohms. Taking 2,000 ohms as an average, the loss of power at 300 volts by surface leakage per car amounts to 45 watts."

Taking Mr. Kapp's figures for a basis of calculation for fifty cars, the surface leakage would be 2,250 watts, or about three horse power.

Now as the potential universally used here is 500 volts, the loss by surface leakage for three sections would be 125 watts per car, or 6,250 watts for fifty cars. This would amount to about eight horse power.

It is therefore safe to conclude, if Mr. Kapp's data and experiments are correct, that the surface leakage would not be serious in the sectional conduit systems.

World's Fair Notes.

Everything within the power of the construction department of the World's Fair is being done to have the buildings in shape and all the apparatus installed in time for the opening on May 1st. A combination of circumstances has operated to make a number of delays which will require strong effort to place the exhibits in position at the appointed time.

The 2,000 horse power Allis engine which is to be used in driving the large 10,000 light Westinghouse dynamos arrived on the grounds last week. On inspection it was found that the electric traveling cranes were of too small a capacity to carry its parts from the cars to its position on the floor of the Machinery Hall. It therefore required the laying of two tracks nearly half the length of the building to get it into position.

The Yale and Towne Manufacturing Company is placing a number of traveling cranes over each of the Westinghouse dynamos to facilitate in erecting them and also to make it easier to take out or put in the armature or field coils. The cranes each have a capacity of 44,000 pounds.

The contract for the plant for charging the storage batteries to run the electric launches was given to the General Electric Company. The plant will be the largest ever erected in this country for this purpose. All the batteries are to be charged at night and will therefore be connected in series and charged from the same circuit. The plant will consist of over 4,500 storage cells, and will be installed on sixty launches which will be run under the control of the Electric Launch and Navigation Company.

The installing of exhibits in the Electricity Building has begun in earnest. Last week several carloads of the Germania exhibit were placed on the floor and are being unpacked and placed in position. The Bell Telephone Company's booth is nearly completed and will be ready for the reception of exhibits. The Western Electric Company are having a model theatre building on a small scale constructed at the north end of the building to show their method of wiring and lighting this class of buildings. The workmen have been engaged for over a week in erecting the Edison tower which is to be located in the centre of the building and which is to contain 3,000 incandescent lamps at an elevation of 82 feet.

Mr. A. D. Newton, manager of the Eddy Electric Company, was a visitor at the grounds this week in the interest of his company, as was General Barney, of the Electric Launch and Navigation Company.

Mr. J. A. Kennedy has been appointed to the position of electric power inspector of the Exposition.

Legal Notes.

The Common Council of Detroit having granted permission for the removal of a building across the tracks of the Fort Wayne and Belle Isle Rail road Company, an electric road, an injunction was obtained by the railway company to prevent the Council giving permits for such removals. The Council thereupon sought to have the injunction dissolved, but Judge Hosmer denied the motion, and the Council will now take the case to the Supreme Court. During the arguments in the case the counsel for the railway company presented an affidavit made by C. E. Collins, an electrician in charge of the railway's electrical apparatus, to the effect that every splice, no matter how well made, increased the resistance in the path of the electrical current.

The American Telephone and Telegraph Company of Syracuse, N. Y., has brought an action for damages against the Consolidated Street Railway Company of the same city to recover $4,000 for property destroyed through the act of the defendant company in attaching its wires to the telephone poles so that the current from its wires traversed those of the plaintiff and entered the test house, igniting some wood in the structure, and before it could be extinguished the place was burned to the ground.

The Westinghouse Electric and Manufacturing Company have filed a complaint at Indianapolis against the Fort Wayne Electric Light Company, asking for an injunction and damages for the alleged infringement of a meter for measuring alternating currents of electricity.

General News.

What is Going on in the Electrical World.

Hudson, N. Y.—The route of a proposed electric road between Hudson and Stottville has been laid out.

Tyler, Tex.—Some Denver capitalists have submitted a proposition to construct an electric railway in this town.

Manistee, Mich.—The Manistee, Filer City and Eastlake electric street railway was opened for business last week.

Portsmouth, N. H. – Shafting is being placed in the Morley button factory for the new Electric Fan Company.

North Attleboro, Mass.—At a meeting here it was the general expression that the town wants electric lights and wants a plant of its own.

Martin's Ferry, Ohio.—A company which proposes to build an electric railway connecting this city and Bellaire has been granted a franchise.

Waverly, N. Y.—Work has been begun on the new electric railway, and will be pushed, Mr. Broadhead says, to the earliest possible finish.

Kenton, O.—The city council has granted a franchise for the construction of an electric street railway to Daniel Flanagan, editor of the *Democrat.*

Ontonagon, Mich.—The State Legislature has passed the bill authorizing this village to issue $30,000 for water works and electric lighting.

Tallahassee, Fla.—The plant of the Tallahassee Gas and Electric Lighting Company has been leased to W. P. Munro, of Eufaula, Ala., for twenty years.

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* Paper read before the Buffalo Electrical Society, March 6, 1893.

Louisville, Ky.—Electric cars will be running in Broadway to Twenty-second street by May 1, and later the line will be extended to the new Base Ball Park.

Madison, Wis.—The Four Lakes Light and Power Company have issued a circular announcing reductions in their rates for both arc and incandescent lights.

New Albany, Ind.—The New Albany Street Railway Company have been legally authorized to substitute electricity for animal power on their entire system in this city.

Thomasville, Ga.—The contract for the building of Thomasville's electric street railway has been let to W. A. Robinson, representing the Thomson-Houston Company.

Providence, R. I.—The Union Railroad Company has been granted exclusive rights to operate the trolley system in North Providence, and will extend its present line to Centredale.

Spokane, Wash.—The contemplated electric railroad from Spokane to Cœur d'Alene City has not been abandoned, as was thought, but will be built during the coming summer and fall.

New Castle, Del.—The legislative bill authorizing the construction of an electric railway between New Castle and Wilmington having passed, work will begin on the route in a few weeks.

Tonawanda, N. Y.—A survey has been made for an electric railroad to run from North Tonawanda to Pekin, to be known as the North Tonawanda, Bergholtz and Pekin Electric Railroad.

Springfield, Mass.—The Postal Telegraph Company are to construct a line from Springfield to Montreal, opening stations at White River Junction, Montpelier, Burlington and possibly Barre, Vt.

Philadelphia.—The Mayor has signed all the trolley ordinances that awaited his signature, and now nearly every passenger railway company in Philadelphia has obtained permission to use the trolley.

Lancaster, Pa.—The entire property of the Lancaster and Columbia Electric Railway has been purchased by the Lancaster Traction Company who will operate the line in connection with the city lines.

Easton, Pa.—The Easton Transit Company has opened as an electric road what was formerly the Easton, South Easton and West End Horse Car line. Its capital is $300,000. It will rebuild the College Hill road.

Kennett Square, Pa.—The Electric Light and Power Company are seeking to extend their field of operations to Toughkenamon, Avondale, West Grove and Unionville and will probably include Hamorton and Hockessin. The alternating system will be used.

Dayton, Ohio.—A company has been organized and incorporated for the purpose of constructing an electric road between Harshmanville, Dayton and Cincinnati. This makes the third company in the contest for an electric road between here and Cincinnati.

Jersey City, N. J.—The Jersey City and Bergen Railroad has been converted into a trolley system. The cars run from Cortlandt street ferry to West Bergen, and connection will be made with the new line over the Plank Road to Newark, now nearing completion.

Indianapolis, Ind.—The *Journal* in describing the new electric light plant which is being built by the Indianapolis Light and Power Company, grows enthusiastic over its dimensions and the quality of the apparatus, and says it will surpass "any like construction in the United States."

New Orleans.—Superintendent Haile of the electric railway says of the increase of business on the Napoleon avenue line, that while 500 fares were formerly a fair day's collection for that line the average is now 5,000.—The conductors and motormen of the new Carrollton road are on strike for more wages and fewer hours.

Gloversville, N. Y.—The Cayudetta Electric Railroad Company have purchased a controlling interest in the Johnstown and Gloversville street railroad, recently equipped for electricity. The two companies have been in open warfare for some time, and this deal makes the Cayudetta company master of the field.

Woonsocket, R. I.—The stockholders of the Woonsocket Electric Machine and Power Company have voted to increase the capital stock from $250,000 to $400,000, with the object of extending its service from Woonsocket as a distributing centre to neighboring towns and villages in Massachusetts and Rhode Island.

McKeesport, Pa.—The McKeesport Electric Light Company's plant was totally destroyed by fire on Friday last. The loss will be from $75,000 to $100,000. The Duquesne Electric Railway and Citizens' Electric Railway, which were provided with power from the light company's plant, were obliged to suspend running.

Norfolk, Va.—Great preparations are in progress at Hampton Roads, Old Point and Norfolk for the approaching naval rendezvous. An attempt is being made to perfect a uniform system of signals for vessels of all nations. This will embrace an electric display of search-lights. The feature is expected to be a beautiful and novel one.

Muncie, Ind.—An Eastern syndicate which owns the lines at Laporte, Michigan City, Marion, Gas City, Elwood and Richmond has purchased the Muncie Street Railway property. It is the purpose of the corporation to connect all of the cities named by electric lines, with a probable extension from Richmond to Cincinnati and from Michigan City to Chicago.

Brooklyn, N. Y.—The Brooklyn, Bath and West End Railroad Company have under consideration a change of the motive power of their road from steam to electricity.—The Westinghouse Electric Company has just concluded a contract to supply the Atlantic Avenue Railroad Company with all the motors that will be needed in the operation of its trolley cars and for its electric generators.

Richmond, Ind.—The Richmond City Railway has been sold to a company of local and St. Louis capitalists, and there has been an entire change in the management. The new board of directors is composed of Col. John F. Miller, Henry C. Starr and R. A. Jackson. It is the intention of the new management to build about four miles of new track this summer and purchase a number of new cars. Isaac A. Gorman, now in the employ of the Pennsylvania Railway, is to be the superintendent.

Syracuse, N. Y.—The *Courier* says: "The organization of a telegraph company of prominent business men of this city is about to be formed, and it is thought that a franchise will soon be asked for. The names of Charles M. Warner, George M. Barnes and Frank H. Hiscock are mentioned in connection with the company. The capital stock will be between $200,000 and $300,000."—A branch of the Order of Commercial Telegraphers has been organized here with thirty members.

New York.—The stockho'ders of the Edison Electric Illuminating Company have voted to increase the capital stock of the company from $6,500,000 to $10,000,000.—At a meeting of the Park Commissioners a resolution was offered by Commissioner Gray to illuminate the Washington Arch with electricity at night.—The General Electric Company has declared a quarterly dividend of 2 per cent. on the common stock, payable May 1, 1893. Transfer books close April 18 and reopen May 2.

Topeka, Kan.—The *Capital* says: "No city the size of Topeka in the country can boast of as fine a street-car system as we have in the capital city of Kansas at this time. The service is regular and reliable, the cars large and clean, and the speed all that can be asked consistent with safety. The company is officered by men of financial standing and business ability who have a commendable pride in keeping up the system and giving our people cheap and rapid transportation."

Owego, N. Y.—In a talk about the proposed electric railway, Col. E. W. Dorwin said: "We propose to connect Binghamton and Owego by electric railway before long. We also propose eventually to build a branch road from Newark Valley to Owego and another from Spedsville to Owego. We have secured a franchise from the village of Owego and a charter from the State, and at present I can conceive of nothing which will hinder the construction of the proposed road in Owego."

Boston.—At the annual meeting of the American Bell Telephone Company, held on Tuesday of last week, it was unanimously decided to increase the stock from $17,500,000 to $20,000,000. The directors' report showed a largely increased business during the past year. The following officers were elected: Clerk, Charles Eustis Hubbard; treasurer, Wm. R. Driver; directors, Thomas B. Bailey, Francis Blake, Chas. P. Bowditch, George L. Bradley, Alexander Cochrane, W. D. Forbes, H. S. Howe, C. Eustis Hubbard, Gard. G. Hubbard, J. E. Hudson, C. E. Perkins, Thomas Sanders.

Buffalo, N. Y.—At the annual election of the Buffalo, North Main Street and Tonawanda Electric Railroad Company the following officers were elected: President, L. F. W. Arend; vice-president, Albert T. Fancher; secretary, Edward Rutherford; treasurer, Charles C. Mead; directors in addition to the above: Frank D. Smith, Anson W. Stone, Clark H. Timmerman, Henry A. Holden, George N. Kneeland and Jefferson Farrar.—The Board of Works propose to fit up a laboratory in the Municipal Building for testing the gas and electric lights furnished the city.

Allentown, Pa.—The Mayor has signed the ordinance giving the Lehigh Valley Traction Company and the Philadelphia and Allentown Trunk Railway Company permission to use certain streets for electric railways. The Traction Company will build a mammoth power station in Allentown. The road is to be built from that city north to Coplay and Egypt and south to Bethlehem. Next year the line is to be extended to Slatington and Easton, making the line eighty-seven miles long. The Philadelphia and Allentown Trunk Railway will have its terminus in Allentown.

Omaha, Neb.—A petition has been put in circulation here by "business men's associations and workingmen's trade and labor unions" against "the grant of a new patent to this great monopoly (the American Bell Telephone Company of Boston, Mass.,) who have raised their rates from $60, when competition existed, to $180 and $240 per year, when the rates charged for the same instruments in Europe, where the patent has also expired, but was not renewed by a corrupt official, is from $18 to $20 yer year."

Kansas City, Mo.—H. C. Eddy, agent of the Western Electric Company of Chicago, proposes to lay before the city council an offer to sell the city an electric light plant of 800 lights on the instalment plan. He proposes to so arrange the 800 lights that the city shall be far better lighted than it ever has been before and that nearly all of the electric, gas and gasoline lamps now in use will be displaced. For the plant and its maintenance for three years he wants $300,000 in three annual instalments; that is to say, he proposes to build the plant, bear all the expenses of maintenance for three years at $100,000 a year and turn the plant over to the city in good condition.

Boston Notes.

An electric road twenty-five miles long to run from Southbridge, Mass., to a point in Windham County, Conn., is projected for construction in the spring.

The Boston and Quincy Street Railway Company is to purchase the property of the Quincy and Manet Beach Railway Company. Both roads are operated by electricity and are very successful. Work will soon be resumed on the track to connect the towns of Weymouth and Hingham.

Patents on valuable electrical devices are granted almost weekly to Professor Elihu Thomson. The last two were for a new type of dynamo and a lightning arrester. Many of the employees of the General Electric Company in Lynn are also patenting various devices.

The Old Colony Trust Company of this city has accepted as security for a loan of $240,000 the entire property of the Nova Scotia Power Company, Halifax, N. S., and with this capital the entire railway system of that city will be equipped with electricity.

The Lynn and Boston Railroad, recently equipped with electricity, is considered the most extensive system of electric road in Massachusetts outside of Boston. It is preparing for an immense business the coming summer. Forty new open cars of the "jumbo" pattern, carrying fifty passengers each, have been ordered. Not only are the cities of Salem, Lynn and Boston connected, but several popular summer resorts such as Beverly, Marblehead, Swampscott and Salem Willows are in the circuit.

The Westinghouse Electric Company continues booking orders for its railway motors at a lively rate throughout New England. Within the last few days contracts have been made with the Westinghouse Company by the New Bedford Street Railway Company for twenty-five car equipments; with the Winchester Avenue Railway Company, New Haven, Conn., for twelve cars; with the North End Railway Company, Worcester, for six cars, and with the Hartford Street Railway Company for thirty-three cars.

What is to be the next move made by the management of the West End Railway is interesting everybody. It appears to be the foregone conclusion that the announcement will soon be made that the entire system has been bought by the Electric Corporation, the corporate name assumed by a number of gentlemen, mostly trustees of the General Electric Company. For several years the most intimate relations have existed between the West End and Thomson-Houston Electric Company, and the general supposition was that the latter really controlled the former. Present appearances justify the belief that if it has not controlled it hitherto, it will do so in future.

ORNAMENTAL ELECTRIC FIXTURES—NEW JERSEY LAMP AND BRONZE WORKS.

The New Jersey Lamp and Bronze Works.

The foregoing illustrations of electric fixtures are from the New Jersey Lamp and Bronze Works, New Brunswick, N. J., a corporation which has recently added a large gas and electric fixture factory to its extensive plant, covering four acres of ground and employing nearly eight hundred hands. For many years the company has made sockets, cutouts, switches, dynamo and motor work to order for large electric light apparatus makers, and its capacity is taxed to the utmost in filling orders for special electrical work requiring delicate and scientific manipulation. The factory contains several departments not usually found in industrial establishments, as a complete printing office in which catalogues and information for the hands are printed, also a large library of technical and electrical books and papers which are issued to the employees, many of whom are graduates of the best technical schools. Several copies of ELECTRICITY are on file in the reading room and after a week's use are bound for future reference. Mr. Ralph W. Booth, Manager, and Mr. G. Wilfred Pearce, the Superintendent, are of the opinion that the men should be informed of all new inventions and see what is being done by others in the same line, and to this end parties of men are taken at the expense of the company to see novelties in the large cities. The platers and fine art metal workers are regularly taken to the fine retail jewelry shops and art stores. The utmost good feeling prevails throughout the works, and all the men have ready access to the Manager's or Superintendent's offices, where grievances are promptly settled.

The invention of new goods by the hands is fostered and encouraged, and a visitor to the works cannot fail to observe the personal interest which all employees are taking in their work. The company prides itself upon its cordial relations with other firms in the same line, and never copies nor cuts goods made by others.

A Compact Driving System.

The L. P. & D. system of driving dynamos had been designed with a view to economize the floor space occupied by electric plants by avoiding the necessarily long distance between the driving and driven pulleys where direct belting is used. The illustration, Fig. 1, explains graphically the details of this system, being the plant in operation at Siegel & Cooper's store at Chicago.

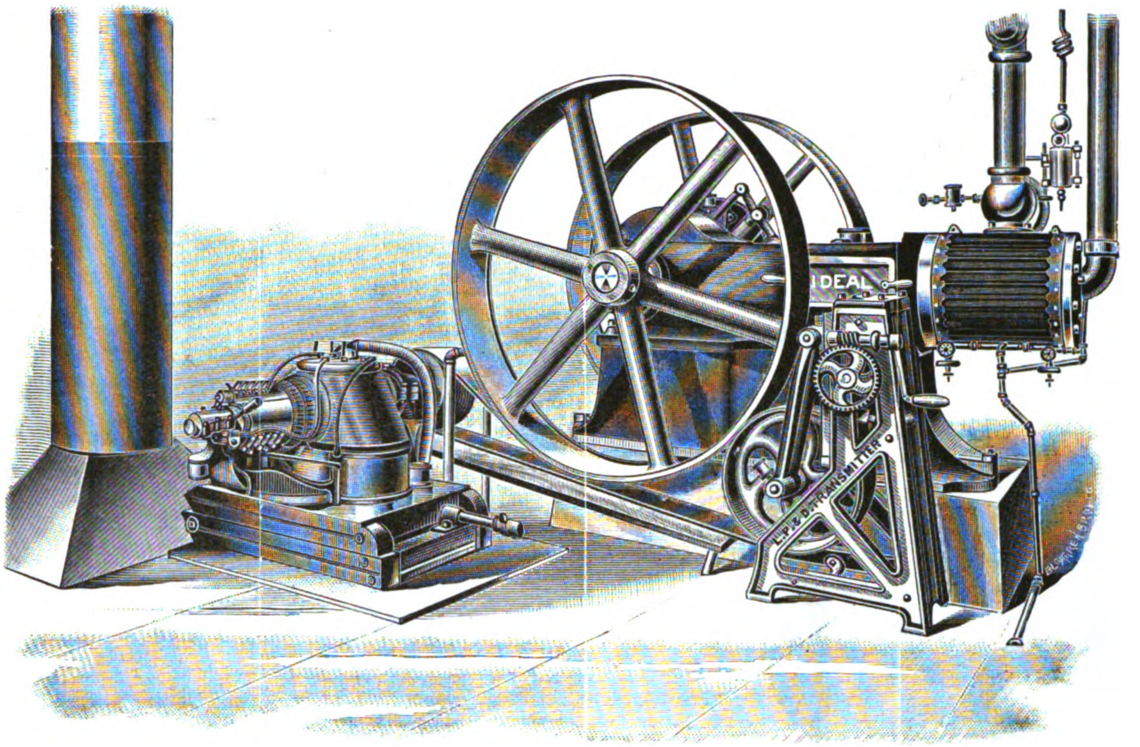


FIG. 1.

The dynamo is a 400-light machine of the Western Electric Company's make connected to the engine, as shown, by an 8-inch belt. The floor space occupied by the combination is but 8 feet by 11 feet.

Fig. 2 shows diagrammatically the mode of applying this system to the pulleys of jack shafts and the saving in space effected, and clearly shows the principles of the system in detail. From this it will be seen that the length of belt in contact with the driving pulley is greater than that in contact with the driven pulley, while the contact on the driven pulley is greater than is found in common systems of belt transmission. It is easily applied to any plant, all that is necessary being to fasten the transmitter so that its pulley will be about two inches from the floor and one-half inch from the driving pulley. The pulley of the driving machine should be placed as near the driving pulley as possible.

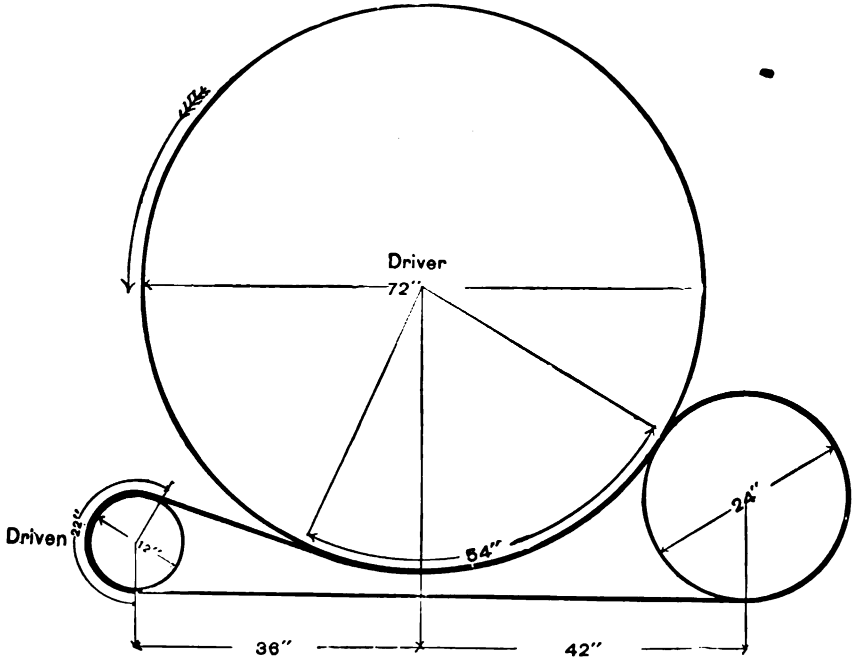


FIG. 2.

The use of this device will often increase the driving power, because a greater contact between the belt and driven pulley can always be obtained than with ordinary belting, and the contact of belt upon the driver will still be greater than that upon the driven pulley.

Chicago Notes.

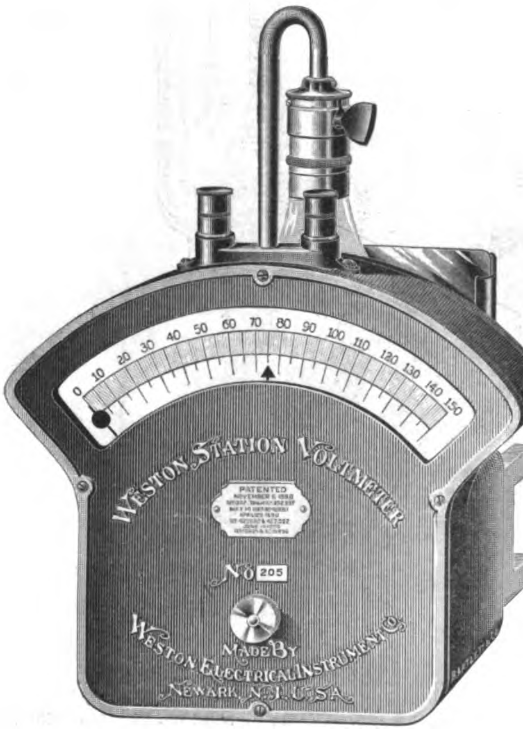
Mr. W. C. H. Noble, formerly with the Electrical Construction and Supply Company of Pittsburg, has been appointed to the position of auditor of the Ansonia Electric Company.

C. A. Baldwin, president of the Massachusetts Chemical Company, made a business and pleasure trip to Chicago last week.

Owing to the increase in their business the firm of Taylor, Goodhue & Ames have decided to remove their office from the Monadnock Building about the first of May. The firm have secured large and commodious quarters on the ground floor at 348 Dearborn street, where they expect to carry a largely increased stock of electrical supplies for retail trade.

The A. H. Atwood Arc Lamp Company have sold their patents and all the machinery for manufacturing the arc lamp recently placed on the market by them to the F. P. Little Manufacturing Company of Buffalo, who will hereafter manufacture and sell the lamp.

Mr. C. E. Schillinglaw, until recently the electrician of the Armour Packing Company, has accepted a position as traveling salesman for the American Circular Loom Company. Mr. Schillinglaw has been connected with the former company in the capacity of electrician for over fourteen years.



Weston Standard Measuring Instruments.

The growing refinements in the regulation of central station machinery have called for a constant improvement in the usual measuring instruments employed, and this demand has been met with unexpected success by the Weston Instrument Company's goods, which are now in general use in all well equipped stations and with all makers of electrical machinery.

In the old type of instruments the use of moving parts of soft iron was general and this possessed inherent difficulties which could not be entirely overcome. The magnetic lag of the iron made the indications vary with the ascending and descending scales, and the weight of the moving parts was such as to make the *dead-beat* quality, so essential to rapid indications, impossible. The principle embodied in the Weston instruments consists in the simple movement of a small coil through a uniform magnetic field against the opposing force of a very light spring. By avoiding the use of all moving iron parts magnetic lag is entirely eliminated, and besides being extremely *dead-beat* and showing an absence of magnetic lag, the correct electrical proportioning of these instruments leaves them extremely free from heating errors even where allowed to remain in circuit continuously.

The illuminated dial station ammeter made by this company is based upon the same general principle as their regular standard portable direct current ammeters, but is much larger and the working parts are enclosed in a neatly designed cast-iron case. This case is dust-proof, to protect the working parts from mechanical injury. It also effectively shields the instrument from disturbing influences of external magnetic fields.

The instrument depends for its operation upon the fall of potential between two points of the circuit carrying the main current, and requires a difference of only about .03 volt to give the full scale deflection, at which time it is taking only .07 ampere, no matter what the total capacity of the instrument may be. Unlike the regular portable instruments, the shunt required to secure the necessary fall of potential is not included in the case, but is separate from it, and is designed to be placed at the back of the switchboard. In most cases a special shunt can be dispensed with and a short section of the mains on the switchboard, or the mains leading from the dynamo, can be used instead. In either case only very thin wires are necessary to carry the extremely small current required to operate the instrument, No. 12 or No. 16 B. & S. gauge being sufficient in nearly all cases.

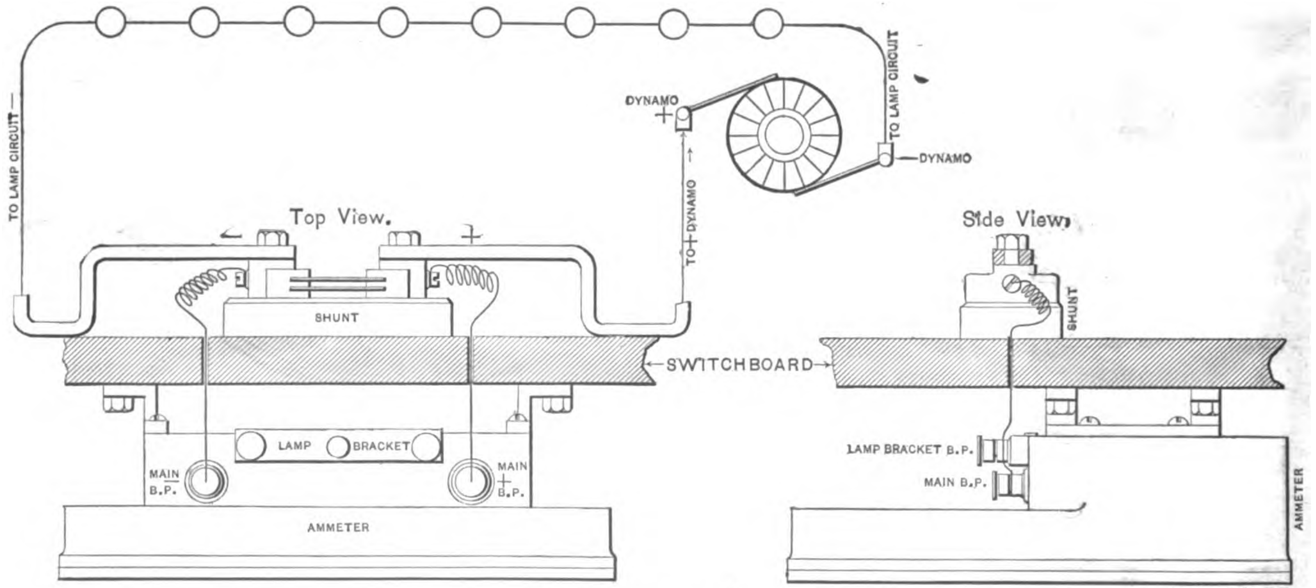
From this it will be seen that these instruments require but a minute current for their operation, and for this reason are extremely economical.

Another important advantage possessed by them is that if the station capacity be increased the same instrument will be found adequate as it is only necessary to recalibrate it in order to adjust it to any range.

The illuminated dial voltmeters, a cut of which is shown below, are equally free from "magnetic lag," and are almost absolutely free from temperature error. No effort has been spared to make them durable, permanent and perfect. They are dead-beat and are considered the very best and most reliable instruments ever made for the purpose intended. They are very high resistance instruments, and are consequently extraordinarily economical of power, while the coils are amply large enough to permit of the instruments being left in circuit continuously without material rise in temperature. They are pivoted and jeweled in just the same manner as the ammeters, and are sufficiently sensitive to show a change of one-twentieth of one per cent. in the voltage.

The diagram shown in Fig. 3 illustrates the method of connecting the ammeters to the lines on the switchboard, and is sufficiently in detail to be self-explanatory.

The shunt used with these ammeters, as shown in this diagram, are preferably placed as far from the instrument as possible.



Bartlett & Co., N.Y.

DIAGRAM SHOWING CONNECTIONS
BETWEEN
AMMETER AND SHUNT

Current Items.

F. A. Dolphin has invented a machine for post office use by which a hundred postmarks can be stereotyped in a minute, making it possible at the end of each hour to cast away the old die and start in with a new one. The new machine will also pick up the letters and will postmark them at the rate of 10,000 an hour. Two of the machines have been accepted for the postal exhibit at the World's Fair.

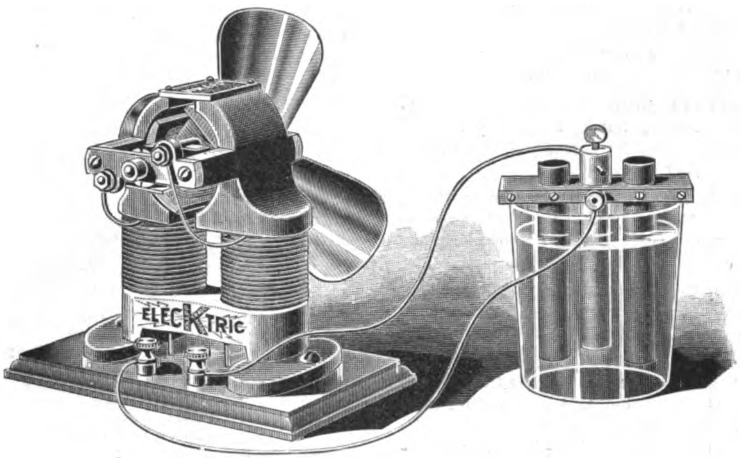
Over forty miles of wire will be used on board each of the two new big Cunarders, Campania and Lucania, for the electric lighting equipment. Each ship is to have a powerful search-light and about 1,350 sixteen candle power incandescent electric lamps.

Touching the life of submarine cables an electrical expert says: "The total mileage in 1852 was 87 miles; January 1, 1893, it was 139,539 miles, exclusive of inland cables. Perhaps the most remarkable history of an ocean cable is that of the light cable laid in 1853 between England and Holland. It was picked up in 1859; part of it was used for the Isle of Man cable, where it remained until 1885. It was taken up and relaid in 1886 in the Hebrides, where it is now doing as good work as forty years ago. The cable laid between England and Dieppe, France, in 1861 is still working. Therefore, it can fairly be claimed that the durability of submarine cable property is unsurpassed by that of any other commercial plant, be it railways, bridges, steamships or machinery."

Berlin has a novelty in the shape of a cab moved by electricity. In order to give the experiment a fair trial several races between ordinary one-horse cabs and the electric vehicle were run, and proved throughout the superiority of the latter.

Knapp's Electric Motors.

The motors and batteries manufactured by the Knapp Electric and Novelty Company, 34 Warren street, New York, have a reputation in the electrical trade entirely satisfactory to the company, whose sales keep pace with the rapidly increasing demands for electrical apparatus. A very efficient product of the company is Knapp's Electric Motor No. 1, a cut of which is given below. This motor is of the same design and finish as the company's larger sized motors. It is dead centre, height 4 inches, weight boxed 2 lbs., and is mounted on a mahogany base. It is fitted with a pulley to run toys and small machinery, and will run from one to two hours on one charge of battery. The manufacturers state that it "develops greater power from the same source than any other motor of its size."

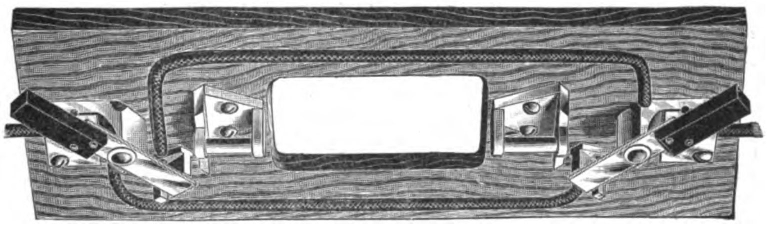


THE KNAPP ELECTRIC MOTOR.

The complete outfit—designated as No. 0 outfit—comprises a plant that is efficient for any experimental work. The battery accompanying the motor is easily refilled, and material that will suffice for several charges can be purchased for a few cents from any druggist. The price of the motor is $3.00; Knapp's Experimental Battery, 50 cents; five-inch fan, 25 cents.

The Dow Hanger Board for Arc Lamps.

In order to meet the demand for a first-class ceiling board to be used in connection with arc lamps Mr. Alex. Dow, the well-known electrical engineer, of Chicago, has designed one having a number of novel features which will commend themselves to those who have had experience with other hanger boards. It has a central opening through which the tubes project, the lamp itself being hung on brass supports next to this opening. The wires can be run into the binding clamps from the end, or they may be bent at right angles and inserted transversely, so as to allow of their being drawn taut without pulling them out of the clamp. Another peculiar feature lies in two simple but effective switches which make the board an absolute cutout. In ordinary practice only one of these would be used, but if the lamp is to be trimmed both switches are thrown to the "off" position, leaving the lamp entirely disconnected from the circuits.



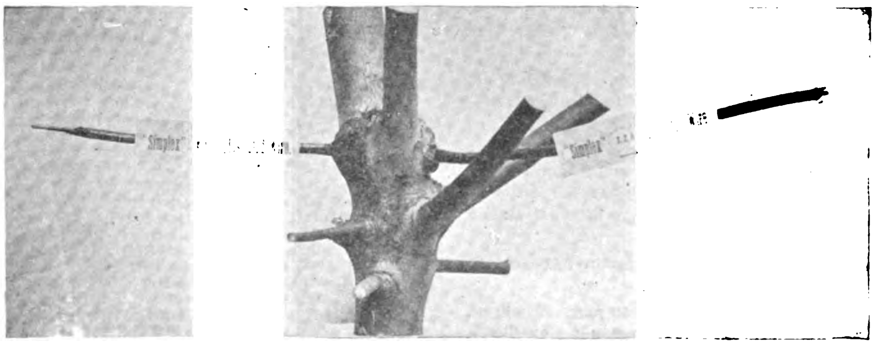
THE DOW HANGER BOARD.

The Dow Hanger Board is built in both the oblong form for double carbon lamps and in round form for lamps with a single carbon. It is being put on the market by George Cutter, of Chicago.

A Wire Curiosity.

Some time ago we called attention to a piece of Simplex wire that had retained its insulation intact notwithstanding the fact that it had got securely imbedded in the substance of a tree, right in the fork between two branches.

Believing that our readers would be interested in seeing how this piece of wire looks in the vise-like grip in which it is held, we publish herewith a cut showing it. Nearly six years have elapsed since this particular piece of wire was suspended on a line which runs through a number of trees in a city not far from Boston; and judging from the thickness of the timber that has grown around the wire, the enveloping process must have set in directly the wire fell into its position in the fork of the branches. Yet during all that time current has been flowing through the wire without a leak, and tests have been made since the limb was cut from the tree which show that the insulation is as good as ever. No wonder Simplex wire is so popular.

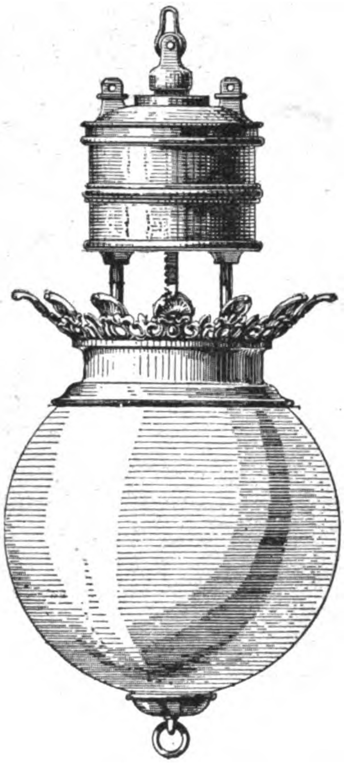


A WIRE CURIOSITY.

The General Incandescent Arc Lamps.

The latest aspirant for public favor in the matter of incandescent arc lamps is the General Incandescent Arc Lamp Company of this city, with factory and offices at Thirty-third street and First avenue.

Mr. Sigmund Bergman, the president of the company, is one of the best known men in the electrical trade, having been associated with Edison interests since early in the eighties. Mr. P. H. Kline, the secretary of the company, is also one of the old Edison guard, who knows the business thoroughly, and who has a host of friends among the trade throughout the country.

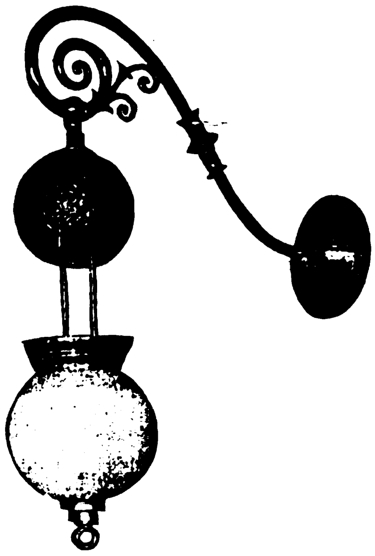


GENERAL INCANDESCENT ARC LAMP COMPANY'S RIBBON LAMP.

Although in business but a few weeks, this company has made rapid headway, and has a full line of its goods on the market. The possession of a large factory building, already practically equipped for its purposes, was a decide advantage.

The show room is one of the most attractive in th country, there being on exhibition arc lamps in variety o styles to suit all purposes of the trade, many of them o high artistic merit.

The lamp mechanism is exceedingly simple, consisting practically of only three wheels, a single magnet, and a spring, and it has no dash-pot. This simplicity means less liability to trouble and getting out of order. The German-silver resistance wires, which are mounted on the outside of the lamps, are insulated with porcelain, which renders the resistance both fire and water proof.



GENERAL INCANDESCENT ARC LAMP COMPANY'S BIJOU LAMP.

The standard 8 and 10 ampere lamps are arranged to run two in series on a constant circuit of 100 to 125 volts, but (up to 6 amperes at present) they can also be run three in series, and the readiness with which three lamps so placed get into perfect action is indeed remarkable. The light from these, as well as of the regular two in series 8 ampere lamps, is equal in steadiness to that of the incandescent lamp.

General Incandescent Arc Lamp Company's Ornamental Lamp.

A unique exhibit in the show room is that of a chandelier of artistic design, consisting of three Bijou lamps burning in series, giving a brilliant and steady light, taking 4 amperes of current.

The standard lamps weigh eighteen pounds, complete (without globe), burn twelve hours, and with an 8 ampere current give about 1,000 c. p. light, with 10 amperes about 1,800 c. p.

COMMERCIAL PARAGRAPHS.

Mr. Frank B. Rae has removed his offices in Detroit from the Cleland Building to No 49 Wilcox street. In addition to the usual run of engineering work, Mr. Rae will make a specialty of designing machines and apparatus for manufacturers.

Messrs. Taylor, Goodhue & Ames, Chicago, announce that they are ready to install Wagner power and fan motors for any exhibits, and to care for the same during the time of the Exposition.

The Bradford Belting Company of Cincinnati have just completed what is claimed to be the largest belt in the world, for use in one of the new power stations in Brooklyn. The belt is 6 feet wide, 116 feet long, and weighs 1,800 pounds.

A new arc lamp for use on incandescent circuits recently placed on the market by Mr. C. E. Bibber, manager of the Consolidated Electric Manufacturing Company, has just been improved in such a manner that it can now be run by means of an automatic feeding device, with a current varying from 90 to 150 volts, without the slightest flickering of the flame or arc, which remains as steady as if on a constant potential circuit. The lamp now as a whole is simplicity itself, and with the aid of this new automatic device the current on the main circuit is cut out from the lamp by the action of the carbon itself when the latter has been consumed to a certain point, thus effecting a great saving in current and an economic and safe use of the lamp.

Judging from the way in which the Massachusetts Chemical Company of this city is shipping its insulating compound, "Insullac," to all parts of the country, the electrical fraternity has fully caught on to its great merits as the best insulator ever introduced in the business since the advent of electricity as a commercial success. Nothing but complimentary things are reported about it, and everybody is more than satisfied.

INCORPORATIONS.

The Buffalo and Niagara Falls Electric Transit Land Company of Buffalo. Capital stock, $62,500. Directors: E. A. Kibbee, of Mayville; Myron B. Dunham, of Warren, Pa.; D. D. Dorn, of Jamestown; Arthur A. Johnston, of Buffalo and others.

The Essex-Hudson Light and Heat Company, at Trenton, N. J. Capital stock, $2,000,000. Incorporators: George R. Gray, Trenton; Emerson McMillan, of Columbia, Ohio, and Henry B. Wilson, of New York. The object of the company is said to be the absorption of gas and electric plants.

The Parkersburg Gas and Electric Company of Parkersburg, W. Va. Capital stock, $23,350. Incorporators: J. V. Rathbone, C. H. Shattuck, C. H. Turner, C. S. Despard and J. M. Jackson, Jr., all of Parkersburg.

The Delevan Electric Light Company, Delevan, N. Y. Capital stock, $5,000. Officers: President, W. F. Persons; secretary and treasurer, Manly E. King; superintendent of construction, James A. Morrison, of Philadelphia.

The Jackson Light and Power Company, Jackson, Mich. Capital stock, $100,000. Incorporators: W. A. Foote, A. N. Foote, J. B. Foote, J. W. Foote and John W. Allen, of Adrain.

The Coney Island and Gravesend Railroad Company. Capital stock, $300,000. President, S. S. Williamson; treasurer, John Curran; secretary, Fred E. Bader. The company expects to operate about thirty-five miles of surface railway in Gravesend and Coney Island, and will use electricity.

The Buffalo and Niagara Falls Electric Railway Company. Capital stock, $1,000,000. Directors: W. Carlyle Ely, of Niagara Falls; Frederick Swift and Wendell Goodwin, of New York City; Willard P. Whitlock, of Elizabeth, N. J.; George H. Wirth, James W. Norton and John S. Sheppard, of Brooklyn, and Joseph A. Powers, of Lansingburgh. The company will construct and operate an electric railway beginning at the easterly line of the City of Niagara and terminating at the point of intersection of Oliver street and the village line at Tonawanda.

The Hamilton, Waterdown and Guelph Electric Railway has been incorporated in Canada, with a capital of $500,000. Among the promotors of this railway are Sir W. P. Howland and other Toronto capitalists.

The Portable Electric Light and Power Company, Peoria, Ill. Capital stock, $250,000. Incorporators: Anson C. Trichenor, Isidor Mantz, Robert H. Walker and Frank R. Covey. The object of the company is the manufacture, sale and rental of electric machines in Peoria county, etc.

A corporation to be known as the Electric Association, Incorporated, has been organized at Portland, Me., for the purpose of establishing and operating electric plants and to furnish illumination, with $500,000 capital stock. The officers are: President, Charles H. Newhall, of Lynn, Mass.; treasurer, John S. Bartlett, of Lynn, Mass.

The Colchester Electric Light and Power Company, of Colchester, Ill., has filed articles increasing its capital stock from $6,000 to $12,000.

The Gordon Railway Signal Company, Denver, Col. Capital stock, $250,000. Directors: Angus C. Gordon, John D. Master and Edward B. Fenner.

The Pieton Chemical Electric Company, Chicago. Capital stock, $200,000. Incorporators: B. H. Ottinger, Harry W. Peck and Thomas J. Lesiour.

The International Pulp Company has filed articles of incorporation with the Secretary of State at Albany, N. Y. The capital stock is $5,000,000, of which $2,000,000 is preferred. The purposes of the company are to mine and deal in talc stone and minerals and for supplying electricity for light and power purposes. The operations of the company will be carried on in the town of Edward, St. Lawrence County, and the principal office of the company will be in Gouverneur. The directors are: Chauncey M. Depew, Touro Robertson, H. Walter Webb, Lewis C. Fuller, Geo. H. Daniels, Alfred Rindskopf, Thomas L. James, Augustus G. Paine, Edgar Van Etten and Thomas W. Bayne, of New York City; William J. Arkell, of Canajoharie; John A. Manning, of Saratoga, and John W. Welch, of Hartford, Conn.

The Queen Electric Company, Chicago. Capital stock, $15,000. Incorporators: David A. Bennett, John F. Schaeffer and Henry G. Hinkle.

The Committee on Incorporations of the Connecticut Senate have reported favorably on the resolution incorporating the Mather Electric Company of Manchester. The Senate has passed the bill incorporating the West Haven Electric Power Company.

The Cleveland Electric Railway Company, Cleveland, Ohio. Capital stock, $6,500,000.

The Kings County Electric Railway Company, Brooklyn, N. Y., of which Patrick H. Flynn is president, has filed a certificate with the Secretary of State at Albany, announcing that its capital stock is $500,000, and that $10,000 of the capital stock for every mile of the road proposed to be built has been subscribed, and 10 per cent. of such subscription paid in cash.

The De Pere Electric Light and Power Company, De Pere, Wis. Capital stock, $30,000. Incorporators: John Dousman, Wm. Armstrong, C. G. Wilcox and J. S. Chase.

The Geneva and Waterloo Railway Company, Geneva, N. Y. Incorporators: S. M. Hamill, Berry T. Miles and Jas. F. Hughes, all of Cleveland, Ohio; Robert W. Henson, Phillip Becker, L. G. Hoskins, F. A. Malette, C. E. Coon, T. E. Truesdale and W. H. Boyer, of Geneva. The route defined is North Main street, Geneva, Main street, Waterloo, and the highway in the town of Waterloo which is a continuation of and connects the said streets. The motive power is not mentioned, but it is probably electric.

ELECTRICAL PATENT RECORD.

Letters Patent Issued March 28, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

494,281. Electric-Car Fender. Edwin Rochester, Ottawa, Canada. Filed Oct. 18, 1892.

494,344. Controlling Device for Electric Cars. James H. Neal, Boston, Mass Filed Dec. 30, 1891.

494,477. Electric Railway. John C. Henry, New York, N. Y. Filed Aug. 19, 1890.

494,478. Driving-Gear for Motors. John C. Henry, New York, N. Y. Filed Dec. 12, 1891.

494,479. Electric-Car Truck. John C. Henry, New York, N. Y. Filed Jan. 2, 1892.

494,505. Car Brake. Milton E. Campany, Hamilton, assignor of one-half to Horace B. Peck, Kalamazoo, Mich. Filed April 5, 1892.

ELECTRIC LIGHTS AND APPLIANCES.

494,149. Process of Manufacturing Filaments for Incandescent Lamps. Alexandre de Lodyguine, Paris, France, assignor, by mesne assignments, to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Filed Sept. 14, 1888.

494,150. Process of Manufacturing Filaments for Incandescent Lamps. Alexandre de Lodyguine, Paris, France, assignor, by mesne assignments, to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Filed Sept. 14, 1888.

494,151. Filament for Incandescent Lamps. Alexandre de Lodyguine, Paris, France, assignor, by mesne assignments, to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Filed Sept. 14, 1888.

494,348. Electric-Lamp Support. Charles E. Richardson, Springfield, Vt. Filed Nov. 16, 1892.

494,499. Globe-Holder for Electric-Arc Lamps. William A. Turbayne, Detroit, Mich., assignor to the Liggett, Turbayne & Company, same place. Filed July 1, 1892.

494,531. Electric-Lamp Vibrator-Regulator. Daniel M. Moore, New York, N. Y. Filed Nov. 23, 1892.

BATTERIES.

494,199. Pyroelectric Battery. Thurston G. Hall, Chicago, Ill., assignor to the Hall Chemical and Gas Company, same place. Filed March 8, 1892.

TELEPHONE AND TELEGRAPH APPARATUS.

494,185. Printing-Telegraph. John E. Wright, New York, N. Y. Filed Nov. 16, 1892.

494,385. Telephone and Signaling Circuit. Frank A. Pickernell, Newark, N. J., and Francis W. Dunbar, New York, N. Y., assignors to the American Telephone and Telegraph Company of New York. Filed Dec. 15, 1892.

MISCELLANEOUS.

494,146. Magnetic Lock. Alcuin E. Kinter, Painesville, Ohio. Filed April 4, 1892.

494,186. Lightning-Arrester. Alexander Wurtz, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, same place. Filed Jan. 14, 1892.

494,225. Electrical Meter. Gustaf Rennerfelt, Buffalo, N. Y. Filed April 1, 1892

494,231. Treatment of Metal Plates Prior to Electrolysis. Charles B. Schoenmehl, Waterbury, Conn., assignor of one-half to Alden M. Young, same place. Filed April 11, 1892.

494,232. Apparatus for Electrolyzing Copper. Charles B. Schoenmehl, Waterbury, Conn., assignor of one-half to Alden M. Young, same place. Filed April 11, 1892.

494,239. Electrical Excitation of Vacuum-Tubes. Harry T. Barnett, London, England. Filed Feb. 5, 1892.

494,278. Electric Bell. Frederick W. Manger and Otto H. Huebel, Brooklyn, N. Y. Filed June 8, 1892.

494,279. Circuit of Electric Signaling. Morris Martin, Malden, Mass., assignor, by direct and mesne assignments, to the United States Electric Fire Signal Company of Maine. Filed July 14, 1890.

494,286. Apparatus for Protecting Buildings from Lightning. Jonathan B. L. Bartlett, Boston, Mass. Filed Oct. 31, 1892.

494,291. Electric Heating Apparatus. Mark W. Dewey, Syracuse, N. Y., assignor, by mesne assignments, to the Dewey Electric Heating Company, same place. Filed March 24, 1892.

494,295. Induction System of Electrical Heating. Samuel B. Jenkins, Boston, Mass., assignor to the Butterfield-Mitchell Electric Heating Company, same place. Filed May 28, 1892.

494,301. Electrically-Heated Radiator. Willis Mitchell, Malden, assignor to the Butterfield-Mitchell Electric Heating Company, Boston, Mass. Filed June 8, 1892.

494,337. Electric Annunciating Push-Button. John King, Chicago, Ill. Filed June 24, 1892.

494,345. Electric Signalling Apparatus. Frederick Perce, New York, N. Y. Filed Nov. 2, 1892.

494,359. Electric Brush. Robert E. Williams, Hot Springs, Ark., assignor of one-half to Charles W. Israel, Paris, Ill. Filed Nov. 29, 1892.

494,451. Electrical Switch-Lock. Frederic C. Weir and Edward W. Harden, Cincinnati, Ohio; said Harden assignor to said Weir. Filed Dec. 20, 1892.

494,489. Electric Signal. Switch Moving and Inter-Locking Mechanism. Joseph Ramsey, Jr., and Edward W. Harden, Cincinnati, Ohio, assignors to Frederic C. Weir, same place. Filed Aug. 13, 1892.

494,495. Electric Bolt-Operating Mechanism for Safes. Emory Stockwell and Herbert C. Stockwell, Stamford, Conn., assignors to The Yale & Towne Manufacturing Company, same place. Filed July 11, 1892.

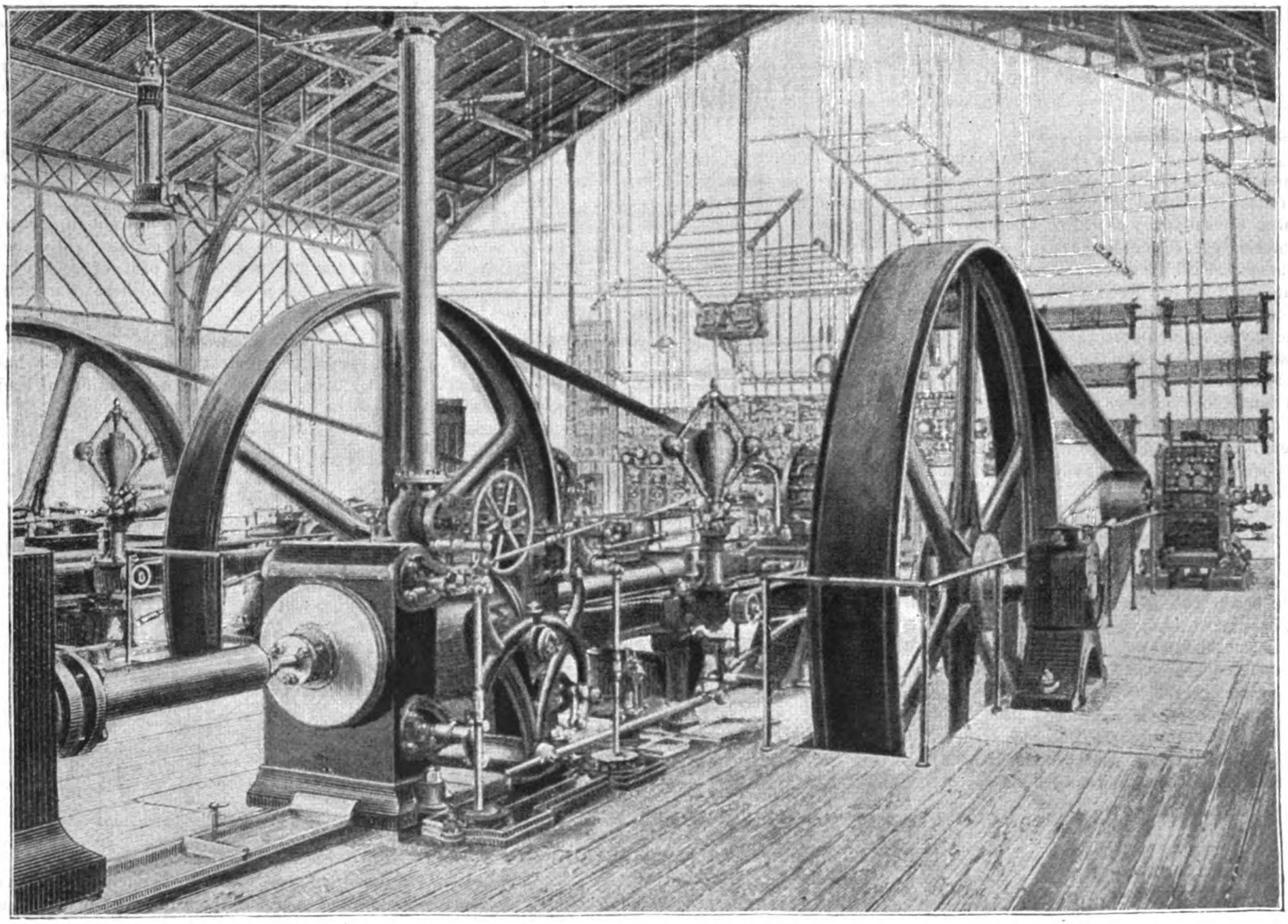
494,520. Electrical Instrument for Medical Purposes. Benjamin Y. Boyd, Wichita, Kan. Filed Dec. 15, 1892.

494,518. Alternating-Current Meter. William Stanley, Jr., Pittsfield, Mass. Filed Aug 11, 1892.

494,525. Block-Signal System for Railways. Eugene Fontaire, Detroit, Mich., assignor to the Fontaine Safety Signal Company, same place. Filed July 11, 1892.

ELECTRICITY.

VOL. IV. NEW YORK. APRIL 12, 1893. CHICAGO. No. 13



GENERAL VIEW OF STATION AT CLERMONT-FERRAND, FRANCE. (SEE PAGE 171.)

Electric Lighting.

The Alternating Current Plant at Clermont-Ferrand.

Clermont-Ferrand, which is distinguished as the first city in France to adopt the use of electricity for street-railway propulsion, also possesses an alternating current lighting plant which was put in operation in July, 1892, and has run without interruption since that time, furnishing the current throughout the city from the station over a distance of more than three miles.

This station is run in connection with the gas company, and is situated at the latter's works, in the outskirts of the city. This location has enabled the company to utilize the water from gasometers for condensing purposes, and this effects considerable economy of operation.

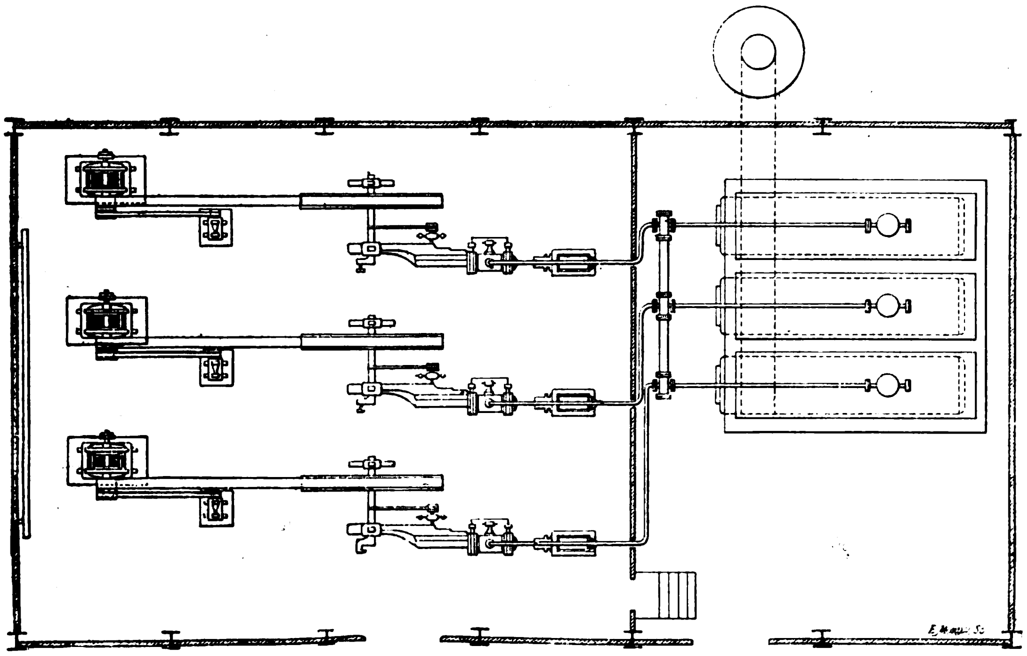


Diagram of Station. (Fig. 1.)

The building is described by *L'Industrie Électrique* as a brick structure with an iron frame having self-supporting arches, with a dividing wall which separates the machinery from the boiler rooms and which is provided with several open panels for doorways. The boiler room floor is on the ground level, and that of the dynamo and engine room is about three feet higher.

The stack is situated outside of the building opposite the main entrance.

The station is composed of three units of 50,000 watts, each comprising a boiler, steam engine and dynamo. The plan, Fig. 1, shows the general arrangement of the machinery. The setting of the boilers is placed so as to allow for the addition of two more in the same room if necessary. The engines are placed perpendicularly to the dividing wall, in the same manner as the boilers, in order to separate the dynamos as far as possible from the latter and allow the belts to interfere as little as possible with ready access to the dynamos. The switchboard is also placed conveniently near the dynamos.

The boilers are of the cylindrical fire tube type with interior grates, each having 100 square meters of heating surface, and can furnish enough steam for two engines on a forced run. They are furnished with two injectors and two feed pumps. The latter receive water under pressure from a feed water heater situated near the gas furnace. This water is raised to a temperature of about 80 degs. C., and conduces largely to the economy of operation of the station.

The heater is necessarily shut down a large part of the time to avoid the too rapid heating of the water and an overproduction of steam.

This certainly constitutes an important consideration for gas companies, and it is probable that the utilization of the wasted heat from the gas furnaces in the case of many gas works, especially those operating a number of furnaces, would provide without extra expense almost three-quarters of the steam necessary to operate an electric light station of considerable size. It must be remembered that in a battery of several furnaces the temperature reaches almost 1,500 degrees and over 600 degrees of heat is available for this work which is otherwise wasted. These considerations are of special interest for the gas companies, which are in many cases obliged to protect themselves by furnishing electric lights. In any case these works would find it of considerable advantage to utilize some of this wasted energy, if not for electric lighting at least for electric power transmission. Each boiler is connected to its corresponding engine by an independent system of pipes arranged so that any engine can be run from either of the boilers.

On account of the surplus capacity of the boilers they require only a minimum amount of attention, and moreover the facility with which steam may be produced insures against the possibility of trouble in case of an unexpected load on the station.

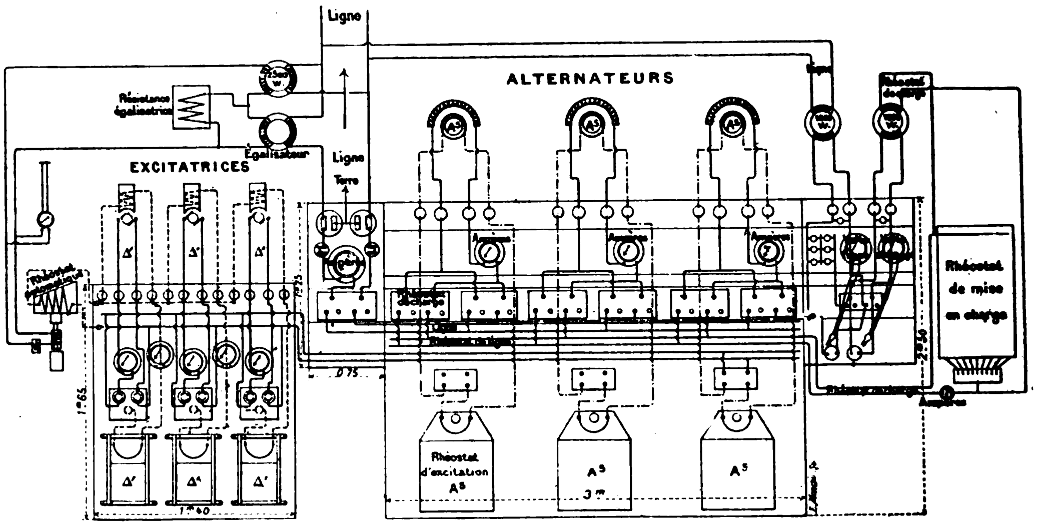


Diagram of Switchboard. (Fig. 2.)

The engines are of the horizontal Corliss type with steam-jacketed cylinders. The dynamos are belted directly to the fly-wheels of the engines. Each machine is provided with a condenser placed behind its cylinder and is operated directly by the piston rod. The valves of the Corliss system are entirely metallic. The steam comes from the boilers into the cylinder jackets where the water of entrainment is automatically separated, and in case of accident to the outlet from the condensers there are valves provided which permit the water to escape into the air.

The alternating current dynamos, of the Zipernowski, Deri and Blathy systems, which are driven from the engines, drive in turn the continuous current exciters which are placed near the engines.

The speed of the dynamos is 500 revolutions, and that of the exciters 900 revolutions per minute. The nominal power of each of the principal dynamos is 50 kilowatts, but they can easily be worked 20 per cent. higher if necessary. The primary distribution is at 2,000 volts pressure.

The exciters can furnish 30 amperes each at 110 volts, and one of them is sufficient to magnetize two of the main generators. All the dynamos are mounted on slides to permit tightening the belts, and these slides are bolted to wooden frames set in the foundations.

The Zipernowski, Deri and Blathy machines have the property of being able to run in parallel, which is an important advantage.

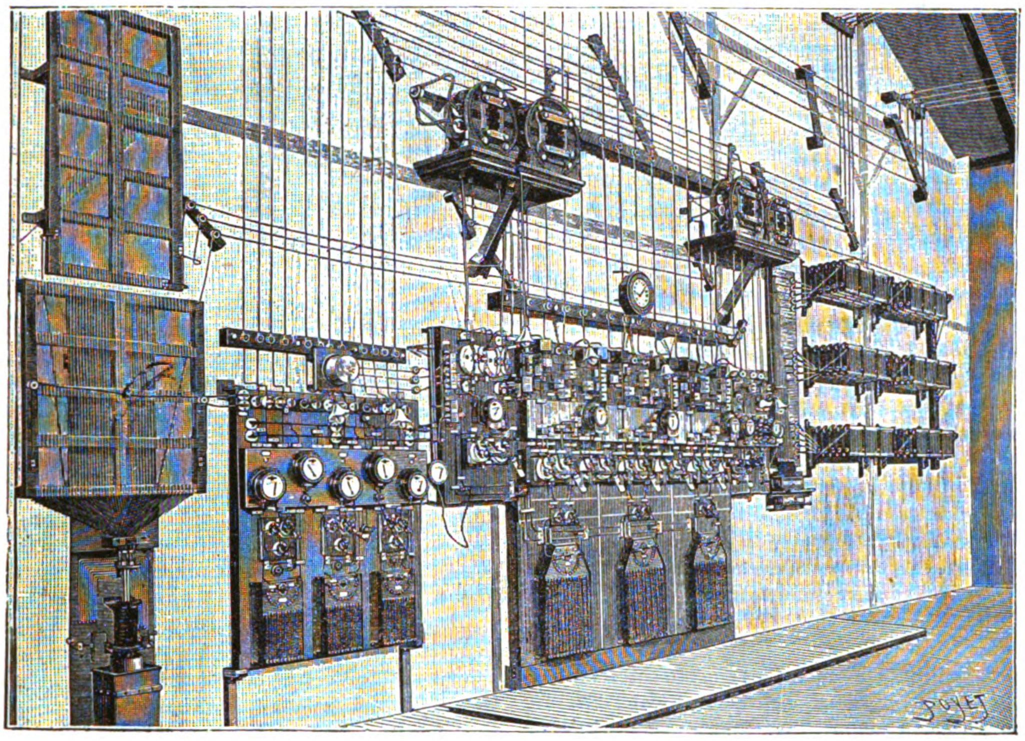
The separate circuits from each machine are brought to the switchboard, where all the work is regulated. The switchboard, which was constructed by Messrs. Lombard-Gerin & Company, of Lyons, is shown in Fig. 3. It is divided into several parts, the panel at the left hand side containing the apparatus relating to the continuous current exciters.

Each alternator has two main switches, one for the line and the other for the rheostat. There are also shown two lightning arresters and a main ampere meter which registers the total load and checks the indications of those on each machine. On the right the charging rheostats are shown, also an apparatus for indicating the phases. A pressure equalizer is used whenever the loss in voltage on the line exceeds two per cent.

The installation has been an entire success from the start, and it is of special interest on account of the gain in economy of its operation by the use of a source of power hitherto wasted in the gas works.

Electrolysis.

An ingenious application of electrolysis has recently been made in the purification of lead and the recovery of silver from argentiferous lead, which results in the production of chlorine—a gas which can be most advantageously employed in chemical manufactures. The chlorides of calcium and magnesium are decomposed with lead nitrate, and the lead chloride so formed is utilized for the electrolytic production of chlorine, whilst the nitrates of calcium and magnesium, which are also the results of the decomposition, are heated for the recovery of nitric acid, which is used for dissolving fresh quantities of crude oxidized lead to form lead nitrate. Silver and other metals may be precipitated from this solution by the addition of spongy lead. As an alternative way of working, hydrochloric acid is used instead of the chlorides for decomposing lead nitrate (or acetate), the products being lead chloride and free nitric acid, which may be used, as before, for dissolving fresh quantities of previously oxidized lead. The fused chloride is, according to the process, which has now been made practical by F. M. and C. H. Lyte, electrolyzed in a glazed earthenware or enamelled iron vessel kept at a suitable temperature. The cell is closed on the top, and is provided with a feed pipe for the lead chloride, a chlorine outlet pipe, and a syphon for drawing off the purified molten lead. The carbon electrodes—alternately anodes and cathodes—are securely fastened to the lid. In another arrangement the carbon plates are all anodes, the molten lead forming the cathode.



GENERAL VIEW OF SWITCHBOARD. (FIG. 3.)

The conductivity of the carbon electrodes may be improved by making them with a core of iron or other metal in the form of a plain, corrugated or perforated plate.—*Electrical Review* (London).

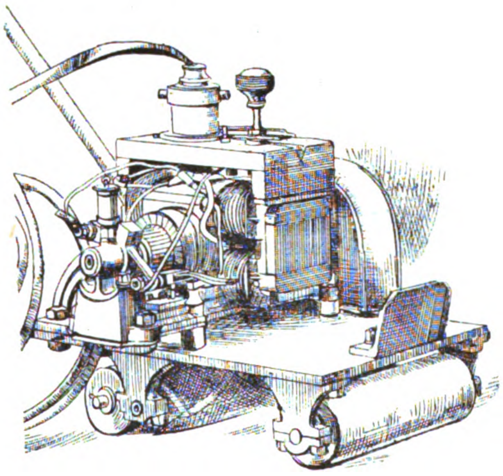
Large quantities of woollen and other goods are dyed in copper pans, and it is well known that in many cases the metal has a more or less deleterious effect upon the brightness of the shades. By coating the interior of the pans with tin this disadvantage may be prevented; but this device is costly, and when the tin is worn off it is often very inconvenient to have the vessels re-lined. The difficulty has now been successfully overcome, in a most inexpensive manner, by an application of an electrical principle. The remedy simply consists in bringing in contact with the copper a number of strips of sheet zinc, of such dimensions that about one-fifth of the surface of the copper is in contact with the zinc. These two metals form an electrical couple which absolutely prevents any copper from getting into solution and injuring the dye. As the zinc strips wear out they are replaced by new ones, an operation which can always be performed within a minute or so, thus involving no serious inconvenience to the continuity of the dyeing operation.—*Electrical Review* (London).

It is estimated that the total amount of light given by the electrical plant which will be used to illuminate the World's Fair grounds will be equal to that given by 12,500,000 standard candles.

A New Electric Tool.

The use of electricity for transmitting power has been steadily increasing during the last few years. Not only is it often found better than mechanical transmission, but in many cases it enables mechanical power to be applied to work where, without electricity, it would be quite impracticable to use anything but hand power. One of the latest machines of the latter kind, described in the *Electrical Engineer* (London), is an electric deck-planer, invented and patented by Mr. Malcolm Sutherland, electrical engineer to Messrs. Wm. Denny & Bros., of Dumbarton.

Our illustration shows one made by that firm, and used by them for planing the decks of the ships they build. It is so simple in construction that very little explanation is necessary. It resembles a lawn-mower in form, and is handled in the same way and with as much ease. A steel base-plate is mounted on rollers, and on the underside of this the revolving cutter is fixed. The electric motor is placed on top, and is geared to the cutter by means of toothed wheels. The latter is one of Rawlin's spiral cutters, and revolves at a speed of 3,000 revolutions per minute, the motor having a speed of 2,000 per minute. The hind rollers which follow in the cut are fitted with eccentric journals, so that, by moving a lever, they can be raised or lowered and the depth of cut nicely adjusted. It does very good work, is faster than hand planing, and relieves the men of a very disagreeable job, as the planing of decks by hand involves kneeling or sitting in a very uncomfortable position. Current is supplied to the motor by means of a twin flexible lead, and the whole machine is of a very compact and portable nature.



A NEW ELECTRIC TOOL.

A Hand Made Electro-Motor.

BY R. RADDATZ.

An electro-motor, as usually constructed, requires considerable lathe and planer work, and it is this that keeps many from building small motors for themselves; for this reason we present herewith the description of a small battery motor capable of giving from one-sixth to one-fifth horse power, and to be worked by a battery of ten bichromate cells—and which can be built without either lathe or planer work, requiring only such work as can be done at home, or as will be done at any blacksmith or machine shop for a few cents.

In several places those of our readers who have a lathe could proceed to advantage in a somewhat different manner from that described, as they will readily see and proceed accordingly.

The working drawings herewith are either ½ or ⅛ size, linear measurement, and the dimensions of all parts not given in the text can be obtained therefrom.

The armature is a Pacinotti ring, the core of which is built up of a number of laminations, one of which is shown in Fig. 3. These laminations can be cut out of Russian or any other soft sheet iron and shaped by means of a tinner's shears and chisel and file.

A sufficient number must be obtained to make a core three inches in depth. Through each lamination four quarter-inch holes must be afterward drilled, as shown in the figure.

Two spiders, of brass or gun-metal, and shown in Fig. 3, must now be obtained. A wooden pattern of these can be made a trifle larger than shown in the figure and one-quarter inch thick, except at the hub where it is about an inch thick, and sent to the brass foundry, where two castings are to be made from it. These castings are afterward finished up with a file, and an exactly central hole drilled to take a three-quarter inch shaft as shown. Then one-eighth inch holes are drilled near the extremities of the arms and corresponding quarter-inch holes drilled in the armature laminations, as already referred to.

Great care must be taken in doing this that the core, after mounting on the shaft by means of the spiders, may run exactly true.

If the first mounting should prove unsuccessful, four other holes can be drilled between those already in the core, with perhaps better success if done with more care. Into the holes drilled are now fitted four one-eighth inch bolts and completely insulated from the laminations by means of a paper tube slipped over each bolt.

The paper tubes may be made of brown wrapping paper wound around the rods and varnished with shellac varnish, and then baked in an oven until thoroughly dry. The laminations, with a spider at each end, are now strung on these insulated bolts, and washers of tissue paper placed between each lamination as well as between the spider and the core. A couple of extra holes must now be drilled through the laminations and fitted with insulated bolts to hold this core together when the spiders and their bolts are removed, as described further on.

A little time is now spent with a file in removing any unevenness in the laminations and in rounding the edges and corners of the spider arms where the wire is to be wound. In this way the core will soon resemble a smooth solid mass.

Care should be taken to see that during the filing and other working upon the core no metallic contact is established between the laminations by means of filings, and that there is no bending of two adjacent laminations nor tearing of the tissue paper, as upon the complete insulation of the laminations from one another and the spiders depends the prevention of eddy currents, which, among other things, produce a great deal of heat in the armature, often burning out the insulation of the wires. The armature here described, if built as directed, is entirely free from this danger, as it will not heat even when the motor is heavily overloaded.

A piece of three-quarter inch shafting is now procured, being twelve inches long as shown, but if space is of some consideration it could be made one and one-half inches shorter. To this shaft are now secured these spiders holding the armature in one of two ways. Keyways being filed in the three-quarter inch central holes of the spiders and two corresponding flat spots being filed on the shaft, the spiders are secured by means of a key driven home—or, what we consider preferable, a 3-16 inch hole is drilled through the spider hub, and the shaft and the spiders secured by means of a pin or plug driven into these holes.

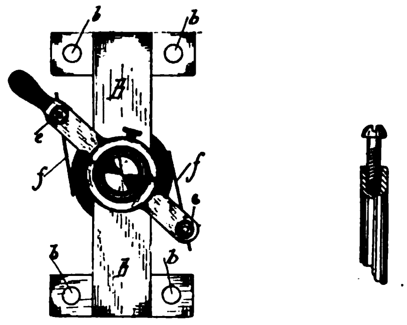


FIG. 1.

The armature core must now be removed from the spiders for winding. Where the arms of the spiders are bolted to the laminations, short pieces of wood of the same size and shape are to be substituted and bolted down, to prevent these spots being covered with wire. Every part of the iron core that is to be touched by the wire which is to be wound in the grooves or channels between the cogs must next be covered with silk applied with shellac varnish and allowed to dry.

The winding can now be proceeded with, using No. 18 cotton-covered magnet wire, filling each channel quite full—not so full however as to come above the top of the cogs and endanger the insulation on the wire, which would be rubbed off against the field magnet.

The beginning and ending of each coil should be on that side of the armature on which the commutator is to be, and the amount of wire and the number of layers, as well as the number of turns in each layer, should correspond in each coil.

Some four layers, with eight turns in each layer, will be about the amount put on.

The beginning of each coil should be marked or bent in such a way as to distinguish it from the ending of the coil.

The writer advises bending the beginning wire into a small loop or eye, and leaving the ending wire straight.

About 23 or 24 feet of wire will be required for each coil, which should be wound on a separate spindle or shuttle one and three-quarters inches wide, whittled out of a piece of cigar box, that can be easily passed through the central hole of the core.

About the method of winding nothing need be said as it is so simple as to defy mistakes.

A layer of wire is put on and may be to advantage covered with a coat of varnish before winding on another layer, which would bring us back to the starting point, and so on until four layers are on, which would leave us at the starting point with the ending wire, which may now be twisted lightly with the starting wire to prevent the coil from unwinding.

Some electricians prefer to wind these coils with an odd number of layers, thus leaving the ending wire on the opposite side of the channel to the beginning ready for direct connection to the beginning wire of the next coil, but this is not advisable in the present case, as the channels are hardly deep enough to hold another layer.

After all the coils are wound they should be covered with several coats of shellac varnish, with the threefold purpose of keeping the coils from unwinding, increasing insulation and keeping moisture, etc., out of the coils.

If the wire is in any way damp, or even if it is not thought to be, the wound armature can to advantage be placed in an oven and baked, which will expel all moisture as well as more firmly cement the layers of wire together.

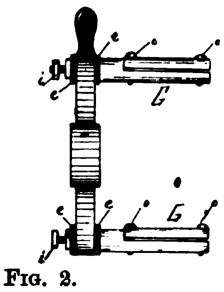


FIG. 2.

The spiders can now be permanently bolted to the armature, and the nuts may be prevented from working loose by burring the ends of the bolts or by solder, or both, although there is probably little danger of the nuts working loose even if not guarded in any particular manner. Two thin nuts could be used to advantage here.

The spiders may now be mounted on the shaft and the pins driven home and burred and we are ready for the commutator, C, Fig. 4, which has 16 segments or bars, as the armature has 16 coils.

An ebonite or boxwood core is mounted on the shaft, as shown, being secured by means of a pin of hickory, or some other tough wood, which is driven tightly into a $\frac{1}{4}$ inch hole through shaft and core. Upon the latter a piece of thick brass tubing is slipped tightly and spaced off by means of a pair of dividers into 16 equal parts, to form the segments or bars. Into each end of each segment a hole must be drilled—the holes at the end away from the armature being countersunk, to take flat-headed brass screws, $\frac{5}{8}$ inch long, the holes at the other end taking round-headed brass screws, $\frac{1}{2}$ inch long. Then the segments are divided or separated from each other by a fine hack-saw cut.

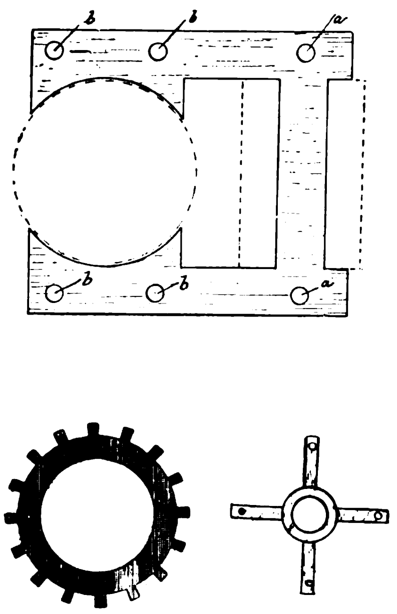


FIG. 3.

If this cut is extended $\frac{1}{16}$ inch into the core the segments can be more effectively separated by means of strips of mica, though this is not necessary.

The wires of the armature may next be fastened to the bars of the commutator as follows: The beginning wire of one coil is twisted together with the ending wire of the next coil and soldered, and one of these ends is looped under a brass headed screw on the segment nearest at hand and the screw tightened up, all superfluous wire being cut away. The beginning wire of the next coil and the ending wire of the coil further on are also twisted, soldered and connected with the commutator under a round-headed brass screw and the useless wire cut away.

In this manner all the coils are treated, the beginning of one being connected to the end of the other and then one of the ends carried under a screw, while all useless wire is removed. The insulation must of course be cut away where the joint is made and the end that is screwed to the commutator should be scraped bright and clean.

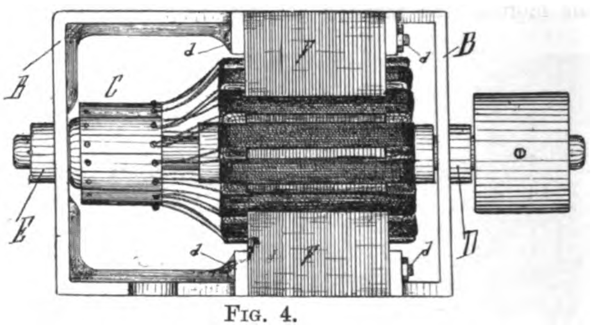


FIG. 4.

We can now turn our attention to the field magnet, an end view of which is given in F, F, Fig. 4. It is also built up of laminations of Russian or some other sheet iron, as was the armature. One of these laminations is shown in Fig. 3. This can be cut out entirely by means of a pair of tinner's shears or snips and a cold chisel and hammer. Holes can be drilled at a, a, as shown, and had better not be drilled at b, b, b, b, through which bolts are afterwards passed to hold the bearings against the field magnet, as well as to hold the laminations together. Through the holes a, a, stove rivets can be passed and the laminations permanently riveted together, or bolts and nuts can be used.

The bearings B, B, Figs. 1 and 4, must now be cast in brass, from wooden patterns as before. They are to be finished smooth with a file and a smooth $\frac{3}{4}$-inch central hole drilled through the hub to take the shaft. The four holes b, b, b, b, Fig. 1, must now also be drilled in each bearing, to receive the bolts d, d, d, d, Fig. 1, and must of course coincide.

The armature is now wound with several layers of paper and wedged into its space between the poles of the field magnet, in the position it is to occupy when running, and the bearings are slipped on the shaft, up against the field magnet and the holes b, b, b, b, Fig. 1, marked and drilled.

If the bearings do not fit snugly against the field magnet, a little filing and scraping will soon remedy this defect. The paper wrapping may now be removed from the armature and the latter mounted, by means of the shaft, in the standards and tried for freedom of revolution.

Supposing that everything works freely, the armature and bearings are removed and the bolts replaced in the holes in the field magnet and screwed up tight.

The field magnet core, where it is to be touched by the wire, is now covered with silk and wound with twelve layers No. 16 single cotton-covered magnet wire, as shown by the dotted lines in Fig. 3, and varnished and the armature replaced.

A solid pulley is now bought and fastened on the shaft by means of a set screw exactly where shown in Fig. 4. It is necessary to have this pulley solid, i. e., not recessed or webbed, as it is to form a bearing against the hub D to prevent the commutator rubbing or knocking against the standard near it.

The whole machine, as far as done now, is next mounted on a base board 10 x 12 inches, and, say, ¾ inch thick. The adjustable brush rocker, shown in Fig. 2, is next made, with a central hole to slip over the hub E, Fig. 4, upon which it may be fastened at any angle by means of the set screw as shown. It is made entirely of brass except the handle which is of hard wood or rubber.

The pins G, G (Fig. 2) are brass rods, threaded at one end to receive two nuts, and insulated where they pass through the rocker by means of ebonite or rubber washers, e, e, e, e (Fig. 2.

They are also sawn as shown, to receive the brushes in the saw cut, the part sawn out being screwed down upon the brushes by means of small brass machine screws, o, o, o, o, the brushes being made of thin sheet copper, three or four strips one inch wide being taken for each brush. Two binding posts are now fixed, i. e., screwed to the baseboard, on the side of the motor that the commutator is on, and between the latter and the field magnet. One of the ends of the field magnet wires is carried under the baseboard, in a groove cut for it, to each one of the binding posts and fastened, and each binding post is connected to one of the brushes by carrying a wire in a groove under the baseboard until directly under the brush pin, where it is carried through a hole, and after coiling around a round piece of wood to form a helio, is fastened under the nut i, i, Fig. 2, care being taken that a good connection is made.

If a tin cell battery is now connected to the binding posts, the motor will run at about 1,800 revolutions, and by means of a 1½ inch flat leather belt other machinery can be run, such as lathes, pumps, emory wheels, etc.

There is shown an easily made and efficient substitute for G, G in Fig. 2. If this form is preferred, a round-headed brass machine screw should be used, with a copper washer or two between the head and the insulating washer, e, e, Fig. 2.

In mounting the commutator core two pins of hard wood could be used instead of one.

These motors are self-starting and quite efficient, and anyone will be amply repaid by their performance for the little time and money spent in making them.

Legal Notes.

The Buffalo, Bellevue and Lancaster Railway Company, whose line is to be operated by electricity, has been empowered by a court order to lay its tracks across those of the Union Road of Cheekowaga, and those of the New York, Lake Erie and Western, and Buffalo, New York and Erie Railroads.

A bill has been introduced in the Tennessee Legislature authorizing all persons or companies using dynamos to furnish light and power to outside customers. It has already passed the lower House, having been recommended for passage by the House Committee on Corporations, The only objections which have been urged against the measure come from the managers of several electric light stations, whose reasons for opposing it are obvious.

The San Francisco and San Mateo electric road is in the hands of the sheriff on a writ of replevin secured by the Thomson-Houston Company for $100,000 of apparatus sold and delivered some months ago. This road is the owner of a right of way which is almost priceless, as it affords an entrance to the city for both passenger and freight business, entirely independent of the Southern Pacific Railroad, which has for years abused its absolute monopoly.

The Electrical Plant on the Steamship La Touraine.

La Touraine, which is the finest of the French ocean liners, is equipped with the most modern electrical plant of any of the company's vessels. The lighting on board steamers is divided into three distinct divisions, comprising, 1st, the permanent lights which are provided for places to which daylight does not penetrate, such as the machinery, boiler sections, holds, inside cabins, etc.; 2d, the indispensable lighting for evening and night in the salons, smoking rooms, corridors and cabins, and 3d, supplementary lighting for the evening up to 12 o'clock for the extra illumination of the salons, etc., when desired.

These three services are supplied by fifteen circuits, as equally divided as possible, each of which can supply an average current of thirty amperes. When the full number of lamps is in service the total lighting requires an output of 424 amperes, which is furnished by two dynamos each of a capacity of 220 amperes. A third machine of the same size is installed as a reserve in case of accident, and these three machines are driven by direct coupled engines, and are placed near the roof of the bridge promenade, upon the skylight grating of the boiler rooms. The dynamos are compound wound and vary about two volts above or below the normal according to the load. They are six-pole Dessozier machines, with the armature sections in series, using but one pair of brushes. The engines are of the compound type, running at 350 revolutions per minute, and the operation of the plant is almost noiseless.

The electric lighting is used in addition to the places mentioned for the mast-head lights and side lamps as well as the merchandise holds.

The Physics of Thought-Reading.

An occasional contributor, says the *Electrician*, has sent us more than one communication on the Physics of Thought-Reading, and claims that such inquiries should not be shirked. He suggests, as Prof. Houston has done, that ether vibrations may explain thought-transference. As soon as this or any other class of phenomena really comes within the domain of physical science we will try to find space for its discussion. One criterion of its inclusion should be a capability of measurement. Hertz's researches were nothing if not quantitative. When the wave-length of thought-transference can be even guessed at by the observation of stationary thought-nodes, or if, like gravitation, the action is found to be a definite function of the distance, the subject shall claim our attention. If thought be a form of radiant energy, it should obey the laws of optics. Reflection of thought is to be found in the phenomena of plagiarism, but how are we to measure the angles of incidence? Interference phenomena are abundant in the House of Commons, and if distortion or perversion of thought be a form of refraction, accompanied sometimes by chromatic effects, it is indeed too prevalent, though the refractive index, or, as it has been called, the coefficient of mendacity, may be difficult to determine. An elegant form of such refraction is known as hyperbole, but what is the focal length of a gross exaggeration, or the negative focus of a disparaging remark? Thought-reading may have its scientific aspects, but it does not at present come within those branches of physical science which are discussed in our columns.

Personal.

Mr. C. McL. Paine, who was formerly the business manager of Electricity, has accepted a similar position with the *Architects' Electrical Bulletin*, published by the Interior Conduit and Insulation Company. Mr. Paine is well and favorably known in the trade, and we congratulate our contemporary on his acquisition.

COMMUNICATIONS.

The Edison Feeder Patent.

To the Editor of Electricity.

Dear Sir: I have noticed in the daily press the announcement of what is claimed to be an important Edison victory in New Jersey in the establishment of the so called Feeder and Main Patent. I have no particulars of the decision, but cannot understand how any Judge should decide that such a patent covered anything worthy of the name of invention, provided the system of multiple distribution is considered a previous state of the art.

To illustrate more clearly, I have shown in Fig. 1, herewith, the simplest form of multiple distribution from dynamo, in Fig. 2 a single branch line, which, as I understand it, Mr. Edison claims is covered by his Feeder and Main Patent. The difference between Fig. 1 and Fig. 2, it seems to me, cannot amount to invention. It is the simplest possible modification of Fig. 1 which would suggest itself to any one wishing to extend that system. It is as natural as for the second leaf to grow on a tree after the first has got a start.

Furthermore, I have shown in Fig. 3 a system of distribution which seems to me quite analogous to that shown in Fig. 2. This is the ordinary arrangement for electro-plating in large works, and is in every respect similar to that shown in Appleton's Encyclopedia of Mechanics, published in 1878, under the article "Electro Metallurgy." A cut is given showing a plating room with vats arranged substantially as shown in Fig. 3.

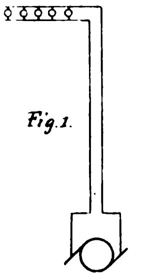


Fig. 1.

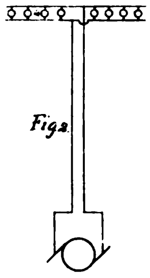


Fig. 2.

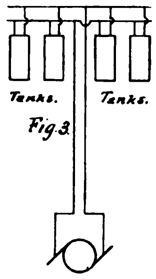


Fig. 3.

In this cut the copper bars or "mains" to which the tanks are directly connected are shown much larger than the wires or "feeders" connecting these bars or mains to the dynamo.

Mr. Edison must have been familiar with this system of connection, and the application of it to lamps cannot be considered an invention.

I predict that if carried to the Supreme Court, or to the new Court of Appeals recently established, this patent would be held invalid for want of invention therein. Yours very truly,

Morgan Brooks.

St. Paul, Minn., April 4, 1893.

To the Editor of Electricity.

Dear Sir: I notice your opinion in the last issue of your paper in regard to Edison's "feeder system" patent. Whatever the decision may be, I think that the importance you have given to this decision will depend entirely on the description of or definition of "the feeder system"; secondly, on the claims.

It would, so it seems to me, affect continuous as well as alternating current distribution, but I am of the opinion that there will be but little difficulty to get round this patent, by simply overcoming or keeping outside of the definition given to the "feeder system." Before, however, we are able to express any extended views or opinions, we ought to know the patent, its scope and claims. Having this information it may be easy to suggest through the technical papers how to evade this patent should it be a master patent. Very truly yours,

Ludwig Gutmann.

Cleveland, O., April 6, 1893.

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The West End Road. For several weeks past the Boston press has devoted a good deal of space to rumored changes in the management of the West End Road in that city. The assumption has been that the road was a financial prize for which many syndicates and able financiers were struggling. Such is not the case.

When Mr. H. M. Whitney began the electrical equipment of the system, he was an enthusiast over the new motive power. He believed that he was laying the foundation for a reputation which would long survive him as a useful man in the community, a public benefactor. Those who know Mr. Whitney best have never doubted his sincerity or honesty of purpose. He believed, further, that the system would be a good financial investment, paying a fair rate of interest on the large capital necessary.

Mr. Whitney's ambition has not been gratified; his ardor has been more than dampened—it has been drowned; and his faith is an unpleasant memory.

In the first place, Mr. Whitney's standing in the community has not been bettered. He has received all the blame for the radical faults of the system, which ought not to have been laid at his door, and no credit whatever for his praiseworthy intentions. The daily press have jumped on him, visiting Thespians have guyed him, and the general public has been taught to curse him.

The company has been the constant victim of well-planned strikes from the Common Council, which have been expensive. It has had to meet a continued succession of attacks from the fire department and insurance people.

It has been put to an expense, moreover, to maintain its equipment in anything like working order which would have driven a weaker concern into bankruptcy. Frogs and track crossings have been renewed again and again, and as many as eighty armature winders have been employed at one time in the repair shops. Electrical men can easily see what this means. Leakages of current have been and are almost appalling.

In addition to this large outlay for repairs and maintenance, the road has been used for all sorts of experiments by the Thomson-Houston Company, and always at the expense of the road. Hundreds of thousands of dollars have been wasted by the West End Company in this way, and the Thomson-Houston people have been the only gainers.

Financially, the road has been anything but a success.

The difficulties in the way seem almost insurmountable, and some of the best engineering talent employed by Mr. Whitney, with practically unlimited means at their disposal, have given up the job, and handed in their resignations.

Mr. Whitney became absolutely discouraged, and got rid of his holdings some time ago. It is good opinion that to-day he holds only one share of stock.

For reasons which are well known to insiders, the Thomson-Houston Company was compelled to shoulder this load, at least temporarily and until Mr. Whitney was relieved. Mr. Coffin was too shrewd a man to saddle the financial responsibility, which included the possible wiping out of the entire equipment, upon the General Electric Company, and he has been casting about for a way to let the public in. The way has not yet revealed itself. Meantime, Mr. Whitney is pushing relentlessly, and with a diminishing patience which is entirely justifiable to those who know the facts; and Mr. Coffin is squirming in dread of the medicine which he must take if the public cannot be worked. It is understood that Mr. Whitney declines to be a party to any scheme whereby the stock is to be unloaded on small investors. He nevertheless insists on getting out, and Mr. Coffin is pretty sure to be his successor, willy nilly.

The weak spots of this system are radical and fundamental, and the situation is a serious one. not only for Boston, but for the entire electric railway industry of the world. A detailed statement of the facts in the case is in the possession of Electricity, and will be published later if it is deemed advisable for the best interests of the trade.

* * *

The Conflict. The *Electrical Engineer* last week gave up its entire editorial page to the subject of the present conflict between the Electric Trust and the independent concerns. The subject was handled in the wabbling style which the public has become accustomed to through the painful efforts of our contemporary to be on both sides of the fence at once. But while the editor has, as usual, drawn out "the thread of his verbosity finer than the staple of his argument," he has (unwittingly, no doubt,) performed a real service to the public. He has enunciated the platform on which he stands. He is "agin" the General Electric Company—if they can be beaten without his aid. He is with them body, soul and breeches if they can win. He sees no silly questions of right or wrong involved in the present problem. If large numbers of his constituency are driven into bankruptcy by the "astute and skillful" Trust, he may regret the stupidity of the constituency, but cannot censure the Trust.

After straining the dishwater, we have left the following, which may fairly be considered as the actual opinion of the *Electrical Engineer* on the one subject of vital importance to the electrical trade of America to-day:

"The General Electric Company will doubtless try to avail itself of every legal right it possesses, through the protection of the Edison patent or otherwise, to make the largest possible return upon its investment; should it not do so it would be false to the law of its being. . . . *Nor can its intentions in this regard properly be called nefarious.*

"The contest is simply between the 'ins' and the 'outs' at present.

"*If the 'ins' have the advantage just now, it is under the rules of the game—the patent law, and other laws of the country.*"

The appearance of such statements as to the American situation in a journal in Singapore or Shanghai would not have been surprising; that they should appear in a well-informed American journal is almost beyond belief. There are, however, two possible explanations, and only two, to account for these remarkable statements.

One is that the *Electrical Engineer* has decided that it could not survive the loss of the Trust's advertising patronage, and that it must keep it at whatever sacrifice of honesty, of journalistic obligations, and of truth.

The other is that it has no moral sense, no conception of right and wrong.

Is this contest simply between the "ins" and the "outs"? ELECTRICITY thinks otherwise.

There are in the United States scores of strictly scientific electrical men, men whose income in dollars and cents will not be affected whatever the outcome of this contest. It is this class of electrical men who are the chief constituents of the *Electrical Engineer*. Can a half-dozen of them be named who believe that this is *only* a contest between the "ins" and the "outs"—that the General Electric Company has a moral right to wreck its competitors by the hundred if it is possible for it to do so? Or that it has a moral right to stifle and retard the development of the art, which it is universally admitted would be the result of its full success?

If the present struggle is simply a "contest between the 'ins' and the 'outs,'" then no further justification is needed for the course pursued by all electrical journals save ELECTRICITY in keeping out of it. No trade paper is expected to take sides in a factional fight in its trade where no question of right or of the public welfare is involved.

On the other hand, no self-respecting trade paper will hesitate to take sides where either one or both of these questions is involved.

ELECTRICITY holds that both questions are involved in this matter.

We hold, first, that concerns outside the Trust have a moral right to a fair field in which to conduct their business, subject only to legitimate competition and patent laws; second, that the public welfare demands open competition in this as in all other lines of business where the public is the purchaser. And further, that it is the duty of the electrical press to expose and defeat, if possible, the corrupt and bulldozing methods adopted by the Trust to gain absolute and undisputed control.

* * *

WORDS may be multiplied into sentences, and sentences into columns, in discussing "Monopoly"; symposiums on "The Lamp Situation" may be begun by printing letters marked "Personal," and pages filled with rubbish. Yet "Great is TRUTH, and mighty above all things." And, thanks to the intelligence of the electrical trade, and to the efforts of ELECTRICITY, the truth as to the present situation is well known and cannot be buried.

* * *

DIED—In spite of constant nursing and heroic effort on the part of its parent, the *Electrical World's* symposium on "The Lamp Situation," at the age of two weeks. It would have been more creditable to that paper if it had died "a bornin'."

Electric Plants for Gas Works. Elsewhere we print a description of an electrical installation run in connection with the gas works at Clermont-Ferrand, France, which points to an important advantage that is within the reach of gas companies for supplying electric current for lighting and power. There can be no question at this time as to the demand for such an electric service, and it must be conceded that electric lighting has proved its superiority over gas lighting for many classes of service—notably for street lighting—to an extent which makes it a powerful rival of the latter.

Of this fact the majority of gas companies have seen ample evidence for some years past, but with the exception of a few isolated cases there has been little effort on the part of these companies to attack this branch of the business.

There appear to be reasons, however, that should lead to the operation of electric plants by gas companies, as the latter are in a position to produce their current with considerable economy, and moreover to afford a satisfactory service to customers. An illuminating company should be able to furnish as far as possible whatever its patrons may require.

The experience of electrical manufacturers in regard to the latter point is suggestive. At first most of these concerns manufactured a special system of electrical machinery and attempted to introduce it for every purpose to which it could be applied. In time, however, users of electrical apparatus came to distinguish between the values of these goods for different classes of work, and the progressive manufacturers saw the necessity of meeting these various demands and are now beginning to supply whatever is required rather than attempt to make a single system cover every case.

The same will undoubtedly be the experience of illuminating companies, and the gas works already established have seen the inroads which electricity has made into their business, but as yet have not taken advantage of the opportunities in this field which are open to them.

* * *

The Rapid Transit Situation. The plan for an underground electric railway evolved by the New York Rapid Transit Commission has so far met with little enthusiasm on the part of capitalists. The proposition submitted by Wilson & Company, bankers, of New York, is the nearest approach to a positive offer yet heard, but even this shows the lack of confidence on the part of the proposed company which has been manifested by capitalists generally.

The proposition of Mr. Wilson resolves itself largely into a request for the city to advance $35,000,000 for the building of this road, and leave but $15,000,000 to be supplied by a syndicate. This plan can hardly be carried out without special legislation, as the law expressly forbids the city to lend its credit to any private concern. But aside from this the proportion of capital to be furnished by the city is so large that it would be but a small step further to have the city undertake the entire work. It is generally conceded that although this work, if undertaken, will involve an expense of from fifty to sixty millions of dollars, there is every evidence to show that a fair return on this investment could be earned. The magnitude of the sum is probably the greatest cause of the shyness of capital, and it must be satisfactory to electrical engineers to see that the engineering possibilities which the scheme involves have not been seriously questioned, in spite of the departures from any present practice that would be necessary.

* * *

The Feeder Patent. We print elsewhere two communications in regard to the Edison Feeder Patent, recently sustained by Judge Green of the United States Circuit Court at Trenton.

The full text of Judge Green's decision has not been given out at this writing, and it is not likely to be until after the annual meeting of the General Electric Company.

A thorough investigation of this case, of the evidence introduced, and of the manner in which it was procured, leads to the conclusion that the only influence which this decision will ever have has been felt already—on the stock market.

If brought before a higher tribunal, the case would be tried under very different conditions from those which existed in the recent proceedings.

The relations of some of the leading manufacturing concerns have changed materially in the past two years.

If any attempt whatever is made to use this decision for the benefit of the General Electric Company in actual business transactions, we shall be greatly surprised. No such attempt will be made upon those who know the facts, and the facts are easily attainable.

* * *

IT LOOKS as though Monopoly would be taught a wholesome lesson in the city of Detroit.

* * *

THE annual statement of the General Electric Company will be a tip-topper. It will show a greater volume of business than has been done by the Westinghouse and General Electric Companies combined.

* * *

IN RESPONSE to several requests for information on the subject, we are pleased to state that the lamp referred to in our editorial of last week on "Alternating Current Lighting" was the Helios arc lamp, letters patent for which were issued to the Helios Actien Gesellschaft für Electrische Licht und Telegraphenbau, of Ehrenfeld-Cologne, Germany. The lamp is now made in this country under license by the Helios Electric Company of Philadelphia.

The graves of Benjamin Franklin and his wife are in bad condition through neglect, and G. Wilfred Pearce, of New Brunswick, N. J., has issued an address to the electricians of the country urging them to raise money to put the tomb in good condition. In his appeal Mr. Pearce says: "The estimated cost of repairing tomb and making fence and tablet is $1,000, and in order that all may contribute I would suggest that 10 cents be the sum from each subscriber. If there are others who care to give larger sums an endowment fund will be created and the income devoted to keeping the tomb in repair for many years to come."

Trust Methods.

They Make Their Own Discounts on Bills Payable.

An instructive example of the peculiar methods practised by the General Electric Company has recently come under our notice, which confirms what we have long maintained, that their manipulation of finances is a law unto itself.

Not long ago the Generalissimo of this huge octopus placed an order with a single firm for goods aggregating in value something like $200,000. The party who had accepted this contract, believing he had "struck ile," was boasting to a friend what a good deal he had made. His friend, who had been through the mill, replied, "Yes, that is all right, but wait until the General Electric Company has to pay for the goods and you'll find they will discount your bills in a lively way."

Thinking there might be some truth in the suggestion, before shipping the last instalment of the goods to complete the contract, the General Electric Company was written to for a settlement. A settlement was tendered in the form of a check made out for $12,000 less than the amount of contract. Promptly a reply was sent that until the balance of $12,000 was remitted the last consignment would not be shipped.

The usual amount of bluff, bluster, brag and bounce was at once resorted to by the Trust, who threatened condign legal punishment if the goods were not shipped at once.

They were not shipped, however, and when it was discovered that the bluff and bluster didn't scare, the balance was paid and the goods at once forwarded.

Shortly afterwards the General Electric Company wanted to place a much smaller order with the same firm. *The order was declined*, with the information that the contractor, having had one experience of General Electric methods, had no hankering for a second ; he could not and would not do any more business directly with the Trust ; if, however, the local company for which the goods were being ordered by the Trust cared enough for the goods to order them direct, the order would be accepted and filled.

And that was what had to be done. The General Electric Company had to come to time; it disgorged the $12,000, the local company ordered its goods and got them, while the Trust had found some one whose stricter and more honorable business methods it had to yield to.

Said the contractor himself only a few days after, "I believe that is only a typical instance of what they are doing right along, which means that the days and doings of such a Trust are numbered."

General Electric.

Common-Sense Statements from Boston.

(*From the Commercial Bulletin.*)

Of course the Electric Trust is different from the Whiskey Trust in the men who manage it if in nothing else. Yet there are points of similarity in each. The Electric Trust does not even enjoy the monopoly of its business to the same extent as the Whiskey Trust, and we record the prophecy right here that eventually General Electric stock will be selling for $50 per share. It may take months, perhaps even a year or two, but the drop will come. It will come slowly, because the stock is held in large blocks by rich men whose faith in it remains as yet to be shaken.

It may seem like heresy to say anything against the stock of this much watered Electric Trust, and we shall no doubt be roundly criticised, but the inherent weakness is there, and some day it is bound to be uncovered. Just consider the capitalization of this concern and what that capital represents. The preferred and common stock outstanding amounts to about $35,000,000; then there are $10,000,000 debenture bonds and $500,000 T.-H. collateral trust bonds redeemable at 105 after July, 1899, making a total of $45,500,000 interest bearing securities outstanding.

At the time of the consolidation the manufacturing plants and real estate of the Edison Company were valued at $6,057,368, and that of the Thomson-Houston could hardly have been any more if as much, but call it $15,000,000 as the value of plants and real estate of both companies and we have $30,500,000 to account for under the head of "water," "earning capacity," and "stocks and bonds of other companies." If memory is correct, these same stocks and bonds came pretty near putting the Thomson-Houston into the same hole which the Westinghouse Company got into at the time of the Barings failure in 1890. It was impossible to borrow money on them, and had it not been for the assistance of a State street house, the Lynn company might not have been any better off than its Pittsburg competitor who had no one to furnish assistance to tide it over the tight money period.

But to return to the subject in hand. Here is this immense load of water upon which to earn and pay big dividends, and people in the electrical business say that with increasing competition and the natural downward tendency of prices, it cannot be done, and sooner or later the question of reducing the 8 per cent. dividend rate on the common stock must be faced. Much talk of big surpluses earned each year is heard, but if these surpluses are not fictitious, why the necessity of constantly issuing the 5 per cent. bonds to provide working capital? The so-called surplus will doubtless be found to be analogous to that famous Whiskey Trust surplus of last December.

General Electric agents on the road acknowledge that their foremost competitor is taking business away from them here in the East, and a salesman familiar with the Western trade says that the company ran behind $500,000 at their Chicago office last year. The Chicago office is the third largest of the company in the country, but all through the West the General Electric is said to be not holding its own. Now with this keen and cutting competition going on all the time, and prices gradually getting down to a competitive basis, what must be the result to a company which is obliged to pay the enormous interest charges of the General Electric ? What, but an ultimate reduction in the dividend rate of the common stock.

Westinghouse Business.

The reorganization of the Westinghouse Electric Company went into effect April 1, 1892. A review of the company's business for the year ended April 1, 1893, published in the Pittsburg *Times*, shows that the number of employees has increased from 1,000 to 3,500. During March, the twelfth month of its fiscal year, the company manufactured and shipped goods to the value of $857,000, making the total output for the year about $5,800,000. The increase in the present capacity of the works as compared with the beginning of the year is nearly 100 per. cent., by reason of the addition of new machinery and the lease of the old Air Brake Works in Allegheny. The net earnings after providing for all ordinary and extraordinary expenses have averaged 25 per cent. of the amount of the sales, so that the earnings for the year ending March 31 will add between $1,100,000 and $1,200,000 to the surplus of the company after providing for the 7 per cent. dividends on the preferred stock.

Mr. Rae's Estimates.

They Rattle the Detroit Combine.

Much discussion has been stirred up throughout the country by the publication in ELECTRICITY of the estimates of Mr. Frank B. Rae on the cost of equipping and maintaining a municipal plant for the city of Detroit.

As was to be expected, the chief criticism comes from the officials of the company which endeavored to throttle Detroit, but which evidently overreached itself, and is now likely to be itself knocked out.

Mr. Rae has had occasion to reply to a criticism in the *Tribune* (Trust organ) and says in part:

> The cost of operation of the present lighting plant, which, however desirable it may be to justify to the directors of the Electric Light Company, is no criterion for a basis of cost of maintaining the class of apparatus upon which my estimates are made.
>
> It will certainly take any business man more than ten minutes to determine that these estimates are "unreliable in nearly every particular." No business man, not thoroughly conversant with the engineering problems involved, would undertake to criticise them at all; and criticism that attacks an engineer's reputation from behind the doors of the editorial column by simply calling his work "grossly inaccurate and unreliable" will hardly have weight with the few intelligent readers of the *Tribune*. It requires no brains to say an engineer's figures are wrong; but it will take more than are possessed by the writer of the editorial referred to to prove that a lighting plant cannot be put in and operated within the figures of my estimate.
>
> As stated in my communication to the Mayor, the estimates made are considered conservative; and capital could be induced to undertake the construction under them; and I understand that one of the largest contracting companies has already signified its willingness to undertake the work.
>
> I desire to say formally, as the papers have stated informally, that I am prepared to meet Mr. Fitzgerald or others of his company at any time and discuss the estimates and cost of operation item by item, which, it seems to me, is a more manly way of settling the controversy than is adopted by the *Tribune* man, who hides behind the editorial column fence and throws mud.

Mayor Pingree has received a communication from Siemens & Halske in which they say:

> "Assuming that length of 'pole line,' cost of 'real estate' and other variable quantities are correct, we have gone over estimate No. 1 and made careful determinations, and find that the total cost of the installation will not exceed the estimate, and that cost of operation, depreciation and repairs are very liberal. As contractors, we would be pleased to undertake the work at prices given in estimate No. 1."

The following, from the *Tribune*, is suggestive:

> Manager Fitzgerald of the Detroit Electric Light and Power Company held a consultation yesterday with Alderman Robinson, chairman of the public lighting committee of the Common Council. Mr. Fitzgerald informed the alderman that the company was ready to begin negotiations at any time for the sale to the city of the towers, poles, wire, lamps and dynamos used for public lighting, the price to be fixed by arbitration.

Current Items.

The "Low Sanitary Car" is undergoing tests at Chicago, Toledo and other Western cities to determine its suitability for summer traffic on electric street railway lines. It is a "reversible" car, and can be either open or closed. By a dexterous movement the sides of the closed car are converted into the seats of the open car, facing the residences along the street. The windows slide into the backs of the seats. The change can be made in three or four minutes.

Capt. W. H. Schley, U. S. N., has invented an electric buoy system which is intended to make navigation safer in entering harbors in thick weather and dense fogs. His plan is to have all the buoys in a harbor on a single electric circuit and to have electric lights and electric bells on each of the buoys. He is now at Chicago arranging for the establishment of an experimental plant which is to cost $25,000.

BOOK NOTICES.

WILLIAM GILBERT OF COLCHESTER, ON THE LOADSTONE AND MAGNETIC BODIES, ETC. TRANSLATED BY P. HENRY MOTTLELAY. PUBLISHED BY JOHN WILEY & SONS, New York.

This celebrated work of William Gilbert, physician, of London, written and published about the year 1600 in Latin, has come to be appreciated as the first authentic work treating of magnetism and electricity. *De Magnete* included not only all the previous knowledge and experiments in this field, but a wonderful amount of original research which placed this work so far ahead of its time that it is only in the light of modern science that its merits have been recognized.

It is probably for this reason that the name of Gilbert was allowed to fall into comparative obscurity, as notwithstanding the marked impression that his work created at the time, its real value was evidently unappreciated.

The present and only English translation of this work of Gilbert's, published by John Wiley & Sons, bears evidence of the most careful research on the part of Mr. Mottlelay, whose efforts to make this work complete have extended beyond a faithful translation to the collation of the numerous and obscure references contained in the original publication, as well as the more recent commentaries upon it.

The book is prefaced by a biographical sketch of the author, containing a large number of extracts from prominent writers which go to prove the esteem in which Gilbert was held as a scientist and philosopher in his day. The translation proper is divided into five books, which treat at considerable length of the phenomena of magnetism and show clearly the extent of the author's investigations and the logic of his deductions. The original illustrations are accurately reproduced as well as fac-similes of the title pages of the early Latin editions. The book is printed on heavy paper, handsomely bound and will be found a most acceptable addition to electrical literature.

THE VOLTAIC CELL. BY PARK BENJAMIN, LL.B., PH.D. JOHN WILEY & SONS, Publishers, New York. 526 pages. Price, $5.00.

This is a very complete description of the most important cells of various types, commencing with the earliest history of chemical generators. It contains a chapter on the general definitions of electrical units, and one on the method of measurements and the capabilities of the cells.

The remaining chapters are devoted to the various cells and their chemical reactions, which are classified according to their respective types, and also include considerable data and numerous tables compiled by recognized authorities which will be found of much practical use to the student in this branch of electricity. The book constitutes the most extensive treatise on this subject yet published.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. TRANSACTIONS, Vol. IX. JANUARY, 1892—DECEMBER, 1892. Published by the Institute.

The present volume of the Transactions of the Institute includes the papers read at the regular meetings, most of which have been published in ELECTRICITY in abstract. Volume IX is considerably larger than any of the preceding numbers and points to the constant extension of the researches embodied in the papers read. The membership has been increased by sixty-three names during the past year.

At a meeting of electrical workers held at Utica a few days ago, Henry Bond, of Buffalo, in some remarks said "he thought it a privilege to look into the faces of men who are dealing with a force almost akin to the force of God, akin because we do not know just what it is."

Chicago Notes.

The Cornish Electric Company have secured offices in the Monadnock Building, from which they will hereafter conduct their business. The company confine their work exclusively to electric light installation, and report an excellent business.

W. D. Packard, secretary and treasurer of the Packard Incandescent Lamp Company of Warren, Ohio, was in the city last week.

Wells Goodhue and William Taylor, of the firm of Taylor, Goodhue & Ames, spent a portion of last week in St. Louis, making arrangements for handling the Wagner direct and alternating motors.

The Electrical Installation Company have recently been organized, and have secured quarters in the Monadnock Building, from which they expect to conduct a large business in installing and equipping electric light and street-railway plants. The company will make a specialty of furnishing plans and drawings for complete plants, including generators, steam engines and boilers. J. I. Case has been elected president, C. H. Holmes vice-president, L. E. Meyers secretary and treasurer, and A. L. Shewmen general manager.

The Electric Light bill which is before the Illinois Legislature for its second reading is creating considerable interest, especially among stockholders in electric light companies and central station men. The bill provides that when 3,000 voters of Chicago, or one-quarter of the voters of any other city, shall petition the County Judge that officer shall submit the question of establishing an electric light or gas plant to the voters at the next regular election. The people shall then have the right to declare whether or not private consumers shall be supplied from the municipal plant. The application of the bill will be limited to such cities as have private plants. There is no opposition to the measure from the smaller towns and cities, because they have not as yet, with few exceptions, granted franchises to electric light companies. Representatives of electric light companies from Joliet, Jacksonville, Ottawa, and one or two other towns were on the floor of the Senate in opposition to the measure. The bill with the amendment will be taken up for discussion next Tuesday. Its chances of passing the Senate are reasonably good, particularly since the Thiele amendment relieves it of objectionable features. The only thing that will kill it will be the opposition of the electric light companies already in business. The bill is known to have been framed by a prominent Chicago man who has made municipal ownership of electric light plants a special hobby, and it is expected to apply more directly to Chicago than any other city of the State.

Boston Notes.

Work is being pushed on the new Union Depot on Causeway street, this city, that is to accommodate all the northern traffic. Some portion of it will necessarily have to be built on piles over the tidal water and several draws will have to be constructed for the convenience of shipping along the Charles River. It is expected that the lighting as well as power for operating the draws, elevators, etc., will all be electrical, which will necessitate one of the largest isolated stations in the world.

The town of Braintree, Mass., having adopted the Municipal Lighting Act, has built and equipped a central station plant, from which some ninety arc lights are being run for street illumination. At the present time two Westinghouse alternating current dynamos are being installed for supplying 2,000 lights. The citizens take to the new illuminant with keen relish.

There is great rejoicing among the men employed by the West End Railroad Company at its electric power station, Albany street, this city. The company has notified the men that in future the working time will consist of fifty-six hours per week, being a reduction of four hours, while their wages have been increased 20 per cent. The men fully appreciate this liberal concession.

Matters were more than a little interesting at the State House two days last week when hearings took place before the Committee on Street Railways on the petition of the Storage Battery Railway Company, of Cambridge, for power to run cars over the tracks of the West End railroad in that city. The latter company is determined to oppose the petition by every means at its disposal. During the hearings some interesting data, pro and con, were adduced and strong arguments were made by counsel for both sides.

Fast Day brought about a resumption of traffic on one or two electric roads in Massachusetts which connect with the popular beach resorts. Owing to the blinding fall of snow that set in early in the morning and continued for six or seven hours, the season's opening was not an auspicious one, but every one interested is sanguine that should the coming summer be a fine one the roads are sure to do a bigger and more profitable business than ever, and with this end in view extensions are being made on several roads.

The city of Lynn has long been known as one of the foremost shoe manufacturing cities in this country. It is fast becoming a race between leather and electricity as to which shall in future occupy first place there. Not only, as is well known, are the mammoth works of the General Electric Company located there, but several other electrical companies have recently organized and started in business in Lynn. Prominent among these is the Heinze Electric Company, which manufactures a complete line of high grade electrical measuring instruments, including volt and ammeters, and other station instruments, for which they are enjoying quite a brisk demand. Then there are several supply and construction companies. Quite recently too the enterprising young men connected with these various companies, together with some employed by the General Electric Company, have organized an electric club or society, somewhat in character like the Thomson Scientific Club, which is doing such useful work for its members.

Since the opening of the long-distance telephone line between Boston and Chicago, a few weeks ago, there has been a most satisfactory business done between the cities. Business men have not been slow to avail themselves of its aid, and though the rates at first appear somewhat high, the money made and saved and the expedition with which business can now be transacted demonstrates daily that it is a cheap and valuable medium of communication for all who use it.

General News.

What is Going on in the Electrical World.

Rockville, Md.—The Tennallyton and Rockville Electric Railroad is being double tracked to Bethesda Park.

Lansing, Mich.—The matter of equipping the Capitol buildings with an electric lighting plant is under consideration.

Buffalo, N. Y.—The Buffalo and Williamsville Electric Railroad was formally opened on the 4th inst. It is 4½ miles long.

Peekskill, N. Y.—The route of the new electric railway has been laid out and men will be set to work on the road in a few days.

Hastings, Neb.—The Hastings Electric Light and Power Company's plant has been sold at sheriff's sale to D. M. Leland for $15,000.

Pawtucket, R. I.—The Interstate Railway Company has begun work on the electric road that is to connect this city with Providence.

Urbana, Ohio.—An electric line between Urbana and Springfield is a topic of interest here which will probably result in the road being built.

Little Rock, Ark.—The conductors and motor-men of the City Electric Street Railway Company have petitioned the company for a reduction in working hours.

Ashtabula, Ohio.—At a recent town election the proposition to bond the town for $150,000 to pay for an incandescent plant was carried by a large majority.

Brazil, Ind.—The electric line between Brazil and Terra Haute is again engaging attention, and one of the interested parties is quoted as saying, "It will be a go."

Dowagiac, Mich.—An effort is being made by our business men to get an Electric Headlight

Manufacturing Company to remove from New York and locate here.

Newark, Ohio.—The signature of the Mayor has finally been attached to the contract for the installation of the Thomson-Houston electric light plant in the city.

Gloversville, N. Y.—Fred A. Caten has been appointed superintendent of the Cayadutta Electric Company. The office of the company will be located in Gloversville.

Addison, N. Y.—D. H. Darrin, electrical engineer, of Buffalo, is preparing plans for an electric light plant for this town to be in readiness for operation by August 1.

Brooklyn, N. Y.—The Grand street road is receiving its electric equipment, and Bowery Bay and neighboring places will shortly participate in the benefits of electric transit.

Florence, S. C.—Among the twenty-five buildings destroyed by fire here on the 3d inst. was the electric light station, and the destruction of the plant has deprived the city of electric lights.

San Francisco, Cal.—The W. A. Woods Manufacturing Company, dealing in mining and electrical machinery at 645 Mission street, has failed for $18,252. The assets as scheduled amount to $14,764.

Roseville, N. J. — The car-house of the Orange electric railway line was totally destroyed by fire on the 3d inst. Twenty-six cars, costing $3,000 each, were burned, and the total loss is over $100,000.

Wilmington, Del.—A meeting is to be held here on the 13th instant to organize the company, appoint its officers and take the necessary measures to begin the construction of an electric railroad to New Castle.

Toronto, Can.—The annual report of the Royal Electric Company showed gross receipts of $189,765, expenditures $118,967; leaving a balance of $70,798, being a fraction over 10 per cent. on the capital.

Trenton, N. J.—A scheme is on foot to erect a dam over the Delaware River, a short distance above this city, for the purpose of forming a water power for an electric plant for light and power service in this neighborhood.

Charleston, S. C.—The street railway cars of Charleston are still operated by animal power, but there is prospect of a change to electricity as it is reported the system has been purchased by outsiders with that purpose in view.

Butte, Mont.—The Smith Electric Company and Kinney & Jackson have sold their electric and construction business to the Montana Electric Company. This places the electric supply business in the hands of one company.

San Antonio, Tex.—A trial is to be made on the Southern Pacific Railroad of a storage battery for lighting the cars, an invention of Boyd Anderson, chief engineer of the Texas-Mexican Electric Light Company's power station.

Bridgeport, Conn.—A syndicate of capitalists, headed by Colonel N. H. Heft, formerly of Easton, N. J., has purchased the Bridgeport, Conn., Railway, now using horses for motive power, and will made an electric railway of it.

Cleveland, Ohio.—City Electrician G. M. Hoag has submitted maps and plans for a complete system of conduit for electric wires in the business part of the city. The plans of Mr. Hoag provide for 106,923 feet of conduits at an estimated cost of $91,803.

Long Island City.—$100 reward is offered by the president of the Electric Illuminating Company of Hunter's Point for information that will lead to the arrest of the thieves who cut and carried off 2,500 feet of copper wire from the poles of the company.

Brunswick, Ga.—The Brunswick and St. Simons Street Railway has been purchased by A. H. Lane, Judge A. J. Covatt and Judge Bolling Whitfield, of Brunswick, and William O. Allison, of New York, who will convert the road into an electric line.

Norwalk, Conn.—An attempt was made to wreck the engine at the electric light station a few nights ago by the placing of a quantity of emery in the oil cups of the eccentric rod. Fortunately the fact was made apparent in time to avert serious damage.

Tampa, Fla.—There are now three electric light companies in Tampa, the Consumers' Electric Light and Street Railway having gained a footing. As this company has a fine dam and powerful head of water it will have some advantages over its rivals.

Altoona, Pa.—A meeting will be held here on the 14th inst. to discuss "the advisability of making a donation to any electric street railway company that might feel disposed to accept their offer to assist in laying a street car track from some connecting point in Altoona to Newburg."

Franklin, Mass.—The Woonsocket Electric Company having absorbed the Union Electric Light Company, the office of the latter company in this place has been closed. The wires will be connected and current for our electric lighting service will be supplied from the Woonsocket line.

West Chester, Pa.—It is apparent now that the Lancaster and Philadelphia Electric Traction Company's road will be pushed forward, and if the predictions of the *News* are verified, before many months electric cars will be whirling alo the Chester Valley at the rate of fifty miles per hour.

York, Pa.—The Edison and Westinghouse Electric Light Companies of this city are indulging in a rate war. The Westinghouse Company started their plant about a month ago, immediately after which the Edison Company reduced rates. The Westinghouse people have made another cut.

Lebanon, Pa.—W. P. Coldren, of this city, has invented a device for controlling the brake and current of electric cars with one lever. It has been subjected to practical tests and worked successfully. Steps will be taken at once for its general introduction throughout the country, and for exhibition at the World's Fair.

McKeesport, Pa.—The electric light station recently burned is being temporarily restored. The boilers were found to be very slightly damaged. The old dynamos, which were entirely ruined, have been taken away and new ones are being installed. A new station will be built as soon as arrangements can be made to begin the work.

Long Branch, N. J.—Preparations for the new electric railway to run from North Long Branch to Red Bank are in active progress. The road will start at North Long Branch, connecting with the Pleasure Bay horse cars, and go to Red Bank by way of Port-au-Peck, Elkwood Park, Monmouth Park, Oceanport and the Scuffletown road.

Philadelphia.—The Mayor's message, given to the public last week, is strongly in favor of putting all electric wires underground; it praises the Municipal Electrical Bureau "as the finest equipped and most practical" body of the kind in this country, and advocates city ownership of electric lighting plant. The message states that there are 2,650 arc lights in use by the city and 700 will be added this year.

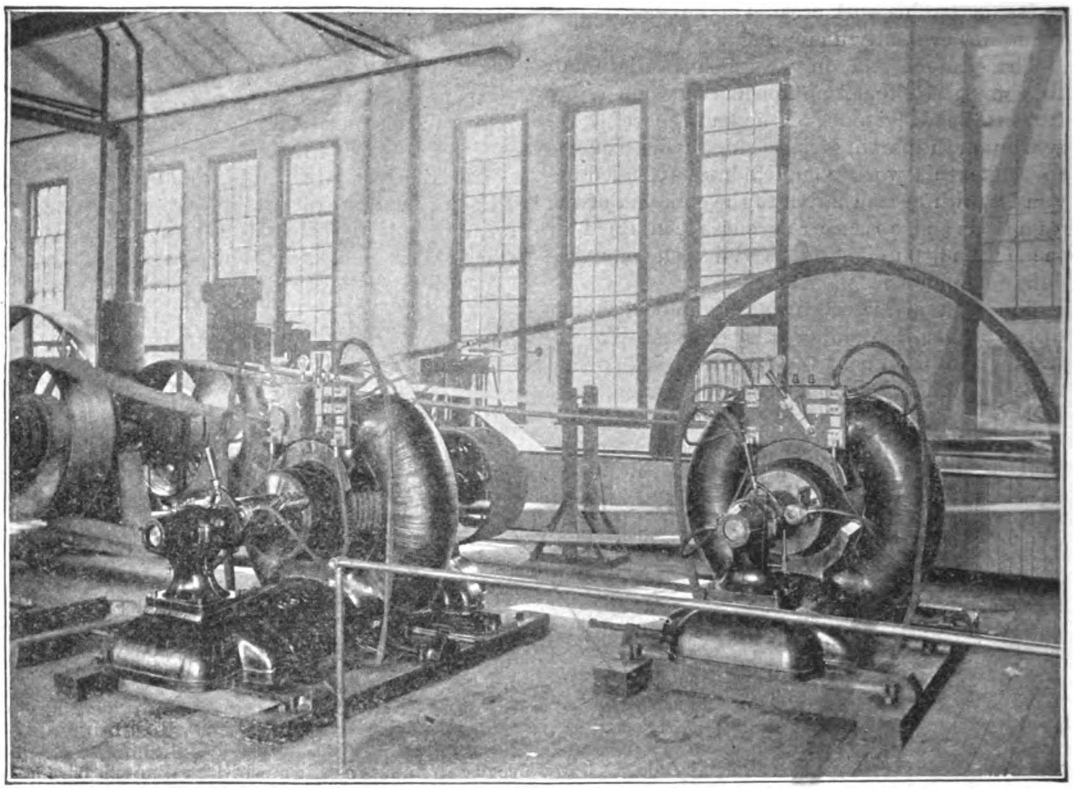
Montclair, N. J.—At the annual town meeting last week a motion was adopted to the effect that a town meeting must be called to act upon any franchise asked for by an electric railway company to lay rails in the streets, and no franchises is to be approved except such as provides for regulation of construction and rates of fare, for limitation of life of franchise, and for compensation to the town through a percentage of gross receipts.

New York.—The Telephone and Telegraph Company, which controls the long-distance lines, has again increased its capital, this time to $7,000,000. The increase is stated to be the outcome of continued growth of construction.—An attachment for $23,267 has been issued against the Ongley Electric Company, No. 1 Broadway, in favor of T. W. Robertson, the president of the company. The company was incorporated under the laws of New Jersey and has a factory in Hoboken, N. J.

Hoboken, N. J.—The West Hoboken council has granted the North Hudson Railroad Company permission to operate lines by electricity and the Jersey City, Hoboken and Rutherford Railway Company permission to lay track, erect poles and operate an electric road on the Paterson Plank Road and Summit Avenue.

Fall River, Mass.—The petition of the Fall River and Taunton Electric Railway Company for a charter for their proposed road to Taunton is in the hands of a legislative committee, where it has met opposition from the Taunton Street Railway Company, on the ground that the proposed line would parallel and compete with about four miles of the latter company's tracks. The entire length of the proposed road is 16½ miles, viz., 1¾ miles in Fall River; 6¼ miles in Somerset; 4¾ in Dighton; 3¾ in Taunton.

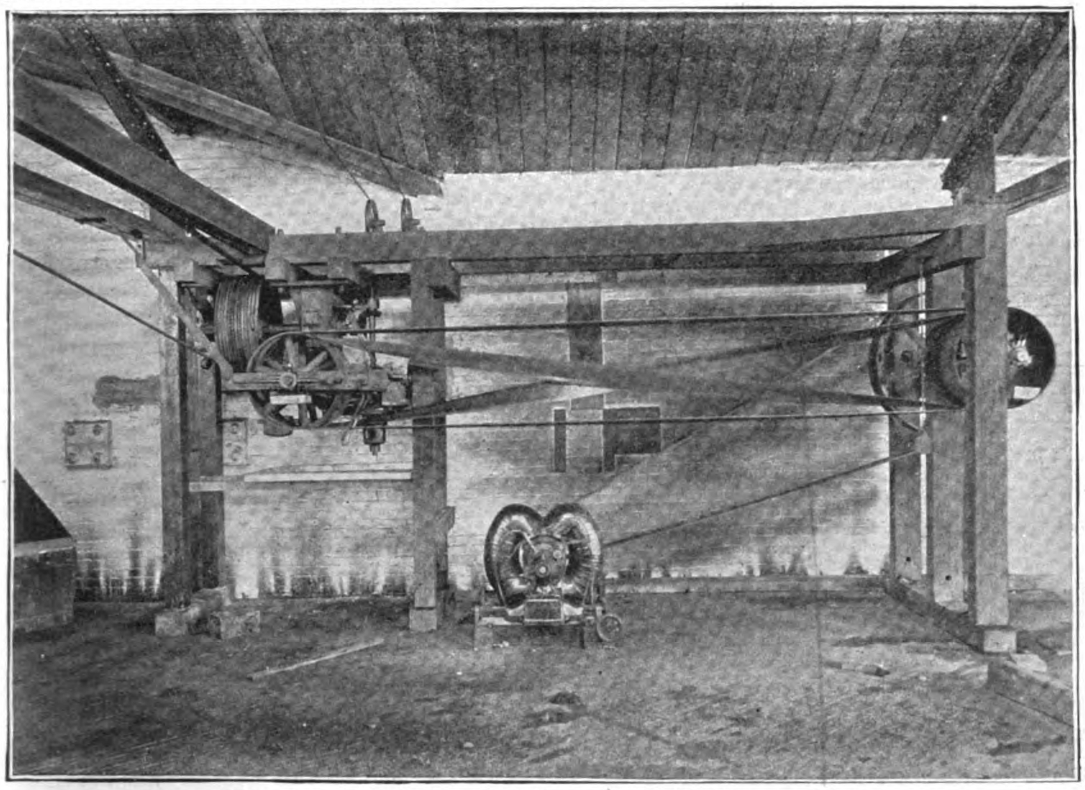
Hartford, Conn.—The *Courant* says: "The Waterhouse Electrical Manufacturing Company has recently been incorporated in London with a capital of $100,000. The Waterhouse brothers, the well known electricians and manufacturers of arc lamps, of this city, are in the London enterprise. Addison G. Waterhouse, the inventor, has been in England for several months overseeing the arrangements there. Mr. Gamble, the Ohio man, who is also in the firm of Waterhouse, Gamble & Company, is interested in the English concern. The new concern will go into a general electrical manufacturing business and looks for large orders in a field that is only just opening."



C. & C. DYNAMO. WORKS OF FRASER & CHALMERS, CHICAGO, ILL. (FIG. 1.)

Electric Power Transmission in Factories.

The advantages of equipping large mills and factories entirely with electric power are beginning to be appreciated by those interested in such work, and the number of such installations that will be put in during the next few years will undoubtedly be very large. Commenting upon this fact the C. & C. Electric Motor Company present several considerations. They first direct attention to the fact that where electric power is used the saving of power otherwise lost in belting, shafting and gearing is a very large item and increases rapidly with the size of the plant. Varying with the character and arrangement of the factory this loss ranges from 25 to 50 per cent. of the entire power generated and consumed in the factory. Again, in almost all manufacturing establishments the individual machines do not run constantly but are stopped or run idly for periods varying from a fraction of a minute to several minutes at a time. Here another great saving effected by the use of electric distribution is demonstrated. Under the old system the throwing on or off of small machines makes practically no impression upon the great moving mass of shafting. With electric power, however, the instant a single machine is stopped or runs for a moment on a lighter part of its work the current supplying the motor is reduced and the effect is felt instantly at the cut-off of the engine through the dynamos. Steam is thereby saved and the demand upon the coal pile lessened. Another point which merits attention is the cost of renewal and repairs of shafting and belting, which can be reduced to a minimum by means of electric distribution of power, as the line once put up never loses its initial efficiency.



4,000-lb. Elevator Driven by 20 h. p. C. & C. Motor. (Fig. 2.)

A good electric motor requires very little attention. No special knowledge is necessary and very little time is taken up in keeping it in good condition.

An advantage worth noting is that with electric power any part of the works may be run independently of the rest, and power may be obtained at any point with the greatest facility. For example, where one department is required to run overtime all the others can be cut off in the engine room, and no power is wasted, and where power is required for temporary use at different points, the motors may be moved about and connected into circuit where the work is to be done. When new machinery is to be put in, all that is required is to run a pair of wires. which can go anywhere around corners or through floors without difficulty or additional loss, and connect them to the motor.

Another advantage of electricity is seen in transmitting power from floor to floor or through walls, no belt holes being required, the wires being run through tubes of insulating material, thus avoiding any opening whatever. Openings in floors always tend to increase insurance rates and are likewise more or less dangerous to employees.

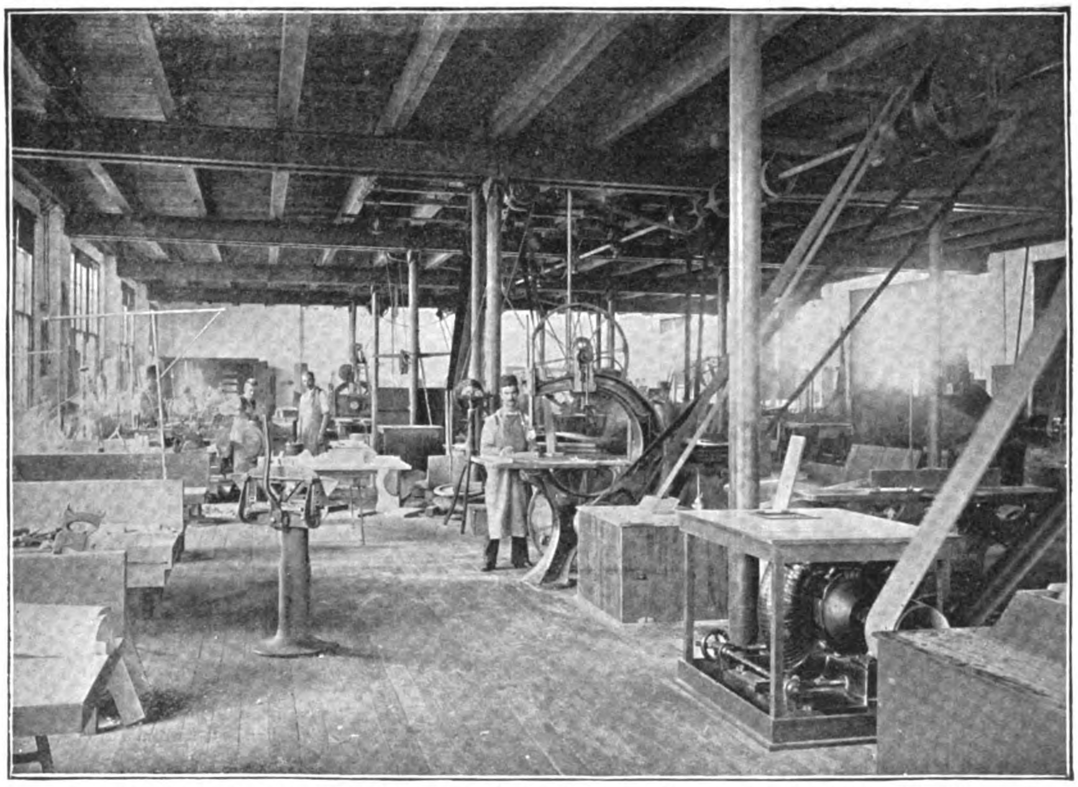
Still another feature of electric power is the opportunity afforded to measure accurately the power used in any department or in the whole factory. A recording wattmeter in the dynamo room gives a constant and accurate record of the daily consumption of power, while the ammeters on the switchboard give the power being used in any circuit at any time. One of the valuable results of this is that the attendant in charge is enabled to note any unusual load, which would lead to seeking and remedying the trouble.

The number of circuits from the engine room is, of course, determined by the nature and extent of the plant and of the work therein. A large number of separate circuits increases the first cost but may be more economical in the end.

By the use of electricity both light and power can be obtained with equal facility from one dynamo if desired. It is not necessary now as formerly to have a collection of various dynamos in the engine room for the purpose.

Electric power means perfect cleanliness in the factory, something particularly desired by many manufacturers; for example, in textile fabric mills and dye works, where the loss from soiled material is very great and largely due to dust and oil from belts and shaft hangers.

The illustrations shown herewith of the new works of the Fraser & Chalmers Company, at Chicago, Ill., furnish an excellent example of electric power distribution in works occupying a number of buildings and covering a large area.



Pattern Shop: Planer, Saws, Lathes, etc., Driven by C. & C. Motors.
(Fig. 3.)

This concern is one of the largest manufacturers of mining machinery, steam engines, boilers, etc., in the country and its works are entirely equipped with electric motors of the C. & C. Company's type.

To cover the ground occupied by any other method would require costly and wasteful mechanical contrivances which would be constantly liable to breakdowns.

Separate engines and boiler for each building can hardly be considered on either first cost or cost of operation, in comparison with electricity from a central power house.

The power house is located away from the main buildings and near the centre of the works. From the power house run three substantial circuits delivering current with a loss of from 2 per cent. to 5 per cent. to motors in the foundry, pattern shop and boiler shop. In the power house are two C. & C. 80 K. W. Standard Compound dynamos driven by two Fraser & Chalmers Corliss engines. These dynamos are designed to deliver current at 250 volts. regulating automatically for all loads, and supply power and incandescent light for the entire works.

Fig. 1 shows the arrangement of the dynamos, and Fig. 2 the switchboard, which is placed at a convenient point in the engine room. The three main circuits are brought to the switchboard and are connected through double-pole switches to the dynamo bus bars at back of switchboard. Each circuit has its independent ammeter showing the power consumed in each department at all times.

A voltmeter with switch for connecting to either dynamo is mounted in the centre of the board and regulators for changing the voltage if desired are placed immediately below, as shown.

The switchboard is arranged to be enlarged as more circuits are required. The motors throughout the shops are provided with automatic cut-off starting switches, so that when the current is cut off at the main switchboard each motor is cut off from its circuit. This prevents the possibility of injury to motors from the current being suddenly thrown on them from the power house.

In the foundry the 65 H. P. motor runs a 6 and a 4 Root blower, supplying blast for the cupola furnaces. The motor is belted to the blowers. Here is also a 4,000 pound Reedy elevator driven by a 20 H. P. motor, shown in Fig. 3. For handling heavy castings, moulds, etc., there is a Yale & Towne jib crane worked by two Standard C. & C. motors. The hoisting and lowering motor is of 7½ H. P. capacity, working up to 12 H. P. maximum, and the trolley motor is 5 H. P.

A general view of the pattern shop is shown in Fig. 4.

The power equipment consists of a 25 H. P. motor and a 20 H. P. motor which run a 24-inch planer, cross-cut and rip saws and 2 band saws, also 4 lathes and 1 grindstone. There is also a 15 H. P. motor running an elevator in this department.

Fig. 5 shows a view of the boiler shop looking from end to end. This shop contains a great deal of heavy machinery, and the freedom from line shafting and counter belts is noticeable. Most of the machines are divided into groups of two or three driven by one motor, though in some cases there is a separate motor for each machine.

There is a 5 H. P. motor running boiler-plate shear and large upright drill; 10 H. P. motor running large hand punch, bevel shear, turret lathe and 16-inch shaper; 10 H. P. motor running slitting shear and large boiler-plate punch; 5 H P. motor running boiler-plate punch, shear and small vertical drill; 10 H. P motor running 10 foot boiler-plate roll and 20 foot plate planer; 10 H. P. motor running a Williams, White & Company's bulldozer; 10 H. P motor running a large bevel shear, upright drill and punch; 5 H. P. motor running 2 sets of 5 foot sheet iron rolls and automatic sheet iron punch; and a 5 H. P. motor running a No. 1 Root blower supplying draught for forge fires.

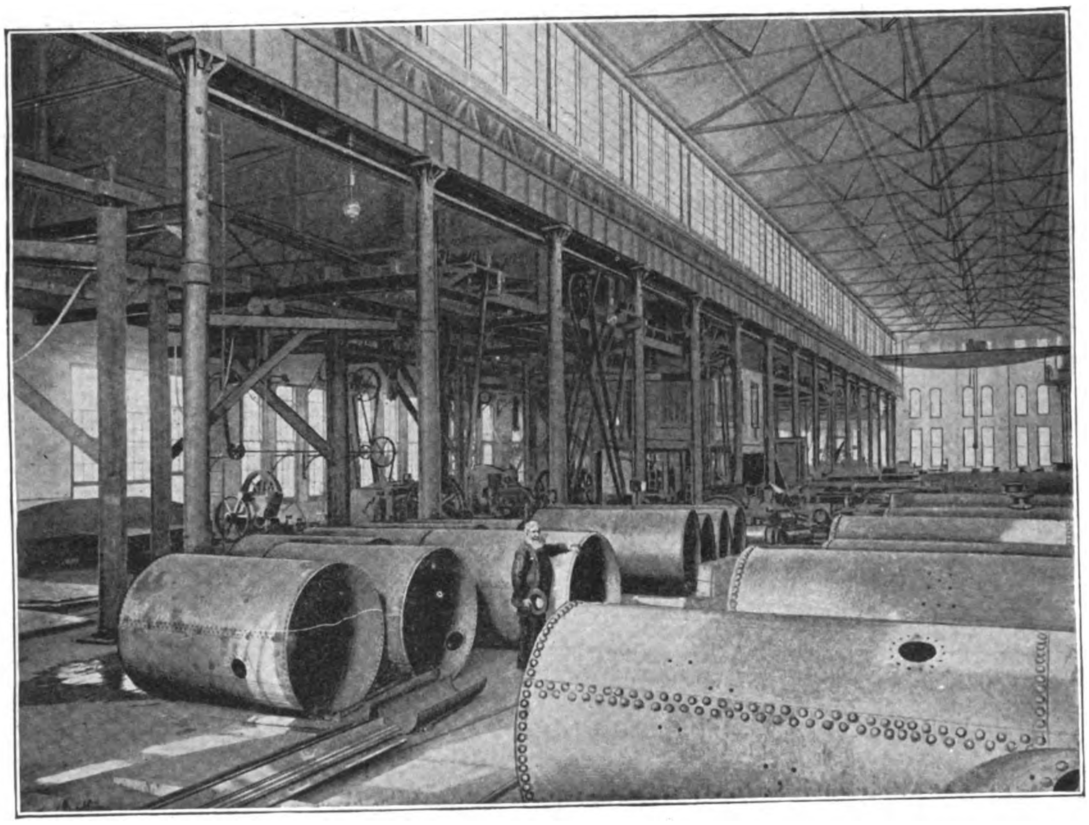
The C. & C. Electric Motor Company have also equipped the works of the De La Vergne Refrigerating Company at the foot of East Eighteenth street, New York City, and the Brooklyn Cooperage Company, Brooklyn, N. Y., with their machines, both of which plants have given perfect satisfaction.

Queen & Company, Incorporated.

Queen & Company, Incorporated, Philadelphia, are making a special drive of their "Magnetic Vane" Ammeters and Voltmeters, which instruments are favorably known throughout the country.

They are adapted for constant switchboard use, and will render service twenty-four hours per day without disadvantage. This is an important feature and will be appreciated by those familiar with the subject. A number of the larger manufacturing concerns use the meters for installation work as they present great advantages in being constant, accurate, durable, handsome in appearance and low in price. More than twice as many were sold in 1892 than during the previous year.

Circular No. 420, which contains full information, will be mailed by the makers upon application.



Boiler Shop, Fraser & Chalmers. (Fig. 4.)

COMMERCIAL PARAGRAPHS.

The United Columbian Electric Company have nearly completed the arrangement of machinery in their new factory at Kingston, and it will be in full operation in a few days.

It is pleasant to note the full success of the Keystone Electric Company of Erie, Pa. They have recently purchased a site for a new factory, and will at once erect a building 50 x 100, two stories in height. The capital stock has been increased to $50,000.

The Belknap Motor Company, of Portland, Maine, have shipped their ten-ton exhibit to the World's Fair. This exhibit includes dynamos, motors, coffee mills, electric fans, combined engines and motors, and many other electrical contrivances. Mr. Brown, manager of the company, has invented a revolving sign which is unique, and which will undoubtedly attract considerable attention. It is a triangular frame, over which is a sheet of tin painted red on one side and blue on the other. Letters, giving the name of the company, location of factory, and appliances manufactured, are cut through this tin. Under the tin revolves a sheet of canvas decorated in different tints. As this canvas revolves the letters appear in varying hues. On the top of the frame is a row of various colored electric lights, and at each end a colored fan revolves. The power is furnished by a small electric motor situated in the center of the frame.

The Brown Electric Company, which carries a full line of lighting and railway supplies at its new store, corner of Summer and Federal streets, Boston, reports business in all its branches as more than satisfactory.

The Mather Electric Company, whose well known system of lighting and power is in use in many of the largest stations in this country, continues booking orders at a rate that is taxing its extensive factory at Manchester, Conn., to the utmost. One of its traveling representatives has just returned from an extended tour through South America, where he has done most excellent business, and where the future promises to be unusually prosperous and profitable for this company, the merits of whose system are widely known in that part of the world.

Canvasite, the new canvas-covered wire manufactured and placed on the market by the Circular Loom Company of Boston, is meeting with well deserved recognition everywhere. Mr. Brooks, the enterprising manager of the company, has just returned from a long Western trip during which he booked many large orders.

The Eastern Electric Cable Company, Boston, still continues to run its greatly enlarged factory night and day in the main hope of catching up with its orders. Though it has not a single salesman on the road, the merits of its specialties are so well known that the mail alone brings all its orders, and at the present time it is working on several contracts each of which calls for several million feet of wires or cables.

The W. S. Hill Electric Company, Boston, is to be congratulated on the success it is achieving with its petite generator, the "Columbian," which is being shipped to all quarters, while the demand for Hill switches, cut-outs and motors shows no sign of abatement.

Mr. Harry Bishop, General Western Agent of the Massachusetts Chemical Company, reports the sale of eighteen barrels of Insullac as one week's work. For the short time Mr. Bishop has been in the West introducing the compound, it speaks well for his ability as a salesman and also shows the merits of Insullac.

The Norwich Insulated Wire Company of this city have recently closed a contract with the Canadian Bell Telephone Company for the cables which are to be used in the new underground lines in Toronto. The entire system of the city is to be run in conduits.

INCORPORATIONS.

The Northport Electric Light Company of Northport, Suffolk County, N. Y. Capital, $25,000. Directors: J. W. Fowler, J. W. Olmstead, Charles T. Sammis, O. Darling and others.

The Pontiac Electric Light, Heat and Power Company, Pontiac, Ill. Capital stock, $40,000. Incorporators: Henry A. Foster, C. M. Hamilton and A. P. Foster.

The Kankakee Electric Railway Company, Chicago, has increased its capital stock to $60,000, and removed its principal offices to Kankakee.

The Hartford Electric Light Company, Hartford, Ind. Capital stock, $8,000.

The Montana Electric Company, Butte, Mont. Capital stock, $50,000. Incorporators: John O'Rourke, George T. Schmelzel, Seth B. Smith, W. T. Jackson, V. E. Poissant, C. L. Smith. The objects of the company are to deal wholesale and retail in all manner of electric supplies, machinery and fixtures, furnish, equip and regulate all kinds of electric plants, street railways, central stations and isolated electric light plants and all kinds of electric motors, also to carry on a general electro-plating business.

The Buffalo and Niagara Falls Electric Transit Land Company, Buffalo, N. Y. President, G. D. March, of Sherman; vice-president, W. C. Lindsey, Jamestown; secretary, John J. Young, Buffalo. The trustees include the above and A. J. Dean, Sherman; L. Bordell, Jamestown; Arthur A. Johnson, Buffalo, and E. A. Kibbe, Mayville. The company has bought twenty-five acres of land between Elmwood Avenue, Buffalo, and the Military Road at $2,500 an acre.

The Electric City Promoting Company of Buffalo. Capital stock, $20,000. To deal in real estate and promote business enterprises.

The Hudson River Traction Company, Tarrytown, N. Y. Capital stock, $5,000. Directors: E. M. Davison, J. M. Wainwright, A. J. F. Van Deventer and G. E. Rose, of New York City, and John W. Graynor, of Morris Park, L. I. The object is to construct and equip railroads and other works of improvement in the counties of Westchester, Putnam, Dutchess, Columbia, Rensselaer and elsewhere.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED APRIL 4, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

494,705. Electric-Locomotive Regulation. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company of Connecticut. Filed July 12, 1892.

494,721. Electric-Railway Trolley. Edward Martyn, Detroit, Mich. Filed Sept. 19, 1892.

494,871. Trolley-Pole Catcher. Edward L. Langheinz, Brooklyn, N. Y. Filed Nov. 10, 1892.

ELECTRIC LIGHTS AND APPLIANCES.

494,995. Cut-Out for Brush Lamps. Benjamin Adair and Charles H. Klewer, Denver, Col. Filed Nov. 18, 1892.

DYNAMOS AND MOTORS.

494,565. Controlling-Switch for Electric Motors. Warren S. Hill, Boston, Mass., assignor to the W. S. Hill Electric Company of Maine. Filed March 31, 1892.

494,608. Means for Switching Generators or Motors In or Out of Circuit. Nathan Van Denburgh and Frederick H. Loveridge, Chicago, Ill. Filed Feb. 23, 1892.

494,629. Commutator-Brush for Dynamos. David W. Dunn, Pittsburg, Pa. Filed Aug. 13, 1892.

494,739. Brush-Supporter for Dynamo-Electric Machines. Axel Ekstrom, Lynn, Mass., assignor to the General Electric Company of New York. Filed Nov. 16, 1892.

494,781. Circuit-Controller for Electric Motors. Warren S. Hill, Hyde Park, assignor to the W. S. Hill Electric Company, Boston, Mass. Filed May 16, 1892.

494,836. Dynamo-Electric Machine. Arthur S. Baxendale, Selangor, England. Filed April 22, 1892.

494,856. Electric Generator or Motor. Walter T. Goolden and Llewelyn B. Atkinson, London, England. Filed Jan. 3, 1893.

494,978. Electric Motor. Francis B. Crocker and Schuyler S. Wheeler, New York, N. Y., assignors to the Crocker-Wheeler Electric Company, same place. Filed June 20, 1892.

BATTERIES.

494,849. Separator for Battery Elements. Chamsonovitz P. Elieson, New York, N. Y., assignor of one-half to Francis A. Pellas, Oggebbio, Italy. Filed July 9, 1892.

494,852. Galvanic Battery. Derrick H. Fitch, Cazenovia, N. Y. Filed Nov. 22, 1892.

MISCELLANEOUS.

494,562. Telautograph. Elisha Gray, Highland Park, Ill. Filed July 16, 1887.

494,585. Means for Electrically Heating Crucibles. Willis Mitchell, Malden, assignor to the American Electric Heating Company, Boston, Mass. Filed June 13, 1892.

494,586. Apparatus for Electrically Heating Crucibles. Willis Mitchell, Malden, assignor to the American Electric Heating Company, Boston, Mass. Filed July 28, 1892.

494,587. Electric Coal-Mining Machinery. Edmund C. Morgan, Chicago, Ill. Filed July 6, 1891.

494,610. Electric Switch. George W. Webb, Wilkes-Barre, Pa., assignor of one-half to Walter Gaston, same place. Filed April 20, 1892.

494,657. Electric Meter. Milton E. Thompson, Boston, Mass. Filed May 19, 1891.

494,750. Switch for Electrical Currents. Henry P. Ball, Schenectady, N. Y. Filed July 1, 1892.

494,762. Electrical Annunciator. John B. Rogers, Washington, D. C. Filed May 31, 1892.

494,765. Means for Closing an Electric Circuit. Harry L. Tyler, Corning, N. Y. Filed Aug. 20, 1892.

494,786. Automatic Cut-Out for Electric Signalling-Boxes. Jacob F. Mehren, Chicago, Ill., assignor to the Gamewell Fire-Alarm Telegraph Company, New York, N. Y., and Chicago, Ill. Filed Jan. 8, 1892.

494,787. Automatic Cut-Out for Electric Signalling Mechanisms. Jacob F. Mehren, Chicago, Ill., assignor to the Gamewell Fire-Alarm Telegraph Company, New York, N. Y., and Chicago, Ill. Filed Jan. 8, 1892.

494,807. Coin-Operated Phonograph. Ellsworth E. Flora, Chicago, Ill., assignor to George B. Holt. Filed May 5, 1890.

494,827. Voltaic Cell. Edward Weston, Newark, N. J. Filed Nov. 24, 1891.

494,828. Electrical Measuring-Instrument. Edward Weston, Newark, N. J. Filed Jan. 14, 1892.

494,829. Recording-Voltmeter. Edward Weston, Newark, N. J. Filed March 18, 1892.

494,830. Ground-Detector for Electric Circuits. Edward Weston, Newark, N. J. Filed Sept. 10, 1892.

494,832. Electric Clock. Herman Wubbeler, Beaver Falls, Pa. Filed May 21, 1892.

494,956. Ammonia or Other Pump. Nils Johnston and John Stocker, St. Louis, Mo. Filed Aug. 29, 1891.

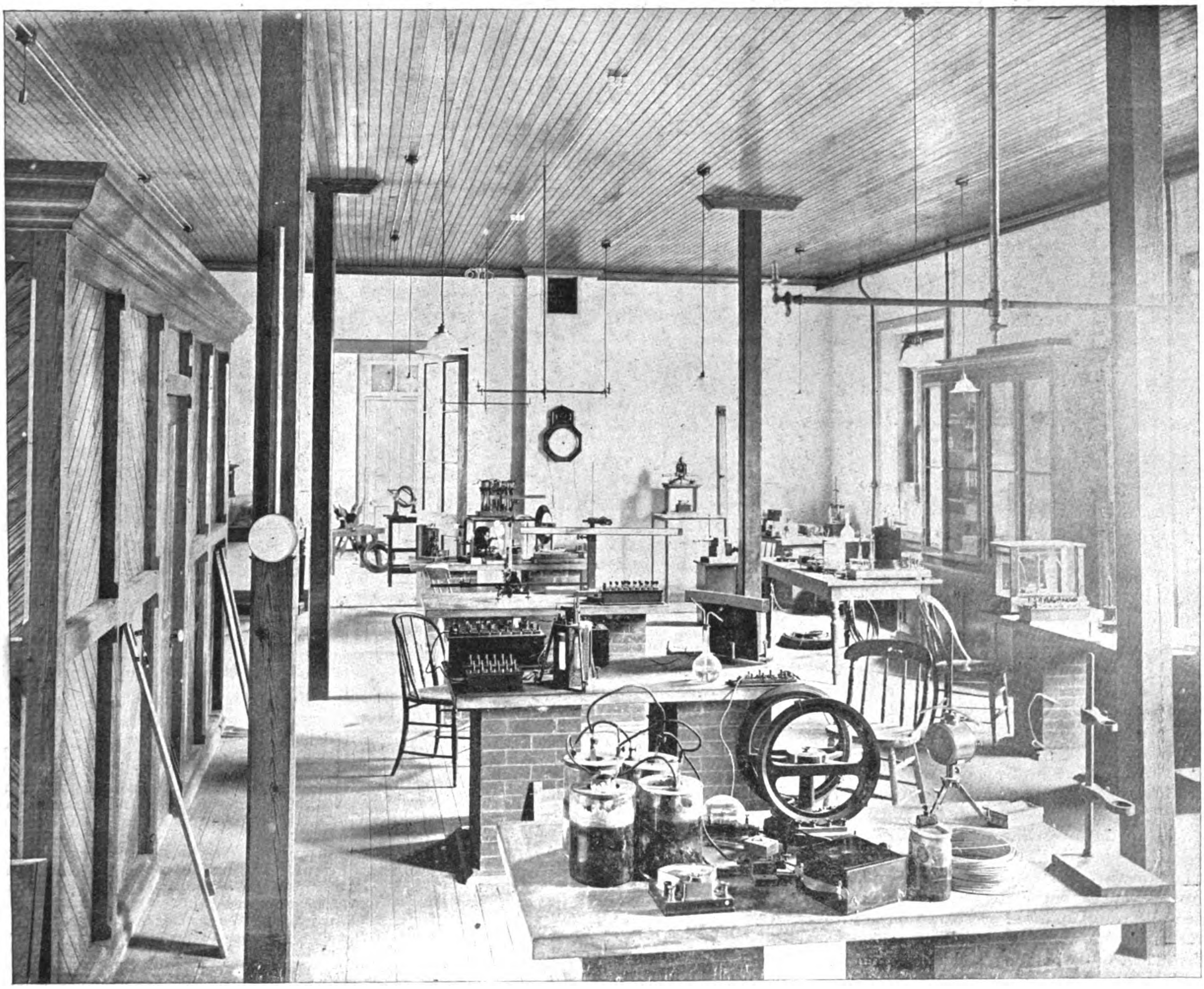
494,961. Electrical Measuring-Instrument. Adolf Koepoel, Berlin, Germany, assignor to Siemens & Halske, same place. Filed Nov. 17, 1892.

494,964. Galvanometer. Edwin F. Northrup, Ardmore, assignor to Samuel L. Fox and Edward B. Fox, Philadelphia, Pa. Filed Nov. 5, 1892.

494,966. Circuit-Closing Clock. Herbert S. Page, Medford, assignor to Edmund D. Spear, Boston, Mass. Filed Oct. 3, 1892.

ELECTRICITY.

VOL. IV. NEW YORK. APRIL 19, 1893. CHICAGO. No. 14



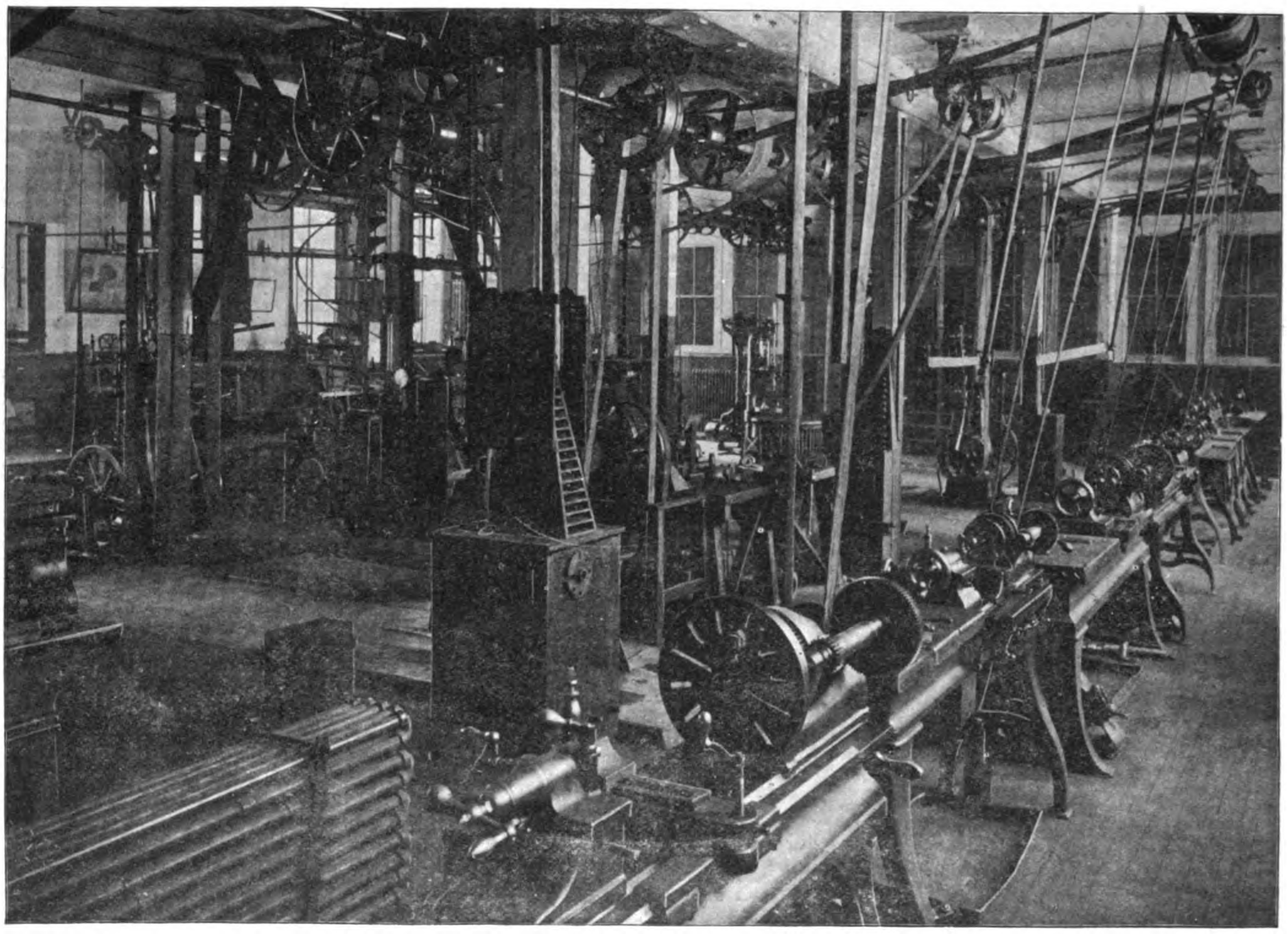
ELECTRICAL LABORATORY, STEVENS INSTITUTE OF TECHNOLOGY. (SEE PAGE 182.)

A Practical Course.

The Electrical Branch of Mechanical Engineering Established at Stevens Institute.

The Stevens Institute of Technology, which is recognized as the pioneer in the line of engineering schools, while adhering strictly to the scope originally prescribed for its course, has not failed to keep pace with the rapid advances which have characterized the science of engineering in recent years. The application of electricity to numerous mechanical problems has been such an important factor in engineering work that courses have been established in many places which are devoted exclusively to electrical engineering and which must necessarily be pursued at the expense of a more general technical education.

The question of establishing such a course at the Stevens Institute was decided in the negative only after careful consideration, in which the importance of this branch was in no way ignored. The subject, however, was considered as a legitimate branch of mechanical engineering rather than as a distinctive science, and the important positions in electrical work held by many Stevens graduates is evidence of the wisdom of this decision. A department of applied electricity has since been included in the regular course of mechanical engineering, for which the Institute is indebted to the liberality of its president, Dr. Henry Morton. The electrical laboratory, situated on the ground floor of the building, is shown in part in our Frontispiece. This room is provided with several piers of masonry capped with stone slabs, the whole being set on foundations independent of the building, and is free from the least jar due to the vibrations of the floors. From each table three sets of wires are run beneath the floors to a switchboard so that any desired connection between the tables can be made without running wires between them.



MACHINE SHOP, STEVENS INSTITUTE OF TECHNOLOGY.

Two sets of wires are run from each dynamo to a switchboard, from which another set of wires is run to the laboratory. This arrangement permits any part of any machine to be connected and controlled from any part of the laboratory. The dynamo room, which is situated in a gallery directly over the workshop, is equipped with a large Westinghouse alternating current machine and several types of constant current dynamos.

The dynamo room contains facilities for the precise measurement of power consumed by the generators, the most noticeable of which is a Webb floating dynamometer. This instrument, which is a somewhat novel one, consists of a wooden float placed in a tank which is but slightly larger, and upon which the machine to be tested is mounted. The shaft of this machine is connected by a flexible coupling to the end of a rigid shaft, and while running the machine and float are tilted according to the power transmitted, the principle being the same as that of the cradle dynamometer although the apparatus is much easier to adjust and operate. It may also be adjusted to any required degree of sensitiveness by the addition of enough extra weight on the float to raise its centre of gravity as near the point of unstable equilibrium as may be desired. In addition to this there are Brackett cradle dynamometers and prony brakes.

The laboratory instruments include the usual equipment of galvanometers, electrometers, condensers, rheostats, ammeters, voltmeters, etc., selected from different makers with the idea of familiarizing the students with as great a variety of instruments as possible.

During the junior year of the course the students attend lectures by President Morton, and in the senior year practise laboratory work and experiments under Dr. Geyer.

The general course in mechanical engineering, combined with a thorough system of manual training in the machine shops, has resulted in turning out a class of engineers many of whom are well known in the electrical field, and who thus exemplify the remark of Lord Kelvin, that the electrical engineer should be nine parts mechanical and one part electrical.

There can be no better proof of the value of this course than the fact that applications for admission are now so numerous that the present facilities of the building and the modest endowment of Stevens Institute have caused the necessary exclusion of a large number of students, and an earnest effort is now being made by her faculty and alumni to provide this needed addition to the Institute, which the following extract from a letter from President Morton fully explains:

"The desire of the faculty and trustees not to refuse the benefits of our course to worthy applicants has led us to strain every mode of accommodation to its utmost limit, and the position now is such that not only is it physically impossible for us to accommodate the increased numbers certain to apply next season, but we are prevented from making numerous improvements in various departments, which are most desirable, in order that we should hold our leading position among technical schools, for lack of space within our present buildings.

"We are in fact in the position of a manufacturing concern whose business has outgrown its 'plant.'

"With a manufacturing establishment the remedy would be simple, because the increase in businesss would warrant an increase in capital investment, which, under such circumstances, could be readily secured by the usual financial methods.

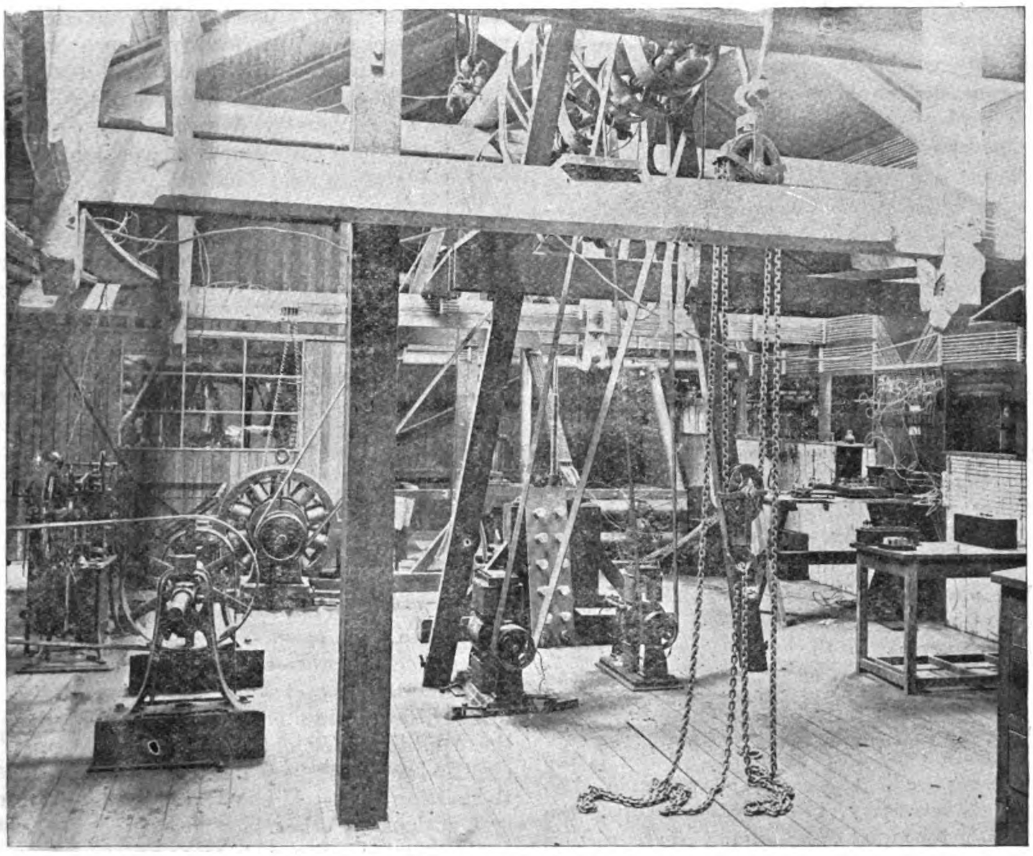
"But with an educational institution the case is different. No such institution for the higher education has in the history of the world been a source of financial profit. On the contrary, all such institutions the world over have required large endowments or equivalent Government support.

"We may well feel proud when we compare what we are doing with only a modest endowment as measured by the funds at the command of other institutions; but there is a limit to what the best of management can accomplish with limited means, and it is hardly necessary to say that our trustees would not be authorized to diminish our small endowment-fund by taking from it the amount necessary to erect additional buildings, the filling and maintenance of which are not unlikely to constitute a further draft on our resources.

"We must then look to the liberality of our friends (among whom none I am happy to say are more sincere than our alumni) to carry on and supplement the good work of our founder by supplying us with at least the additional buildings needed to carry on our work with increasing efficiency, and thus to maintain our pre-eminent position, as well as to extend our range of usefulness.

"What it is proposed to do, if the means can be provided, is to erect an additional building, at a cost of $50,000, which shall accommodate the departments of chemistry, physics and languages, and thus give us space in our present building for the much needed extension in our departments of drawing, mathematics, engineering and applied mechanics.

"The interest already exhibited by the alumni in this matter has been most gratifying, and I do not doubt that their good example will be followed on all sides. For myself I can only say that what I do towards this work will be only limited by my ability, and I am sure that many others have the same inclination."



DYNAMO ROOM, STEVENS INSTITUTE OF TECHNOLOGY.

Electrical Quackery.

Our electrical contemporaries across the water it seems are determined to do all in their power to expose the frauds and business methods of electrical quackery establishments in England.

In our issue for March 15 we gave a short account of an action taken against the London *Electrical Review* by one Dr. Tibbits, who had written a handsomely-paid-for testimonial regarding the Harness Electropathic Belts as provided by the Medical Battery Company. This case, our readers will remember, was decided in favor of our contemporary. We since learn that another very important case has also been heard in the London Law Court, in which the said belts were the articles questioned. This case was taken by the *Electrical Review* against the suppliers of the belts, the Medical Battery Company, and damages were claimed by the editors for libel against them. The libel was contained in a circular letter which had been distributed among nearly all the London news-vendors—at any rate to the extent of 500 copies—and read as follows:

"Sir: Having been consulted by my clients, the Medical Battery Company, Limited, the proprietors of Harness's Electropathic and Zander Institute, of 52 Oxford street, London, W., with reference to some malicious libels published in the *Electrical Review* and *Science Siftings*. I beg to give you notice that if these or any future publications containing defamatory articles or paragraphs are sold or circulated by your firm, my clients will hold you responsible. In the same way you will be held responsible for the exhibition of any libellous bills or placards."

This letter was signed by the solicitor to the Medical Battery Company, and naturally made all the news vendors rather unwilling to trade in the journal mentioned—in fact, evidence was brought to show that some booksellers had absolutely refused to sell any more copies.

The action came on for hearing on March 7 before the Lord Chief Justice of England and a special jury. Counsel for the defendants were Sir E. Clarke (one of the most eminent of English counsel) and Mr. Germaine, while for the plaintiffs there appeared Mr. Finlay, Q. C.; Mr. Lawson Walton, Q. C., M. P., and Mr. Banks. This of itself shows that our contemporary was prepared to fight to the last.

Mr. Finlay in his opening speech strongly condemned the belts, as will be seen by one or two sentences which we cull from his remarks:

"These belts are utterly and absolutely useless." . . . "Defendant was seeking to stifle what he knew or suspected was a well-deserved criticism."

Mr. Finlay called evidence to show that a number of news agents had refused to continue the sale of the *Electrical Review* on account of the letter, and he was about to call a number of witnesses who had worn belts, to prove that they were worthless, and the whole business of the company an absolute fraud. The appearance in the box, however, of a Mr. Jeffery (who was known to the belt people, having had an action taken against him formerly, in the Bloomsbury County Court, for the cost of a belt supplied him, in which case the Judge ordered to be returned to him the amount he already had paid, called from counsel for the defendants the remark that evidence of this sort was irrelevant to the case. The Judge, however, ruled that it should be brought in. Mr. Finlay was again preceeding to bring in this evidence when counsel for the defendants stated that he was instructed by his clients to say that if this evidence were to be brought in they would plead guilty to the libel and leave the question for the jury to assess the damages.

This was quite an unexpected collapse of the case, as it had been hoped that the whole of the exhaustive evidence collected by the plaintiffs would be made public in this manner, and thus help to expose the whole business.

The following morning the Lord Chief Justice summed up the case for the jury, who without leaving the box, after about two minutes' consultation, gave judgment in favor of our contemporary, the *Electrical Review*, with damages £1,000.

The thanks of the electrical fraternity are due these publishers for so courageously endeavoring to suppress such frauds and impostures.

We understand that there are other actions pending against another London scientific journal which has also a counter action against the Medical Battery Company for damages for trying to stop its circulation.

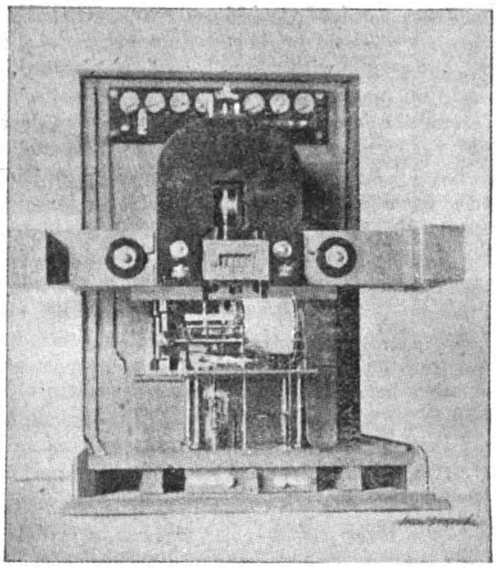
Electric Safety Curtains.

The description of a new electric safety curtain at the Comedie Françaís, Paris, which appeared in our issue of February 22, was a paid contribution from an occasional foreign correspondent of ELECTRICITY, Mr. F. W. N. King. The matter was in type in this office before the issue of *La Nature*, containing a description of the same device, had appeared in Paris.

In the issue of ELECTRICITY for February 22 there was another very interesting item, entitled "An Open Letter." Has our conscientious contemporary also overlooked this?

A Large Wattmeter.

We give below an illustration of a joulemeter for 800,000 watts, taken from London *Industries*. It is a Brillié type of meter recently made for the Société Normande d'Electricité at Rouen by the Compagnie Anonyme Continentale pour la Fabrication des Comptoirs à Gaz et autre Appareils, of Paris. It is to be expected that a company with such a formidable name should make something large, but they have done more than could reasonably be demanded in making an 800 kilowatt joulemeter. It is a registering instrument, designed for a three-wire system. By a registering meter is meant that at any instant it acts as a wattmeter and registers the power, and it also intergrates the power, thus reading in kilowatt hours. The principle is the same as in the Brillié meter.



Electric Heating and Forging.

The economy and importance of the electrical heating and forging processes which are being carried out in Boston under the Burton patents appear to have been proved under practical conditions, and the description of some of the details of this system, given below, which are abstracted from a paper recently read before the Harvard Lecture Club by Mr. G. D. Burton, are as follows:

One of the most important features in connection with this subject is that we are enabled to heat and work metals successfully by the electric current, and our ability to do so lies in the fact that the operator is enabled to absolutely control the current while the bars or pieces are heating, so that they will not become overheated, and to that degree that each succeeding piece, if necessary, can be heated to the same temperature, and also, if required, the operator can instantly regulate the current so that several bars can be heated at one time, and while they are heating he can continue his forging operations either by hand or machine tools.

In most all cases the electric regulator is placed in the working or high potential circuits, and is constructed so that it contains a sufficient amount of electrical resistance to take the full strength of the current produced by the dynamo.

From this regulating point the current is conducted over the main line for light, heat and power in a given quantity, measured by volts and amperes.

Therefore, it must be admitted that this electric resistance, or rheostat, is to the dynamo what the governor, or regulator, is to the steam engine, which has never been operated economically and successfully unless provided with a device of this character.

Now, I have told you that all of the electric regulators are placed in the high potential circuit, and I believe that I am right in this assertion. If I am not, I hope some one will correct me, and in making this statement my object is to show you wherein we differ in the construction of our apparatus and in the manipulation of the electric current from other systems in general use.

When I made known my ideas regarding the heating of a bar of metal by electricity, many stated that it could not be done, and, if done at all, the power required would be so expensive that the process would never become a commercial success, the people with whom I conferred having in mind the enormous power required to heat a bar of metal, believing that it would require at least 75 H. P. to heat a piece 1 inch square and 8 inches long, and that there must be a power source back of the dynamo sufficient to compel it to generate continually its full capacity; that the regulator, or rheostat, must be introduced into the high tension circuit in order to control the current, otherwise it would be so intense that, when the bar was placed in the circuit, it would either burn the bar of metal, or burn out the machine. On the other hand, they took into consideration that when there were no bars heating the machine would still be generating this enormous current, which would be consumed by the resistance, or rheostat, and thereby lost.

In this case, to show you where the theory was wrong as regards the methods we use, I will explain to you our system of heating metals by electricity, and will show you that with our method of placing the regulator it does not act as an obstructor to the current, and that it is so located that when there are no pieces heating there is no power generated excepting about 1 H. P., which is necessary to overcome the friction of the apparatus, and that the size of piece or pieces heating determines the power required to heat said pieces within the capacity of the machine. Why I use the expression—with the capacity of the machine—is that I desire to make clear to your minds if a metal bar was inserted into the metal holders, larger in cross-section than the conductors, or metal holders, the machine would not furnish power sufficient to heat the bar, for the bar would not offer proper resistance to the path of the current, in which case the power would immediately drop down, and very little would be generated, and what there was generated would pass unobstructed around each endless ring of the converter, through the bar held within the metal holders.

Therefore you see the impossibility of overheating or burning out any of the electrical connections employed in the construction of our apparatus.

We have tried many times to find a weak spot, and have inserted in the metal holders bars of large area in cross-section, for the purpose of determining the possibility of burning out, or short-circuiting, some part of the apparatus, but thus far we have not succeeded in doing so.

The difference in the application of our system as compared with the systems in general use for lighting and power purposes, is found in our method of generating, converting and regulating in an economical manner the current produced.

We do not use a resistance or regulator in any of the working of high potential circuits in connection with any part of the apparatus. We regulate our supply of current according to the work to be done, the work itself acting as the governor. The larger the piece, and the shorter the time required in heating the piece, the greater is the power required. If the time is extended, less power is necessary, the bar calling upon the generator through the medium of the regulation of the exciter current for what power is required to heat the piece, be it large or small and within the capacity of the machine.

This connection of mechanism enables us to perform all the valuable heating effects of the smith's forge without its wastefulness and other disadvantages which occur in working metals by the old methods.

We are also enabled to do work by the electrical process which it is impossible to do by the ordinary forge.

We find that if the rheostat is placed in the circuit between the alternating dynamo and the converter, or in the circuit leading directly from the exciter to the dynamo, any attempt to use the rheostat to regulate the current, so as to fully control the heat in the bars, at once interposes so much resistance in that circuit that it heats and lowers the voltage, which arrests the progress of the heat in the bar or pieces held within the metal holders, which we believe to be due to the resistance of the rheostat itself, and this heating of the rheostat varies its resistance to the current so rapidly that it becomes beyond the control of the operator to use it as a governable rheostat. We find also that the bars under heat require a higher voltage to be delivered as they become hotter in the current of the secondary coils of the converter, so that if the rheostat is placed in the main circuit it still operates against the requirements of the process to be performed. It is also found that the rheostat when placed in the secondary circuit of the converter is utterly incapable of regulating the current of such immense volume and low potential as our mechanism produces, so as to heat the metal evenly and control its heating to that degree that the proper heat is always obtained. Therefore, we have always placed the rheostat, or regulator, in the shunt wound circuit of the exciter, for the purpose of exciting the field coils of the generator in proportion to the amount of heat that it is desired to produce in the pieces of a determined size held in the metal holders connected to the secondary coils of the converter.

By this method we have found that it is possible to transmit the current from the transformer to the metal holders for a considerable distance with very little loss. We use, for conducting the current when carried to a great distance, as for the distribution of the current to various forges in a large factory, copper bars 3 inches in diameter, which are sufficient in size to carry around such a shop the current produced by a 100 H. P. generator. With conductors of this size, no difficulty will occur from over-heating of the conductors or the machines.

The voltage and amperage delivered to the metal holders by these conductors from the transformer varies according to the size of the pieces heating from 4 to 30 volts and from 6,000 to 10,000 amperes.

For illustration: the average horse power required to heat 72 cubic inches of metal in four minutes is less than 53 mechanical H. P. Three bars of iron, 1 inch x ½ inch and 4 feet long, are heated at the same time to a forging heat with our 50 H. P. apparatus. We have heated 108 cubic inches of metal to a working heat with the same machine in eight minutes with an expenditure of 47 mechanical H. P.

Three pieces of steel, 3 feet long and 1 inch square, composed the 108 cubic inches of metal referred to.

Our electric process is used for heating iron, steel, brass, copper, etc., and for welding, forging, brazing, hardening and tempering, and where the conditions for obtaining power are equal, electric heat is cheaper than coal, oil or gas, for the heating process is more rapid by the electric system than any other.

The metal is improved because a more uniform heat is obtained. In most work several reheatings of the piece are required when the customary forge is used.

The electric process avoids this, for the piece is evenly heated all through, and retains the heat about three times as long, and can be worked into the desired shape without subjecting it to the usual process of reheating. The product, when finished, is better, and the liability from over-heating is not as great as by the old methods.

We have produced a rheostat made upon a different principle, using a liquid instead of wires, thus avoiding the possibility of the rheostat heating, and, when constructed upon this principle, we find it is possible to use it for governing the current in some circuits where it is now impossible to use a metallic resistance on account of its heating. The liquid rheostat is much cheaper to construct, and responds instantly to the action of the current, performing the same functions.

A New Electrical Association.

The formation of a new electric light association, to include the electrical lighting interests of the entire State, brought together a number of prominent men at Harrisburg, Pa., a few days ago. Among those present at the meeting were Hon. Robert E. Wright of Allentown, Senator J. S. Hess, C. A. Wolle and G. H. Wolle of Bethlehem, Hon. J. F. Cox of Homestead, J. F. Geeser of Waynesboro, W. H. Friday of Pottstown, W. H. Rosensteel of Johnstown, Robert F. Crowell of West Chester, and Secretary Robert D. McGonigle and G. H. Blaxter of Pittsburg.

The proposed organization is to be named the Electric Light Association of Pennsylvania, and is formed for the purpose of exchanging views and discussing matters relating to the electric lighting business. There are now in Pennsylvania about 150 electric light plants.

A committee of five on organization was appointed, of whom C. A. Wolle of Bethlehem is chairman and Robert D. McGonigle is secretary, either of whom will give any information desired in regard to the association.

"Chicago in the Front Rank."

The New Sunbeam Lamp.

We recently called attention to the new incandescent lamp patented by John Van der Kammer, and as the lamp has now appeared in the market under the name of "The New Sunbeam Lamp," the same being for sale by the Star Electric Lamp Company, it will no doubt be matter of interest to many to know something of the peculiar qualities of the lamp in its commercial form.

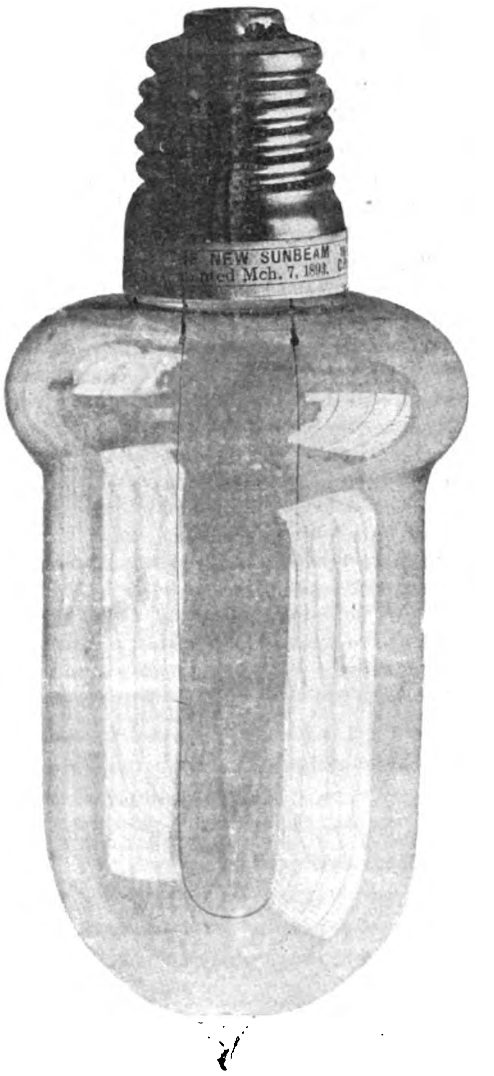
It will be remembered that the mechanical construction of the lamp embraces the features of a glass globe combined with a metallic base, somewhat after the manner of some of the very early lamps which preceded the vacuum lamp, the circuit being formed by wires secured to the inside of such base, and the burner itself, the two ends of which are connected to the two inside wires in much the usual manner. Thus the conductors pass through the metallic portions of the receiving chamber, as in some of the earlier lamps. Mr. Kammer's method of securing the metallic plates to the glass portions of the receiver is novel and exceedingly ingenious, and at the same time is said to be thoroughly practical and quite sufficient for the purpose.

The difference in expansion between the metal base and the glass globe is of no consequence in a lamp constructed in this manner, for there is sufficient flexibility in the metal to permit it to accommodate itself to the expansion of the glass. The metal base can therefore be made of some of the baser and cheaper metals, as for example, copper. This lamp, however, not being a vacuum lamp, the character of the gas is such that the base can be most easily made of some metal which will resist the action of such gas, as for example, platinum. The manufacturers promise soon, however, to employ in place of the platinum some cheaper metal, preparing it in advance so as to resist the action of the gas.

The fact that the New Sunbeam has a comparatively high pressure of gas within it, renders the maintenance of a perfect vacuum chamber of less consequence than in the vacuum lamp, and therefore permits the change in the construction which is set forth in the mechanical patent on the lamp. A seal which might not be satisfactory for a vacuum lamp, and perhaps could not be used for that purpose, might be entirely satisfactory for a gas lamp. The metal seal at the base obviates the necessity of joining glass to glass in the usual manner and also the use of the internal seal piece, so that if the lamp is slightly damaged in the process of its manufacture it may be conveniently repaired and resealed at the lower end. Moreover, this form of base and construction permits the re-using of the bulb itself, and the manufacturers offer inducements to users for the return of unbroken bulbs. Since these metal plates are of comparatively large size, no platinum wires being employed, manufacturers also offer inducements to users for the return of such metal plates or the butts containing them.

While the novel features in the mechanical construction of the lamp are striking, the results attained by the use of gas in the lamp, both as to the properties of the complete lamp and as to the methods of its manufacture, are both surprising and gratifying.

The inventor of this lamp has abandoned the idea of perfecting the vacuum lamp for the reason, as he claims, that a perfect vacuum being absolutely impossible, the vacuum lamp necessarily has a limit to its degree of perfection. In other words, the vacuum lamp being based upon the idea of a perfect vacuum, and a perfect vacuum being unattainable, the vacuum lamp must of necessity retain within itself the cause of its own early destruction, and in practice it is found that the vacuum lamp, as ordinarily made, is quickly destroyed by comparatively slight excess of current. This inventor therefore set himself to the task of constructing an incandescent lamp on the principles set forth in the earlier gas lamp patents and publications concerning the incandescent lamp. Gas lamps were well known prior to the production of the vacuum lamp, and various kinds of gas were employed in them and at various degrees of density. Several difficulties were found with the earlier gas lamps, as for example it was found that the gas in the lamp, even though greatly attenuated, would tend to disintegrate or destroy the burner, possibly by the impact of its highly heated particles upon the surface of such burner. It was also found that there took place a process, which has been described as electrical carrying, which rapidly destroyed the burner. It was also found that with such gases as were then known there was great loss of energy from the heating of the gas in the lamp. There were many other difficulties with the gas lamps, which finally resulted, as it appears, in the abandonment of the idea of producing a gas lamp and the substitution therefor of a vacuum lamp. This inventor has turned again to the gas lamp as a means of avoiding the weaknesses of the vacuum lamp, and has endeavored to produce a gas lamp which should not have the objectionable features of the early gas lamps. It often happens that a process for a long time abandoned as impracticable is revived and rendered of greater utility by the ingenious effort of some inventor who is not intimidated by the general adverse opinion, and so in this case, although the gas lamp has for years been declared impracticable, the inventor, by the employment of sundry ingenious expedients, has produced a lamp which does not appear to show any of the objectionable features of gas lamps as formerly made, and which is not liable to the weaknesses shown by the vacuum lamp. The new lamp, though containing a considerable quantity of gas, appears to be even cooler while burning than the ordinary vacuum lamp. There is no disintegration of the carbon, and no electrical carrying incident to overwork, even when greatly over-run. For example, when a 100 volt lamp is run at 150 volts for a considerable time, the burner will be found to be of its normal color throughout, and practically unchanged. Moreover, the character of the gas employed is such that whatever injury the burner receives or tends to receive from such over-running is promptly and completely repaired by the gas itself, so that in most instances when the lamp has thus been over-run it will be found not only that the burner is unchanged in its form and appearance, but that its resistance is actually slightly diminished, so that, for example, a 110 volt lamp burned at 160 volts for a short time will give the full candle power at 109 volts instead of 110.



THE NEW SUNBEAM LAMP.

Some of the delays in producing the lamp are attributable to the difficulty of obtaining the gas-producing substance in sufficient quantities to answer the purpose of the manufacturer. The gas which is employed is produced from a very rare substance, and one which the inventor and the chemical experts of the company assert has never before been used in connection with incandescent lamps and which it is very difficult to obtain. It appears now that all such difficulties have been removed, and the lamp will therefore be manufactured in quantities. The manufacturers of this lamp claim for it great utility for certain uses, on account of the quality above referred to, as for example on all such circuits as are supplied with currents of varying pressure.

The fluctuation of several per cent. in the current will not vitiate the lamp or increase the resistance of its burner, at least not until such fluctuations have extended over a long period, or in other words, the practical life of the lamp.

But not only does the lamp show such peculiarities in its service as above suggested, but the manufacturers claim that there is a great change in the method of manufacture. Gas being constantly present in the lamp, and the means of preserving or repairing the carbon being constantly at hand, the lamp requires no such elaborate process of manufacture as does the vacuum lamp. In the vacuum lamp every effort must be put forth to secure an initial vacuum of the highest possible degree, and to drive out of the lamp and the parts contained therein the last trace of such occluded gases as may tend to remain therein, and this requires an expensive process of pumping and electrically energizing the lamp during such process of pumping. Moreover, after this high degree of vacuum has been obtained it is necessary that the lamp should be so constructed as to retain the vacuum and permanently exclude all atmosphere from the lamp and close it against practically the whole of the atmospheric pressure. Now, in the New Sunbeam Lamp, since there is a gas left permanently in the lamp, it is plain that such perfect exhaustion of the lamp and its parts is unnecessary.

The Danbury, Conn., electric street railway is to be equipped with Westinghouse apparatus and work will begin at once on fitting up the cars to be used.

ELECTRICITY.

The Popular Electrical Journal.

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Electricity Does Kill. M. D'Arsonval, the French scientist, has lately published in the *Moniteur Industriel* an extended argument in support of the theory that the electric current does not kill, and that the subjects or victims might be resuscitated by proper methods, no matter how powerful the shock received.

A review of M. D'Arsonval's statements has been printed in the New York *Sun*, and his views are supported by Messrs. Joseph Wetzler and Dr. W. J. Morton, in interviews with a *Sun* reporter.

A summary of the labors of Prof. D'Arsonval on deaths and accidents caused by high-tension currents has just appeared. The results obtained have been presented to the Biological Society of France, together with the conclusions of an experiment made by M. Francis Béraud at M. Lacassagne's laboratory at Lyons, and have been embodied in a monograph. The conclusions deduced are strongly confirmatory of the claims made by M. D'Arsonval:

"Electricity is shown to kill in two ways.

"1. By producing mechanical lesions of the vessels and nervous system.

"2. By inhibiting the great functions wholly or partially (stoppage of respiration, of the heart, of the exchanges between the tissues of the blood, etc.)

"D'Arsonval holds that a person struck by an electric shock should be treated exactly as one drowned, and the formula which he has given to electricians has called back to life a number of men since its publication. MM. D'Arsonval and Bérand stigmatize the putting of criminals to death by electric shock as a complicated, barbarous and unreliable proceeding, and they dare American doctors to practise artificial respiration upon the criminal after his so-called 'death.' D'Arsonval maintains that the use of dynamic electricity produces in man a kind of anæthesia, under cover of which he is mangled alive, and must be so in order to really become a corpse."

This subject is worthy of careful investigation by our State authorities and by the Prison Reform Association. There is no limit to the possibilities involved in the thorough establishment of M. D'Arsonval's claims.

If the murderer can be resuscitated after receiving his shock in the death chair, further observation might prove that the shock had been beneficial. He might wake up a regenerated man, free from his predilection for crime, and become thereafter a useful member of society. If this latter theory is borne out, the application of the misnamed death penalty might be well adopted for minor offences. It would be cheaper and better than the present barbarous methods of prison confinement.

If we mistake not, however, there have been very conclusive experiments conducted on this side of the water, on men and animals, proving that the electric current does kill, and that it kills instantaneously and without pain to the victim.

We doubt very much if any of these scientists would be willing, for the love of pure science and the dissemination of knowledge, to undergo a shock such as is administered at Auburn, and take their chances on resuscitation.

* * *

"Figures won't lie, but liars will figure."

The Feeder Patent. One instance has come to our notice where the General Electric Company has tried to use the decision of Judge Green at Trenton to frighten intending purchasers of competing railway apparatus.

For any bearing which this decision can have on railway or alternating current work it is not worth the paper on which it is written.

The leading expert for the plaintiff, Prof. Chandler, took pains to assert that the patent had no such wide scope; and furthermore it expires next year.

Intending purchasers will do well to read the electrical journals, and especially Electricity, more carefully. They can save themselves much annoyance from being handicapped with inefficient apparatus by acquiring a clear understanding of the patent situation.

* * *

The Boston *Commercial Bulletin* estimates that a fair valuation of General Electric common, based on the figures presented in the annual statement, is $42 per share.

Twelfth Annual Exposition of the American Street-Railway Association.

The Executive Committee of the American Street-Railway Association has announced that the Milwaukee Industrial Exposition Building has been secured for the exhibition of supplies and manufactures of every nature used in the street-railway business, in connection with the Twelfth Annual Meeting of the Association, to be held in the city of Milwaukee, Wis., commencing the third Wednesday in October, 1893, and lasting three days.

The building has been engaged for two entire weeks, beginning October 9th and ending October 23d, thereby giving ample time for the setting up and removal of the largest and heaviest exhibits.

The hall for the meeting is also in the same building, on the second floor, and delegates will be enabled to examine the exhibits with much greater satisfaction than heretofore on this account.

An advantage which will be appreciated by those desiring power will be found in the 150 H. P. engine on the premises. The only additional charge therefor will be that which the cost of furnishing the same will amount to pro rata among the exhibitors using power.

The nearness of Milwaukee to Chicago is considered to be a great advantage this year for making a satisfactory and extensive exhibit, as everybody will, of course, attend the Chicago Exposition; and it is believed not to be necessary to submit any argument setting forth the advantages of taking part in this exhibit, to be made under so much more favorable circumstances than any other previously held.

The heaviest machinery and largest castings will all be under cover, and can, of course, be inspected much more advantageously than when in the street.

Applicants for space are requested to notify the secretary, Wm. J. Richardson, as early as possible.

In the Federal Court at Trenton, N. J., Merit Thorn has recovered $12,000 damages from the Western Union Telegraph Company for injuries received through picking up an unguarded wire belonging to the telegraph company which had dropped across an electric light wire. The boy received a shock that affected his nervous system, so that his memory was entirely destroyed. The jury also gave the boy's father $125 for loss of services. It is thought likely that the case will be appealed to the United States Supreme Court.

General Electric's First Annual Report.

The Financial Condition of the Company.

A Remarkable Statement.

The first annual meeting of the General Electric Company was held at Schenectady on April 11.

A somewhat singular report was presented, ostensibly showing the results of the first eight months' business of the company.

In view of the facts that the existence of this company is a standing menace to the conservative business element in the electrical trade, that it has from the first sailed under false colors, that its success in establishing a monopoly, if possible, would result in an inevitable cessation in the development of the art and in debarring the public from the great benefits of electric lighting and motive power at low cost, we feel justified in devoting considerable space to this statement.

As far as it has been able, this company has endeavored to create the impression that it is the only one having a moral right to engage in the business. From the very magnitude of its stock-jobbing operations it has attracted the attention of the investing public. Investors who have given much thought to the matter perceive its weakness, its rottenness, the absurdity of its claims, and thereby discredit and suspicion are thrown upon the entire range of electrical investments, hundreds of which would be found, if investigated thoroughly, to be worthy of confidence.

The utter collapse of the General Electric Company is as sure to come as the seasons are to follow in their destined order. The sooner it comes, the sooner will the atmosphere be cleared, the honest and conservative men in the electrical trade have a fair show, and the public receive the full benefits of the development in the electrical art.

If the publication of this, the first annual statement, does not precipitate that collapse, it will be because the stockholders do not use their brains and their lead pencils.

Following is an abstract of the report, with the financial tables in full:

THE REPORT.

The General Electric Company was incorporated April 15th, 1892, and began active business on the first day of June, 1892; so that the report presented by your directors at this meeting of stockholders covers a period of eight months ending January 31st, 1893.

LOCAL LIGHTING AND RAILWAY COMPANIES.

While your company has about 6,000 customers included in the different departments of its business, the interesting and important development is in the direction of local lighting and railway enterprises.

The following information, with respect to local illuminating and electric street-railway companies using your apparatus, will be of interest to the stockholders.

LIGHTING COMPANIES.

The total number of such central station companies using Edison and Thomson-Houston apparatus is 1,277, supplying about 2,500,000 incandescent and about 110,000 arc lamps.

The growth of these companies has been phenomenal, and it is very satisfactory to note that those which have been established longest are making the most rapid increase in size of plant and volume of business.

During the past year there has been a very marked appreciation in the value of the securities of local companies, especially in the larger cities, testifying to the increased confidence of investors in such properties.

RAILWAY COMPANIES.

	Feb. 1, 1891.	1892.	1893.
Total number of roads operating and under contract	151	214	435
Total number of cars in actual operation	1,578	2,790	8,386
Number of miles of road in actual operation	1,252	2,315	4,927

LICENSEES.

The relations between your company and its various licensees, and between it and those of the underlying companies, are of the most satisfactory character. Your directors appreciate that the interests of the company are closely connected with the welfare of its licensees, and there is a corresponding recognition on the licensees' part that the cordial co operation of your company is essential to the fullest development of their business.

No effort will be spared to secure from the recent patent decisions in your favor the greatest possible benefit to these licensees. The public, through them, will be distinctly benefited, because of the concentration of local illuminating and power business in the licensed central stations equipped for supplying light and power at minimum rates.

The prices at which apparatus and lamps are now furnished by the General Electric Company, for use of such stations, are, in many instances, lower than those which prevailed prior to sustaining the lamp patent, while the quality and efficiency of the apparatus are largely increased. Thus the licensees are enabled to cheapen their production and their prosperity is greatly enhanced—a prosperity in which your company has a direct and permanent share.

PATENTS.

The patent situation is encouraging and promising. The decision of the highest court sustaining the fundamental incandescent lamp patent, which decision has been followed by many other tribunals, has vested in your company the right to the incandescent lamp business of the United States, a result of great value to the company.

The strenuous efforts made by your competitors to develop an incandescent lamp which will not infringe this patent have been thus far wholly without success, and there is no reason to believe that any different results will be achieved in the future.

The decisions heretofore rendered in favor of the Thomson-Houston and Brush companies, covering the double carbon arc lamp, automatic current regulation and electric storage are of very great value to your company.

Although it is well known that the patented inventions of Edison, Thomson, Brush, Van Depoele, Rice, Sprague, Bentley, Knight, and other inventors now or heretofore connected with your organization, are the basis of substantially the entire arts of electric lighting, electric railways and electric motive power now in general use, the situation up to the date of the organization of the General Electric Company was not favorable to the best development of business under these inventions.

Suits against infringers are now in active progress on many important patents, other than those already sustained by the courts, covering essential features in electric railway, lighting and power apparatus. These suits will be pushed as vigorously as possible.

In dealing with the numerous past infringers, your directors are of the opinion that the substantial interests of the shareholders can be protected without a harsh or offensive exercise of your rights, and in such way as to greatly benefit the company and to satisfy consumers and the public of its desire to act in an entirely fair and liberal spirit.

FINANCIAL.

There are annexed to this report the company's condensed balance sheet and statement of profit and loss as of January 31st, 1893, showing that in the eight months during which your company has been in operation its profits amount to $1,024,954.59 in excess of three quarterly dividends on the common and one semi-annual dividend on the preferred stock.

In order that the stockholders may understand the position of the company, the following explanation as to the general character of the items in the balance sheet is submitted.

INVESTMENT ACCOUNTS.

Under this head will be found the assets now represented by the stocks of the three underlying companies, substantially all of which have been acquired by your company.

Details in regard to these companies are presented, from which it will be noticed that the basis upon which they were acquired by your company represents a cost of about $8,000,000 for all their patents, other valuable rights, licenses and other contracts. This is after writing down the assets they still own—manufacturing plants, factory inventories, etc., to conservative valuations.

The transactions of your company are to a considerable degree with local companies working under contracts licensing them to use the patents, about two thousand in number, under which your company operates. Your company is now supplying apparatus to about thirteen hundred local companies, the royalties from which run from $1,500,000 to $2,000,000 per year. It is believed that the royalties will be greatly increased in the future, so that $8,000,000 would appear to be far within the actual value of the patents, contracts, etc., which are represented thereby.

Your company has to a large degree acquired the business, other than manufacturing, of the Thomson-Houston and Edison General Companies, and has liquidated a large part of their liabilities. This course will be continued during the present year.

The preferred stock of the United Electric Securities Company has been sold since the close of the fiscal year at a price in excess of the value at which it appears in the balance sheet. The common stock of the same company—$825,500 out of a total issue of $1,000,000—is taken in the balance sheet at par. The company is making large profits and paying regular quarterly dividends.

The stock of the Canadian General Electric Company, a manufacturing and selling company controlling the Edison and Thomson-Houston patents in Canada, is taken at par. Its sale at an early date is expected, it being now under option to a Canadian syndicate at above par.

The stocks of the Fort Wayne Electric Company and Northwest General Electric Company are paying eight per cent. dividends on the value at which they stand in the balance sheet.

Stocks of "Miscellaneous Companies" carried at $71,566, comprise holdings in various corporations not considered local or licensee companies.

OTHER ASSETS.

With reference to these items it may be stated that in the judgment of your Board they are taken at safe figures. They consist of stocks, bonds, cash, notes and accounts receivable, merchandise on hand and work in progress; and it will be noticed that they amount to $29,559,600.61 as against total current liabilities of $5,246,219.

The stocks of local companies which appear in the balance sheet at $5,772,622.80 (par $11,632,011.65) have been valued carefully with the intent to carry them at a figure which can easily be obtained for them. As a further margin in this respect, stocks amounting at par to $1,301,940 (most of which accrued to this company under license contracts with recently organized companies) are taken in the balance sheet at the nominal value of $1.00 for each block, although there is reason to believe that within a moderate time these will develop a substantial earning capacity.

The bonds are almost entirely those of local companies. They are nearly all first mortgage bonds, payable in gold, and stand in the balance sheet at about seventy per cent. of their face value. All of these bonds excepting $439,000 at par value—$251,088.07 book value—are regularly paying their interest, and the comparatively small amount in default is carried at prices lower than it is believed will be realized.

Some of the bonds carried in the balance sheet have been sold since the close of the fiscal year at prices in excess of their book value, and the rest will be sold from time to time through the United Electric Securities Company and other channels as heretofore.

The amount now being paid in dividends (exclusive of those received on the stocks of the underlying companies) and interest on your company's holdings of stocks and bonds shown in the balance sheet exceeds the amount required to pay interest on your company's $10,000,000 outstanding debenture bonds.

After careful examination, deductions have been made from the notes and accounts receivable to cover fully all bad and doubtful items.

The item "Inventories" represents all the company's stock of apparatus, material, machinery, fixtures, etc., in the offices and storehouses of your company's seven districts, and includes the machinery, tools, and material in the various repair shops connected with such district offices.

"Work In Progress" represents the actual cost to date of all labor, material, etc., on unfinished contracts now in course, which, when completed, will afford a considerable profit.

The cost of patents acquired by your company during the eight months has been charged off as an operating expense.

CONTINGENT LIABILITIES.

Your company makes a practice of endorsing and discounting some of the notes it takes from its customers. Such endorsed notes are not included in notes receivable in the balance sheet, where only those now held by your company are taken into account. The outstanding notes receivable which had been endorsed and discounted on January 31st, 1893, amounted to $3,787,312.69.

C. A. COFFIN, President.

UNDERLYING COMPANIES.

EDISON GENERAL ELECTRIC CO.

The cost of acquiring 149,699 shares of the capital stock of the Edison General Electric Company was		$14,969,900.00	
Less net amount credited to that company, after charging it with money advanced, and with an arbitrary amount of $695,000 as a guarantee against its customers' notes and accounts transferred to the General Electric Company, and after crediting it with sundry assets taken over by this company		6,336,691.54	
Making present cost, as shown on the Balance Sheet			$8,633 208.46
This amount represents the following:			
Manufacturing plants, being the investment in lands, buildings, machinery and tools at Schenectady, N. Y., and Harrison, N. J.		$2,677.548.09	
Machinery and materials sold to U. S. Wire and Cable Company but not yet paid for		282,147.76	
Schenectady and Harrison factories inventories		2,576 887.14	
Cash and notes and accounts receivable		409,117.86	
Total		$5,945,700.85	
Less debt		1,551,660.71	4,394,040.14
Leaving			$4,239,168.32

represented by patents which have cost the Edison Company about $2,000,000; and by holdings of the entire capital stocks of Edison underlying patent owning companies, under contracts with which all large Edison licensees give to the Edison Company a percentage of their entire issue of stocks and bonds.

THOMSON-HOUSTON ELECTRIC CO.

The cost of acquiring 399,347 shares of the capital stock of the Thomson-Houston Electric Company was		$18,381,970.00	
Less net amount credited to that company, after charging it with money advanced, and with an arbitrary amount of $1,000,000 as a guarantee against its customers' notes and accounts transferred to the General Electric Company, and after crediting it with sundry assets taken over by this company		9,965,118.22	
Making present cost, as shown on the balance sheet			$8,416,851.78
This amount represents the following:			
Manufacturing plants, being the investment in lands, buildings, machinery and tools at Lynn, Mass.		$1,240,006.77	
Lynn factory inventory		2,263.347.59	
Cash and notes and accounts receivable		428.126.91	
Raw copper		135,525 94	
Consignments		8,396.71	
Stocks of the Brush, Excelsior, Fort Wayne and Schuyler Electric Companies, and stocks of other manufacturing and patent owning companies, par value $7,312,980, carried at	$4,013,420.11		
Stocks of the Central Thomson-Houston, Eastern Electric Construction, Northwest General Electric, Thomson-Houston Electric Light and Thomson-Houston Motor Companies, par value $1,468,350, carried at	891,750.00		
	$4,905,170.11		
Liquidation value, say		2,500,000.00	
		$6,575,463.92	
Less debt		1,547,964.21	5,027,499.71
Leaving			$3,389,352.07

represented by patents, including Brush patents on double carbon arc lamps, storage batteries and patents on current regulation, all of which have been sustained in the United States Courts, and by about 1,400 other patents owned by the Thomson-Houston Company and manufacturing companies controlled by it.

THOMSON-HOUSTON INTERNATIONAL ELECTRIC CO.

The entire capital stock of the Thomson-Houston International Electric Company was acquired at a cost, as shown on the balance sheet, of		$1,212,000 .00
This amount represents the following:		
Stocks of other companies	$13,139.00	
Cash and notes and accounts receivable	468.076.02	
Charges against its branch offices	468,914.69	
Inventory and consignments	39,019.98	
	$989.209.69	
Less debt	307,953.32	681,256.37
Leaving		$530,743.63

represented by the rights in foreign countries under patents of Thomson, Rice and others, including contracts for delivery of $100 000 stock of the Canadian General Electric Company and substantial interests in other manufacturing and exploiting organizations in foreign countries.

CONDENSED BALANCE SHEET—JANUARY 31, 1893.

ASSETS.

INVESTMENT ACCOUNTS.

Stocks of Underlying Companies:			
Thomson-Houston Electric Co	$8,416.851.78		
Edison General Electric Co	8,633.208 46		
Thomson-Houston International Electric Co	1,212.000.00	$18,262,060.24	
Real Estate:			
Edison building, N. Y. City	410.804 62		
Less mortgage thereon	200,000.00		
	210.804.62		
Other real estate	87,922.12	298,726.74	
Stocks of United Electric Securities Co:			
Preferred, par, $454,300	408.870.00		
Common, par, $825,500	825,500.00	1,234,370.00	
Stocks of Manufacturing and Other Cos.:			
Canadian General Electric Co., par, $1,000,000	1,000,000 00		
Excelsior Electric Co., par $6,000	1.300.00		
Fort Wayne Electric Co., par, $704,700	352,350 00		
Northwest General Electric Co., par, $155,000	155,000 00		
Miscel. companies, par, $481,033	71.566.00	1,580,216,00	$21,375,372.98

OTHER ASSETS.

Stocks and Bonds of Local Cos.:			
Stocks, par, $11.362.011.65	$5,772.622.80		
Bonds, par, $4,858,380.00	3,400.629.07	$9,173,251.87	
Cash	3.871,033 58		
Notes Receivable	5,151.950.64		
Accounts Receivable	7,078,879.15	16,101,863.37	
Inventories	2,307.225.13		
Less 10 per cent	230.722.51	2,076,502.62	
Work in progress		2,207,962.75	29,559,600.61
			$50,934,973.59

LIABILITIES.

Capital Stock:		
Common	$30.426,900 00	
Preferred	4,236,900.00	$34,663,800.00
Five per cent. gold coupon debenture bonds		10,000,000.00

OTHER LIABILITIES.

Accrued interest on debenture bonds	$83,333 32	
Dividends declared but unpaid	608,538.00	
Notes and accounts payable	4,554,347.68	5,246.219 00
Surplus January 31, 1893		1.024.954.59
		$50,934.973.59

STATEMENT OF PROFIT AND LOSS—JANUARY 31, 1893.

EXPENSES.

Interest and discount	$89,513.42
Interest on debenture bonds	152,917.17
Dividends paid and dividends declared but not yet paid	1,971,056.50
Patents, now charged off	118,151.42
Surplus carried forward	1,024,954 59
	$3,356,593.10

EARNINGS.

Net profit from the business of the eight months, over and above all expenses, deductions for bad debts, etc.	$3,356,593.10	$3,356,593.10

To show the rottenness and corrupt business methods of the greatest electrical concern in America, a concern which ought to be the pride of every electrical man, is an unpleasant task. The best interests of the trade, of the art, and of the general public, demand it, however, and it has remained for ELECTRICITY to perform the work.

It is pertinent at this point to call attention to the fact that the firm of Woodhouse & Rawson, who occupied in England a very similar position to that occupied by the General Electric Company on this side, has at last been driven to the wall by reason of the continued exposures of the British electrical journals, and that the most serious and damaging charges of the latter have proved to be well within the bounds of truth.

Now let us look at the statement with the eyes of common sense, and in the light of undisputed facts—facts known to every one who has conducted a manufacturing business of any magnitude in any line.

When a combination of smaller concerns is formed, and the stock taken over into a trust, the natural and invariable rule—a rule without a single exception—has been that the net assets of the component companies were placed at the highest figure possible. It was so in this case.

Now Mr. Coffin has said that the assets of the General Company have been written down to a conservative estimate. Yet how plain it is that this is not the case.

The original assets of the underlying companies appear in the balance sheet at a higher valuation than the one at which they were taken over.

In addition we find that $580,216 of stocks of manufacturing and other companies appears twice over. This cannot be a typographical error.

In the statement of assets of the Thomson-Houston Company there appear the items of:

Stocks of the Brush, Excelsior, Fort Wayne, and stocks of other manufacturing and patent-owning companies (par value $7,312,980), carried at	$4,013,420.11
Stocks of the Central Thomson-Houston, Eastern Electric Construction, Northwest General Electric, Thomson-Houston Electric Light, and Thomson-Houston Motor Companies (par value $1,468,350), carried at	891,750
	$4,905,170.11
Liquidation value, say	$2,500,000.00

By referring to the assets of the General Electric Company in the condensed balance sheet, we find the following items, which require some explanation:

Excelsior Electric Company	$1.300
Fort Wayne Electric Company	352,350
Northwest General Electric Company	155,000
Miscellaneous companies	71,566
	$580,216

These securities have already appeared in the $8,416,851.78 of assets of the underlying Thomson-Houston Company in the same column, and it is hardly fair to call on them for double duty.

A conspicuous feature of this statement is the omission of the item of the volume of business done in the eight months. Financiers and investors may be thrown off the track by this omission, but not so with men engaged in similar lines of business.

The bulk of business can, however, be estimated approximately—probably within $50,000 of the actual figures.

We find as assets:

Notes	$5,151.950.64
Accounts	7,078,879.15
	$12,230,829.79

Assuming that these items are correct in the balance sheet, and estimating, as is customary among electrical manufacturing concerns generally, that one-sixth of the gross business for the year is carried on the books at a given time, we see that the General Electric Company has done nearly $75,000,000.00 of business for the year, or more than any twenty concerns (including itself) in the electrical trade in this country.

In the assets of the companies taken over to form the General Electric Company there were book accounts (notes and accounts receivable) aggregating over ten millions.

It is probable that these accounts, or a large part of them, go to make up the twelve millions of similar assets in the balance sheet. They were book accounts a year ago, are book accounts won, and will be, very likely, ten years hence.

The probabilities are that the General Electric Company has done at the rate of about $15,000,000 of business. Has it been compelled, in order to do any business, to do it all on paper ?

Our estimate of $15,000,000.00 of business for the company is based on the opinions of men of sound judgment in the trade, and furthermore—The item of "Work in progress, $2,207,982.75," which, as is stated in the report, covers "the actual cost to date of all labor, material, etc., on unfinished contracts, now in course," may fairly be multiplied by six to get at the total business. This is based upon the actual experience of those in similar enterprises.

Indeed $15,000,000.00 is a very liberal estimate, as the company's exhibit at the World's Fair is a large one, valued at nearly a million dollars, and it is not entirely fair to call this contract work, as the machines are not sold.

The next items to which we desire to called attention are perhaps the most remarkable in the entire report. Cash on hand appears to be $3,871,033.58, and the notes and accounts payable are given at $4,554,347.68.

Is it credible that in a business where the average discount is 3 per cent. for thirty days payment (offering an opportunity to make 36 per cent. a year), any concern with over $3,000,000 cash on hand should allow bills and notes to accumulate to this amount ?

We think not.

Moreover, the figures given, $4,554,347.68, force the conclusion that the company is ninety days behind in the payment of its bills.

Scarcely one of the items of assets but deserves careful scrutiny. No railroad company whose stock is listed at the New York Stock Exchange would have the presumption to present so vague and incomplete a statement of its affairs.

The Thomson-Houston International Company is not an earner, and it is doubtful if it ever will be.

The Brush Company, properly managed, might be a good property. It has, however, been practically wrecked by Boston control, and last year lost over $30,000. It cannot do even as well this year.

The stock of the United Electric Securities Company is entirely problematical in value. What value it has is based upon various collateral, "cats and dogs" of local companies, not over 50 per cent. of which are likely to prove profit earners. Bonds of plants like the one in Syracuse, costing not over $300,000 and bonded at $750,000, and never earning interest as yet on even $300,000, cannot be considered gilt-edged securities.

A detailed list of the stocks and bonds of local companies which the Securities Company holds as collateral against its own issues might show that fifty cents on the dollar was about the actual value of the $825,000 of common stock, or it might show, as electrical men generally believe, that the common stock has no value.

If the experience of similar companies is a fair precedent on which to base opinion, the notes and accounts receivable, amounting to $12,230,829.79, will shrink 25 per cent. This would reduce the most substantial part of the assets in liquidation by over $3,000,000, or nearly as much as the cash on hand at present.

Our estimate of the value of these various assets is somewhat below that given in the balance sheet. It is as follows:

The plants and property of the Brush, Ft. Wayne and Schuyler Companies, $1,000,000.00. Central T.-H., Eastern Electric Construction, Northwest General Electric, T.-H. Electric Light and T.-H. Motor Company, *no value*, all expenses being paid by the General Electric Company; they are simply selling agents, showing shortages, which are made up by the General Electric Company.

The T.-H. International Company is also simply a selling agent, and its stock has no solid foundation for value in any amount.

The United Securities Company is also practically a selling agent, only it sells stocks and bonds instead of apparatus.

Stock of the Canadian General Electric Company may perhaps be worth 50 cents on the dollar.

Stock of the Excelsior Company is worthless.

The items of assets, seven and one half millions, for patents owned by the underlying companies, are absurd. Only one patent is owned by these companies covering a result which is not obtained by dozens of other manufacturers without infringing. This is the incandescent lamp patent lately sustained. There is already one non-infringing lamp on the market, and within sixty days there will be four.

The patents will all expire in the next few months, at least all of the important ones.

These patents are not worth $100,000 in a lump. It has cost twenty times that for the patent litigation of these companes, and the returns are nil.

In brief, we believe that a correct and honest statement would show the total liabilities to be twenty millions above assets available in liquidation, and that the common stock is to-day worth less than fifty cents on the dollar.

We will stand by this opinion until the day comes—and it is not far distant—when disinterested parties will make up a statement of the actual condition of the company.

Detroit Electrical Works.

A Receiver Likely to Be Appointed.

A chattel mortgage for $185,500, covering the plant, fixtures, patents, notes and money of the Detroit Electrical Works, has been filed to secure Hugh McMillan, the president of the company, for advances made.

The stockholders have held a meeting to protest against this action, and will contest the legality of the mortgage. They will also petition for the appointment of a receiver.

The troubles of this company have been known for some time. The chief difficulty has been that the present management has been totally ignorant of the requirements of the business, and has dispensed with the services of those who did know.

ELECTRICITY will have something further to say on this subject in an early issue.

The large driving wheel of the Brush Electric Light Works at Niagara Falls burst recently, doing considerable damage but fortunately in juring none of the workmen. The accident was found to be due to the tremendous centrifugal tension caused by the accelerated motion of the wheel owing to some of the mills closing down on the hydraulic race. The wheel was of cast iron, weight 25,000 pounds, with 18-inch face. A similar accident happened at the works last fall by which one man lost his life.

Legal Notes.

The following petition has been forwarded to the United States District Attorney concerning the Berliner Telephone patent. "The Trades League of Philadelphia, an organization of some 1,200 of the largest firms of the city, and which is actively engaged in an effort to decrease the exorbitant telephone charges imposed upon the subscribers in Philadelphia, and which movement is endorsed and supported by nearly every business organization in this city, would respectfully suggest that you would be warmly commended from one end of the United States to the other by the business men who have to use this, at present, high-priced business accessory, the telephone, if you would press with all diligence the suit commenced by your predecessor, Attorney General Miller, in the Circuit Court of Boston, Massachusetts, February 8th, to annul the so-called Berliner patent, which was applied for June 4th, 1877, by Emile Berliner, and issued to the American Bell Telephone Company, as assignee of Emile Berliner, on November 17, 1891, under which patent the American Bell Telephone Company claim the right to protection for fourteen years more to come. As this matter is one of grave importance, and in which we feel a deep interest, we will very much appreciate an early reply."

Application was made to Justice Bartlett of the Supreme Court last Wednesday by Cardoza & Cardoza for a preliminary injunction on behalf of Mary Ryan, as plaintiff, against Michael J. Coffey, president of the Board of Aldermen, Mayor Boody and the Brooklyn City Railroad Company. Mrs. Ryan sues as a property owner along the line of the proposed route for which the Board of Aldermen has voted to grant a franchise for the construction of an electric road.

Judge Bartlett declined to grant the motion; but he intimated that upon the presentation of proper papers he would grant an order to show cause why an injunction should not issue.

Speaking of the suit brought by the Thomson-Houston Company against the San Francisco and San Mateo Railway Company, the president of the railway company, Behrend Joost, said:

"After taking the contract to build and equip the road the S. S. Construction Company sublet the job. One of the sub-contracts was made with the Thomson-Houston Company, that corporation agreeing to supply all of the electrical appliances we required. The bills aggregated $163,000, and of this amount we have paid $113,000.

"In this suit the value of the supplies is estimated at $100,000. There has been wear and tear, and I dare say the figures were put low because the indemnity bond in a case of that kind must be in a sum double the amount stated as the value of the property involved.

"The amount actually due the plaintiff is only $40,000 or thereabout, but I am informed that it is the intention of the Thomson-Houston Company to seek to regain the property transferred to us, utterly ignoring the payments already made.

"The suit has been brought against the railway company, that corporation having possession of the appliances supplied to the S. S. Company. But the question as to whether the railway company is bound by the contracts of the construction company will probably be raised should the litigation proceed."

The injunction by which the Wyandotte Electric Light Company prevented the Western Electric Company of Chicago from operating the new public lighting plant installed in Wyandotte, Mich., by the latter company, has been dissolved by a decree of the court.

The case of the Lynn Gas and Electric Company against the Connecticut Fire Insurance and twenty-two other insurance companies has been finally decided in favor of the electric company in the court of last resort. The amount of the verdict was $12,000. The case was based on the destruction of the engine room and a big Corliss engine, caused by a fire in the tower of the company (trifling in itself and soon extinguished) short-circuiting an electric current connected with machinery in the engine house, fifty feet away; the short circuiting strained and broke a pulley and a flying fragment from the broken pulley struck and disabled the governor of the engine, in consequence of which the engine destroyed itself and the building. The Gas and Electric Company insisted that the whole damage was a loss by fire, and the court agreed with that view. The verdict covers the entire loss.

World's Fair Notes.

Whether the World's Fair will be ready to be formally opened by President Cleveland on May 1st depends upon how fast the exhibits can be placed in position more than upon their reception at the grounds, as is shown by the report of the Superintendent of Installation. Last week a daily average of three hundred cars of exhibits and about 500 wagon loads were received from city exhibitors. Extra men have been hired to install the goods and get them in shape for the opening day. Most of the foreign exhibits from electrical firms are in the Electricity Building, and are being placed in position as fast as they are unpacked. About 200 boxes of the German exhibit are already in position on the second floor of the building. Since the extension of the time for receiving from April 10 to May 1, the American exhibitors have realized that it is necessary to have their goods on the grounds if they are to be installed at all before the last mentioned date.

The Westinghouse Electric Company are working two shifts of men in order to have a portion of the incandescent plant ready for the opening exercises. Two of the large 5,000 light alternating dynamos are ready to be run as soon as steam can be turned onto the engines. The switchboard from which all the circuits are to be operated is nearly completed.

Up to the present time, of the arc light plant which is to light the grounds and buildings the following machines have been installed: 6 Excelsior, 26 T.-H., 20 Standard, 12 Ft. Wayne, 12 Brush, 6 C. & C., 4 Mather and 4 Eddy.

Work on the generating station for the Intramural Railroad is being rapidly pushed, and it is expected that a trial trip will be made during the coming week.

C. D. Wyman, general manager of the Columbia Electric Launch Company, came to the park last week and is superintending the installation of the storage batteries in the boats. Fifteen of them are to be ready May 7 and the remainder as soon as possible thereafter.

The firm of Stranahan, Riley & Wilkinson have been granted the concession in the Electricity Building and Machinery Hall to demagnetize watches.

BOOK NOTICES.

Electrical Measurements and other Advanced Primers of Electricity. By Edwin J. Houston, A. M., New York; The W. J. Johnston Company, Ltd., New York. 429 pages. Price, $1.00.

This is the second volume of Prof. Houston's elementary treatises, and it presents the subjects of electrical measuring instruments, electric batteries and electric lighting in a non-technical manner.

The work confines itself to descriptions and explanations of the principles of various kinds of apparatus rather than to their practical applications, and for this reason is chiefly adapted to the use of students.

A third volume, now in preparation, will complete the series, but there is no necessary connection between the several volumes, each one being complete in itself, as are the several primers in each volume as far as possible.

The subjects of electric lighting and power occupy some 200 pages, and the various systems and apparatus in general use are described very completely.

Boston Notes.

As the time approaches when the hen that is on should have hatched out her brood and "come off," interest and excitement throughout Boston electrical circles increases, and almost everybody is craning his neck to catch an early glimpse at the callow brood. Just to pacify the over-anxious ones we wish to say that by special wire we learn the old lady is feeling comfortable, is sticking close to business; receives no callers, and promises to do her level best to present to the anxious and waiting world, within a few days, a large family of brilliantly plumaged chicks. They will be spring chickens, too.

The paper on "The Fire Hazards of Electric Lights," published in another column, which was read by Captain Brophy, the veteran insurance and electrical expert, before the Boston Society of Arts, Thursday evening, drew together an unusually large attendance of members, including men who are prominently identified with electrical interests, and some of whom joined in the subsequent discussion.

As is well known, Boston has passed through a fiery ordeal since the beginning of the present year, which has cost her fire underwriters or the companies they represent well on to $5,000,000 in losses. In consequence the insurance people have held repeated meetings, discussed these fires and endeavored to trace their origin. Of course some one has started the usual hue and cry against electric wires as the primary cause of all the trouble; insurance rates have been increased no less than 1 per cent., and general excitement prevails. The question is beginning to be asked, Where is the New England Electric Exchange, which during its existence did so much to improve the quality of all electric work, licensed only good men to engage in the business, increased public confidence in the use of electricity and did good all round? It may be that useful organization will have to be resuscitated unless the fraternity is prepared to see its business seriously if not permanently jeopardized by blind, ignorant and unfounded prejudice.

General News.

What is Going on in the Electrical World.

Wheeling, W. Va.—The electric street car strike has been settled.

St. John, N. B.—The electric railway has begun operations and is doing a rushing business.

Roanoke, Va.—The Street Railway Company intend to change the Salem dummy line into an electric line.

Baton Rouge, La.—The electric street-car belt line has been completed, and the cars are running regularly.

Rockville, Md.—A company is to be formed to light Rockville with electricity. The capital stock will be $20,000.

Cleveland, Ohio.—The cable company has let the contracts for the equipment of the St. Clair street line with electricity.

Charleston, Mo.—The Charleston Electric Light Company advertises for sale a new electric light plant which cost $10,000.

Ft. Worth, Texas.—The present street railway will be converted into an electric line as soon as arrangements can be made.

Albany, N. Y.—The Legislature has passed the bill extending the term of the New York City Board of Electrical Control another year.

Phœnix, Ariz.—The Phœnix Light and Power Company has become the successor by purchase of the Phœnix Electric Light Company.

Akron, Ohio.—After a long contest the city council has renewed the contract for lighting the city with the Akron General Electric Company for five years.

Hanover, Pa.—The stockholders of the Hanover and McSherrytown Street Railway have decided to put the road under contract at once; it will be electric.

New Hampton, Iowa.—At the election held here on the 10th inst. the question of putting in an electric light plant was voted upon and carried by a large majority.

Omaha, Neb.—The amended city charter, among other things, authorizes the city to build or buy gas works and electric light plants, and to issue bonds for the purpose.

Athens, Tenn.—There is probability of the Athens Street Railway Company being reorganized and the motive power of the line changed from horses to electricity.

Northampton, Mass.—The bill giving the Northampton Street Railway Company the privilege of extending its tracks to other towns in Hampshire County has been passed.

Richmond, Ind.—It seems probable now that an electric light plant will be established here as soon as arrangements can be made with the gas company, whose contract expires in two years.

Charleston, W. Va.—People here are dissatisfied with mule motive power, and the Street Railway Company will probably have to succumb to the popular demand for electrical propulsion.

Wauwatosa, Wis.—The Wauwatosa Street Railway Company has been granted a franchise for an electric railway line in certain streets of the town. The road will connect with the Pabst electric line.

Wilmington, Del.—The Harlan & Hollingsworth Company are placing trolley wires around their various shops by means of which trucks electrically connected will be moved to any part of the buildings.

Brooklyn, N. Y.—The Board of Aldermen last week granted valuable street-railway franchises to the Nassau Electric (P. H. Flynn's), the Brooklyn City and the Kings County Electrical Railroad companies.

Leadville, Col.—The Leadville Water and Power Company has secured a franchise to erect another electric plant in this city. The company will furnish power for running mining machinery as well as electric light.

Chamberlain, S. D.—Some capitalists have decided to put in an electric light plant here, and intend getting their power from an artesian well, which, in combination with a local mill-owner, they are now having sunk.

Chillicothe, Ohio.—The plant of the Chillicothe Electric Railway and Lighting Company has been sold to a New York syndicate for $140,000. The new company will add two miles to the railway line, and make other improvements.

New York.—The Atlantic Postal Telegraph Cable Company held its annual meeting on the 11th inst. and re-elected the old board of directors, as follows: A. B. Chandler, W. H. Baker, E. C. Platt, J. O. Stevens and T. L. Cuyler, Jr.

Butte, Mont.—At a recent meeting of the Montana Mutual Electric and Telephone Company the following officers were elected: Patrick Mullins, president; J. P. Reins, vice-president; W. McC. White, secretary; Fayette Harrington, treasurer.

Dubuque, Iowa.—The foreclosure sale of the Allen & Swiney electric light and street railway plant to the Old Colony Trust Company of Boston, having been confirmed by the court, the trust company through the General Electric Company of Boston will reorganize the company.

Chester, Pa.—This city is becoming a great trolley centre. Besides its own street lines, it will have two or three lines connecting it with Philadelphia. The Philadelphia and Delaware Street Railway Company is now endeavoring to get an entrance to the city, and if it succeeds, it will give us a through line to Wilmington.

Indianapolis, Ind.—The draft of the electric street-railway franchise to be submitted to competing companies occupies several columns in the local papers. There are now four companies aiming to get a franchise, but it is considered likely that the Citizens' Street Railroad Company will secure the plum.

Laurel, Md.—A company composed of local capitalists has petitioned the city council for permission to lay and maintain an electric railway along the principal streets of the town, the cars on the same to be propelled by electricity generated at the power house of the Laurel Electric Light Company.

Stockholm, Sweden.—An electric railway will soon be constructed from Stockholm to Djursholm. The electric appliances are to be furnished by a firm in Manchester, England, while the boilers and the steam engines will be made at Eskilstuna. The work will be pushed so that the line may be opened for general traffic next fall.

Marshallton, Md.—The citizens of Mill Creek, Christiana and Brandywine, hundreds living along the route of the proposed Wilmington and Brandywine Springs electric railway, held an enthusiastic meeting here a few evenings ago, the object of the meeting being to urge the immediate passage of the bill and to censure the Senators for their tardiness in taking action on the measure.

Middletown, Conn.—The Thomson-Houston Electric Company held its annual meeting at the office of the Schuyler Electric Company in this city on the 10th inst. The following directors were elected: H. A. Pevear, C. A. Coffin, J. N. Smith, V. F. Spinney, S. A. Barton and C. H. Newhall, all of Lynn; E. E. Griffin, T. Jefferson Coolidge, Jr., and S. E. Peabody, of Boston.

Baltimore, Md.—It is reported that all franchises and rights of way for an electric railway between Baltimore and Washington have been secured and that work will begin at an early date. A prominent banking firm of Baltimore is pushing the enterprise and Boston and New York capitalists are interested in it. The road is to be thirty-eight miles long, and is distinct from the Traction Company's projected road and boulevard, which seems to hang fire.

Springfield, Ill.—The People's Electric Street Railway has been sold to a St. Louis syndicate, the same that recently purchased the Springfield City Railway. The roads will be consolidated under one management and will eventually be connected and transfers issued from one line to the other. C. K. Minary has taken control of the roads. It is said that the new company has no connection with the People's Electric Lighting and Heat Company, lately organized.

Philadelphia.—A charter has been applied for by the Electric Traction Company, a new organization, which intends to lease the Frankford and Southwark Passenger Railway Company's road and leased lines, and convert the Frankford and Southwark road into an electric system. There are 100 miles of road, and it is estimated that it will require between $6,000,000 and $8,000,000 to install the trolley on the entire system.

York, Pa.—The Edison Electric Light Company having announced through the press that all persons using incandescent lights that were not acquired through them were infringing on their rights and would be prosecuted, the Westinghouse Company has assured their customers and the public that they need have no fear of prosecution as the company would assume responsibility of any action brought against consumers of their light.

Atlantic City, N. J.—The extension of the electric railway system to Longport by the Pennsylvania Railroad necessitates the enlargement of their electric power house, and in a few days work will be started on the same. A new 300 horse power dynamo is to be added to the already large plant. Instead of motor trains being run every hour this summer, electric cars will probably leave this city every fifteen minutes or so.

Pittsburg, Pa.—A committee of electricians, consisting of John Ridall, of the Brush Electric Company; G. H. Blaxter, manager, and J. H. Willock, director of the Allegheny County Light Company; Superintendent Morris Mead, of the Bureau of Electricity, and others, have gone on a tour of inspection of underground wire systems in the cities of Chicago, St. Paul and Minneapolis. As soon as the committee returns from its tour of investigation, a conference will be held with the city officials in regard to the style of the work to be done here.

Martinsville, Ind.—A syndicate composed of Eastern men are reported to have devised a scheme to make Martinsville a centre of attraction, the waters of the springs here, said to possess medicinal virtues of a high order, suggesting the enterprise. The syndicate propose to build an electric line to Indianapolis, if they can get a franchise for a street railway in Martinsville, and to make such improvements in this neighborhood as to make it a pleasant summer resort for Indianapolis people and the residents of intermediate places.

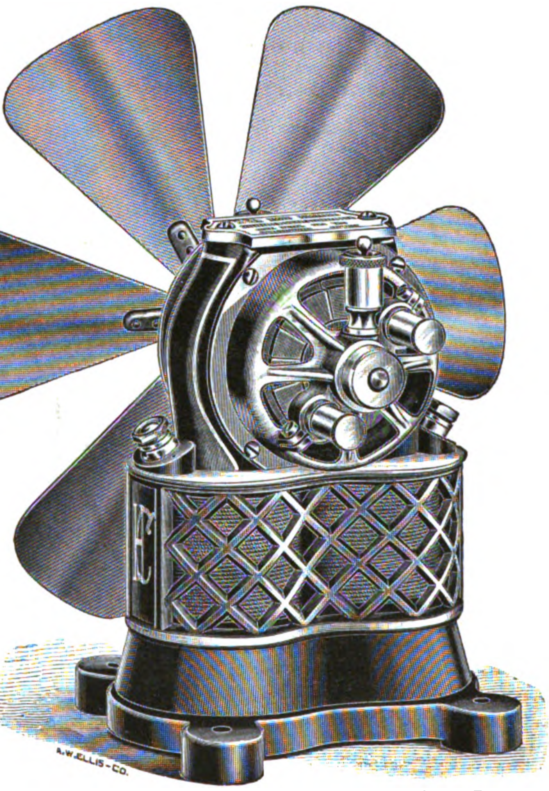
Oakland, Cal.—It is doubtful if there is another city in the world so well supplied with street railroads as Oakland. "When all the franchises have been utilized," says the *Enquirer*, "there will be no less than six electric routes to Berkeley (counting four branches of the Oakland Consolidated Company), four electric routes to West Oakland, four to East Oakland (besides a horse car road), two to Alameda and one to San Leandro and Haywards. Near the centre of the city the lines cross and recross like spider webs."

Winona, Minn.—The Winona General Electric Company, an offshoot of the Northwestern General Electric Company, now own in fact as well as nominally all the public electric light, heat and power plants in the city, as well as the Winona City Railway. The company have filed an amendment to their articles of incorporation, increasing the amount of indebtedness which they may legally incur from $250,000 to $500,000. This company was originally organized as the Winona Light, Heat and Power Company, but on October 10th last its articles of incorporation were amended and the name changed to the Winona General Electric Company.

Mobile, Ala.—The manager of the Mobile Street Railroad has effected arrangements for changing the motive power of the road to electricity.—The Mobile Electric Railway Company and the Mobile Electric Light and Power Company have been consolidated under the name of the Mobile Light and Railway Company. The capital stock of the new company has been fixed at $500,000. The officers elected are as follows: John Wilson, of Leavenworth, Kansas, president; J. H. Wilson, of Mobile, vice-president and general manager, and A. J. Peaper, secretary; John Wilson, J. H. Wilson, J. C. Lysle, W. E. Gordon and A. J. Peaper, directors.—The council has passed an ordinance taxing all telephone, telegraph, electric light and street car poles.

The Lundell Motor.

The 1893 model of the Lundell Fan Motor embodies a self-oiling and self-aligning bearing. The new design of fan guard gives the outfit an artistic appearance, and the black japanned finish is proving popular. This new model is a striking exposition of the character of the electrical novelties of the Interior Conduit and Insulation Company.



The Holtzer-Cabot Fan Motor Equipment. (See Page 192.)

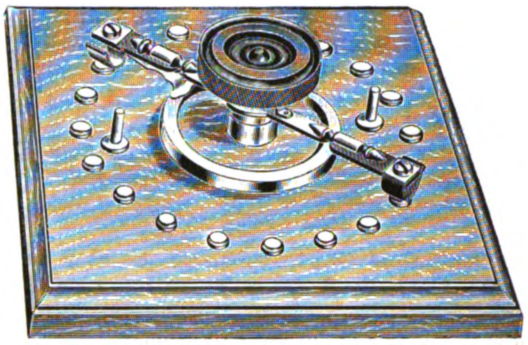
The E. E. & S. Voltmeter Switch.

With the increasing number of isolated plants, electrical practice and apparatus in this line becomes more important. Nearly all large buildings of modern erection maintain their own plants, often very extensive and complete, and usually including a switchboard of slate or marble holding the apparatus for the control of the plant. The grouping of a number of machines in this way, feeding into common bus bars, renders necessary means of controlling each one at any time, and uniting its action, especially with reference to voltage.

For the latter purpose the Electric Engineering and Supply Company of Syracuse, N.Y., have recently placed upon the market in connection with their switchboards and voltmeters the voltmeter switch—illustrated in the accompanying cut.

As the name indicates, the instrument is to be used in connection with a number of generators in place of the primitive strap switch or the cumbersome plug method adopted when the number of circuits becomes too large for the former. They are made in two styles, "single" and "double" pole. The arm is brass, of two pieces, insulated and mounted on the central support. A light spring contact piece is carried on the lower side at each end, and as the arm is rotated by the corrugated hard rubber disk at the center, these touch diametrically opposite posts. One contact spring is lengthened to bear on the ring on the base, and between this ring and the other arm through the center post the voltmeter is connected. The test wires from the circuit are brought to opposite posts, and by turning the arm the voltmeter may be connected to any circuit or cut-out. Stops are provided to prevent reversal of the current.

The switches are shipped of any number of circuits, on wood bases for templates, or are put upon slate or marble bases.



The E. E. & S. Voltmeter Switch.

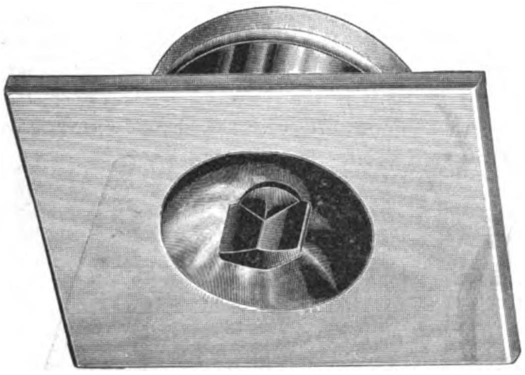
While there is nothing especially new in this instrument it fills a long felt want, and its convenience, neat appearance and workmanship commend it to all station men and electrical users who look after the details of their plants. This is shown by the fact that contractors specify it on boards of their construction.

A Handsome Catalogue.

The J. T. Case Engine Company of New Britain, Conn., manufacturers of the Case Automatic High Speed Engine, have printed for distribution an exceedingly handsome catalogue, letterpress in two colors, containing illustrations of the machinery they manufacture and full and perspicuous descriptions of their celebrated engines and their various parts. Among the practical qualities which they claim for the engines are simplicity, direct action, compactness, lightness of moving parts, large wearing surfaces, automatic lubrication and perfect regulation, and these points are classified under their proper headings and fully described in the catalogue, which also contains tables giving the dimensions, capacity and all the particulars of the machinery manufactured by the company.

The Hart Flush Switch.

The switches manufactured by the Hart & Hegeman Manufacturing Company, of Hartford, Conn., have worked their way into the high estimation in which they are held by the trade by their intrinsic merits. They are elegant in appearance, efficient and reliable, and are finished in any style that may be desired. The switch of which the accompanying cut is an illustration is the Hart Flush Switch, one of the latest productions of the Hart & Hegeman Company. It is attached by screws to a plate of cast brass, and is enclosed in a brass shell fastened to the cast plate, which protects it from injury from dust or any extraneous cause. It can be easily detached for wiring. The plate with the switch attached is screwed to the wall, and is



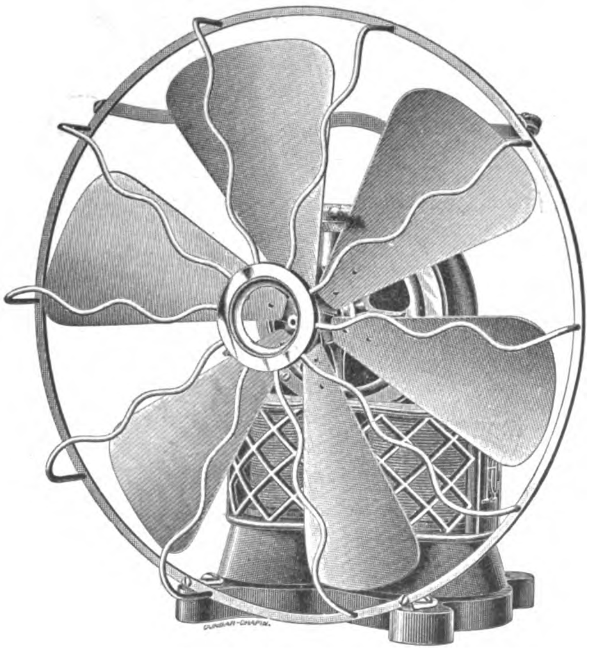
covered with a cap of finished sheet metal flanged at the edges, this being held in position by the switch handle. No screw-heads appear on the surface, as the method adopted to hold the exterior plate renders visible screws unnecessary and gives it a much neater appearance. Common flat head screws may be used for holding the plate to the wall.

The Hart switches are made single and double pole and three-way, and are for sale by all supply houses.

A Unique Fan Motor Equipment.

As the season advances and time hurries us along to the hot days and close nights of summer, the designers and manufacturers of electric motors and fans are hurrying along with their endeavors and plans to meet what will undoubtedly prove to be the biggest boom that has ever yet been known in this branch of the electrical business. As in past years, many new and elegant designs will be placed on the market and all secure a share of public welcome.

The time has arrived when the community can no longer do without these necessary aids to comfort, whether in the home, the church, the theatre, the office, warehouse or factory. A realization of their necessity has been growing from year to year, until at the present time they are in all but universal demand; hence it is that there are now so many varied types bidding for popular favor, and prominent among the most artistic, compact and efficient is the outfit we herewith illustrate.



THE HOLTZER-CABOT FAN MOTOR EQUIPMENT.

It is a new type, pattern 1893, direct current motor, manufactured by the Holtzer-Cabot Electric Company, Boston, a firm enjoying a fine reputation throughout the country for the varied forms and high grade character of its manufactures.

From the accompanying cuts, which clearly indicate the style and character of this equipment, it would appear as though a lengthy description were needless, for it is an artistic piece of mechanism, and as efficient as any device of the kind can be made. This motor consumes but a comparatively small amount of current—only 85-100 of an ampere—and being provided with a commuting switch it produces either a gentle breeze or a cyclonic volume of wind when provided with a 12 inch fan made for the purpose. This motor is wound for either 1,200 or 1,700 revolutions per minute, and when so ordered is supplied with a three speed switch, which is a novel feature of unusual advantage seeing that it enables its owner and user to adjust its cooling and ventilating power to the varying temperatures that occur in the summer season. The motors made by this firm, of which this is a new and improved type, had an enormous sale last year, and already the orders booked for the coming season ensure an unprecedented sale.

As we have stated above, this unique outfit is only one of many devices made by the Holtzer-Cabot Electric Company, one other of their efficient and popular machines being an alternating fan motor, which it is claimed is a powerful machine, economical in the use of current, and runs without heating. So popular has this machine become that the company reports having sold its entire output for the coming season, for it, too, is equipped for ventilating purposes.

INCORPORATIONS.

Commercial Electric Supply Company, of St. Louis. Capital, $15,000. Incorporators: W. F. Carter, H. D. Ames, M. A. Knapp.

The Ashton and Clarksville Electric Railway Company, Ellicott, Md. President, Alban G. Thomas; vice-president, Dr. Hardey; secretary, Philip T. Stabler; treasurer, Charles G. Porter. The proposed line is to start at the terminus of the Ashton, Colesville and Washington road, one and a-half miles east of Sandy Spring and extend about five miles to Clarksville, Howard County, Md., where it will intersect with the electric railway that is to be built from Baltimore to Ellicott City.

The bill to incorporate the Fall River and New Bedford Street Railway Company has passed the Massachusetts Senate.

Articles of incorporation have been filed at Pasadena, Cal., by the Consumers' Gas and Electric Company of Pasadena, with a capital stock of $100,000. The company was organized simultaneously with the Consumers' Gas and Electric Company of Los Angeles, with a capital stock of $1,000,000. The board of directors of the Pasadena Company is composed of Messrs. A. F. Mills and J. A. Buchanan, of Pasadena, and L. A. Fish, George L. Arnold and George B. Shaffer, of Los Angeles.

The Atwater General Electric Company, Columbus, Ohio. Capital stock, $14,000. Incorporators: Arthur S. Atwater, Frank B. Maney, Leonard Case, Geo. M. Schombs, of Cleveland, and others.

The Buchanan Power and Electric Company, Buchanan, Mich. Capital stock, $100,000.

The Electrical Fireworks and Construction Company, Chicago. Incorporators: Emil Giroux, Alfred Guillaume and Elmer E. Barrett.

The Hyattsville Electric Heat, Light and Power Company, Hyattsville, Md., has been organized and a charter applied for. The incorporators are L. D. Wine, Joseph A. Blundon, Charles A. Wells, Henry M. Morrison, W. W. Smith and F. H. Smith. In its operations the company will include Riverdale, Highlands and Bladensburg.

The Armstrong Telephone Company, Dayton, Pa. Capital, $3,000. Directors: George G. Borland, A. K. Goodhart, G. S. Morrow, Dayton; Simon Black, Echo; H. H. Weylman, Kittanning.

Crescent Electric Light Company, McKees Rocks. Capital, $25,000. Directors: John C. Reilly, William J. Burns, Thomas S. Bigelow, James D. Catling, Pittsburg; Frank Thompson, McKees Rocks, Pa.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED APRIL 11, 1893

ELECTRIC RAILWAYS AND APPLIANCES.

495,035. Electric-Railway Trolley. Frank Heath, Minneapolis, Minn. Filed July 11, 1892.

495,388. Overhead Contact Device and Switch. Charles J. Van Depoele, Chicago, Ill.; C. A. Coffin and Albert Wahl, administrators of said Van Depoele, deceased, assignors to the Thomson-Houston Electric Company, Boston, Mass. Filed June 18, 1888.

495,443. Traveling Contact for Electric Railways. Charles J. Van Depoele, Chicago, Ill.; C. A. Coffin and Albert Wahl, administrators of said Van Depoele, deceased, assignors to the Thomson-Houston Electric Company, Boston, Mass. Filed Mar. 12, 1887.

495,456. Conduit Electric Railway. William R. De Voe, Shreveport, La., assignor of one-fourth to C. W. Dawley, Dennison, Tex. Filed Sept. 6, 1892.

ELECTRIC LIGHTS AND APPLIANCES.

495,077. Electric-Arc Lamp. Addison G. Waterhouse, Hartford, Conn. Filed Nov. 28, 1892.

495,240. Incandescent Lamp. George H. Benjamin, New York, N. Y., assignor to Siemens & Halske, Berlin, Germany. Filed Nov. 14, 1892.

495,318. Globe-Holder for Arc Lights. Thomas H. Faben, Toledo, Ohio. Filed Oct. 14, 1891.

495,461. Electric-Arc Light. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company, of Connecticut. Filed Aug. 23, 1892.

495,463. Electric-Arc-Lamp Carbon. George M. Lane, Asbury Park, N. J. Filed Sept. 11, 1890.

495,467. Incandescent Lamp. Henry Green, Hartford, Conn., assignor of one-half to Geo. S. Miller, same place. Filed Oct. 16, 1891.

DYNAMOS AND MOTORS.

495,046. Electrical Motor. August Knoche, Elberfeld, Germany. Filed July 22 1892.

495,138. Magneto-Electric Machine. Joseph N. McLeod, Brooklyn, assignor to the McLeod Electric Manufacturing Company, New York, N. Y. Filed April 15, 1892.

495,139. Magneto-Electric Generator. Joseph N. McLeod, Brooklyn, assignor to the McLeod Electric Manufacturing Company, New York, N. Y. Filed April 27, 1892.

BATTERIES.

495,107 Electrode for Secondary Batteries. George D. Coleman, Chicago, Ill., assignor of nine-twentieths to Craig R. Guerin, same place. Filed June 10, 1892

495,176. Electric Battery. Frank M. Archer, New York, assignor, by mesne assignments, to the Hero Electric Company, Jersey City, N. J. Filed Nov. 25, 1891.

495,177. Electric Battery. Frank M. Archer, New York, N. Y., assignor, by mesne assignments, to the Hero Electric Company, Jersey City, N. J. Filed Nov. 25, 1891.

495,306. Galvanic Battery. Clyde J. Coleman, Chicago, Ill. Filed June 6, 1891.

TELEPHONE AND TELEGRAPH APPARATUS.

495,030. Means for Telegraphing. William H. Fahrney, Chicago, Ill. Filed Oct. 22, 1892.

495,087. Central-Office Apparatus and Circuit for Telephone Exchanges. Edward J. Hall, Morris, N. J., assignor to the American Telephone and Telegraph Company, of New York Filed Oct. 13, 1892.

495,090. Granulated Material for Transmitting Telephones. William W. Jacques, Newton, assignor to the American Bell Telephone Company, Boston, Mass.

495,179. System for Protecting Telephone Apparatus from Lightning. John J. Carty, New York, N. Y., assignor to the Metropolitan Telephone and Telegraph Company of New York City. Filed Aug. 5, 1892.

495,180. Telephone-Gage. John J. Carty, New York, N. Y., and Frank A. Pickernell, Newark, N. J. Filed Aug. 31, 1892.

MEASURING INSTRUMENTS, INDICATORS, ETC.

495,047. Electrical Indicator for Rudders. Charles V. Knowles, Somerville, N. J., assignor to Edwin Holmes, New York, N. Y. Filed Feb 16, 1892.

495,066. Voltmeter and Ampere-Meter. Eugene Gengenbach, Schenectady, N. Y. Filed May 13, 1892.

495,127. Electric-Annunciator System. Edmund R. Wilder, Kansas City, Mo. Filed June 23, 1892.

495,148 Electro-Mechanical Steam Engine Recording-Indicator. Reuben G. Collins, Dollar Bay, Mich. Filed May 2, 1892.

495,175. Dynamometer. Edgar J. Wood, New York, N. Y. Filed March 31, 1892.

495,225. Potential-Indicator. George A. Lintner, Minneapolis, Minn. Filed Nov. 17, 1892.

MISCELLANEOUS.

495,026. Spool for Electric Coils. George W. Demmick, Lynn, Mass., assignor to the General Electric Company of New York. Filed Nov. 23, 1892.

495,088. Multiple Thermal Cut-Out. Warren S. Hill, Boston, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Aug. 10, 1889. Renewed June 2, 1890.

495,058. Commutator-Connector. Edward D. Priest, Lynn, Mass., assignor to the General Electric Company of New York. Filed Nov. 16, 1892.

495,125. Electro-Magnet. Simon H. Stupakoff, Pittsburg, assignor to the Union Switch and Signal Company, Swissvale, Pa. Filed Sept. 5, 1892.

495,136. Cummutator-Brush. Karl Koch, Elsey, near Hohenlinburg, Germany. Filed Nov. 10, 1892.

495,193. Railway Danger-Signal. Arthur W. Berne, New York, N. Y., assignor of one-half to William H. Walsh, same place. Filed Aug. 5, 1892.

495,229. System of Electric Conversion. Edwin W. Rice, Jr., Lynn, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed June 18, 1888.

495,287. Electric Alarm-Clock. Thomas P. Adams, Rico, Colo. Filed May 23, 1892.

495,321. Electric Street-Railway Sweeper. John W. Fowler and John Hutton, Brooklyn, N. Y., said Hutton assignor to the Lewis & Fowler Manufacturing Company, same place. Filed May 6, 1892.

495,393. Apparatus for Electric Welding. Charles L. Coffin, Detroit, Mich. Filed June 11, 1891.

495,394. Machine for Electrically Welding Metals. Charles L. Coffin, Detroit, Mich, Filed Aug. 6, 1892.

ELECTRICITY.

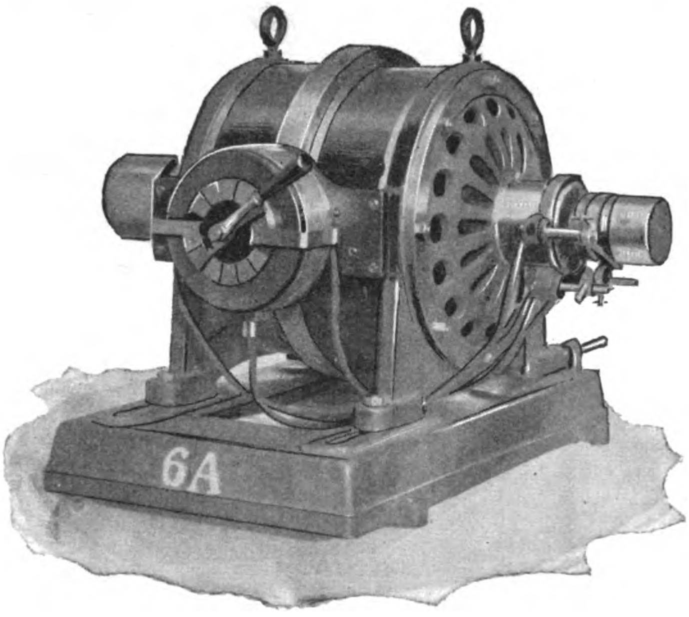
VOL. IV. NEW YORK. APRIL 26, 1893. CHICAGO. No. 15

INTERIOR VIEW—DRAKE, PAYSON & WHITTIER'S SUPPLY HOUSE. (SEE PAGE 206.)

A Practical Success.

The Stanley-Kelly Motor for Two-Phase Alternating Currents.

The alternating current, although possessing great flexibility in its applications to industrial problems, has been greatly handicapped in its competition with direct currents on account of the difficulties experienced in producing practical motors adapted to this system. Although synchronous motors have been used for several years on the ordinary single phase alternating current in general use for lighting, the fact that no torque is exerted by these motors until they reach about their normal speed, and that the current consumption is excessive on light loads, has precluded their general adoption on lighting circuits.



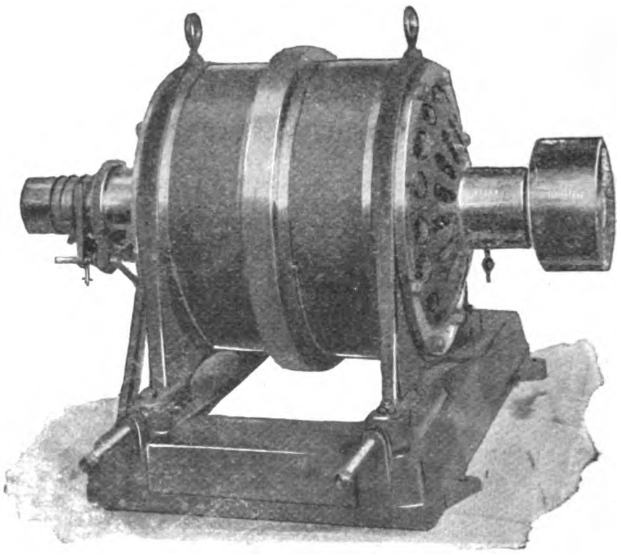
The Stanley-Kelly Motor.

To overcome these defects, the Stanley Electric Company of Pittsfield has introduced a motor of an entirely new design, to be operated on two-phase alternating current circuits, their idea being to introduce a system from which either incandescent or arc lighting as well as power can be furnished. Up to the present time the multiphase alternating systems are the only ones which have been demonstrated to be successful for the distribution of both light and power from the same circuits, and the two-phase current has been selected in this case as being the simplest and requiring the fewest changes in construction of the lines.

The new Stanley motor, shown in Figs. 1 and 2, differs from the rotary field types which have been invented by Tesla and others, and is constructed on entirely different lines. The machine is in principle a species of transformer in which the fields correspond to the primary and the armature to the secondary circuits. The fields are composed of laminated sheet iron forming a ring with interior projecting pole pieces. This field is divided at the centre of its length, and one side is advanced so as to bring its poles midway between those of the opposide side. To avoid the demagnetizing of the fields by the induced armature currents, heavy copper conductors forming a closed circuit are set in the field, and act to neutralize the effect of the armature upon the field.

The armature is wound with two wires corresponding to the two phases, and these windings form closed circuits which have no connection to the field circuit. The two inside ends of the armature coils are connected to one brush, and the outer ends to two others, a three-ring collector being used in order to allow resistances to be thrown in the armature circuit on starting. The brushes and collector, however, are only in service until the motor comes to its normal speed and they are then short-circuited. At the standard frequently adopted in this country, 133 P. P. S., the false currents developed in an alternating current motor are very excessive, and make it generally impracticable to produce a system for both light and power fed by the same dynamo and circuits. These false currents have made regulation impossible, and have made necessary generators, lines and transformers so disproportionately large for the work to be done that it has been uncommercial. In a commercial system for distribution of light and power widely throughout a city, motors which take current about proportionate to their load are essential, and with the various multiphase motors which there has been so much effort to introduce this has not been accomplished.

To avoid this difficulty in the Stanley motor condensers are placed in multiple with the fields of the motor, and the false currents, instead of going back through the transformer through the line to the generator and disturbing the whole system, simply flow in a local circuit through the condensers. Much study has been given for the past two years to the manufacture of condensers for commercial use and with the result that they can now be made thoroughly reliable and at reasonable cost.



The Stanley-Kelly Motor.

The Stanley-Kelly motor is claimed to be as much better on lower alternations as any other type of motor, so that if it is better than other types of motors on 133 P. P. S. it should be correspondingly better on lower frequencies, but by reason of the condensers and the compensating winding of the field it works perfectly and commercially on 16,000 alternations. The condenser does not complicate the system materially, as when it is once set up there is nothing more to do to it and it should require no more attention than a transformer.

Some of these motors have been in practical operation doing work from day to day for the past six months, and for the past two months an 80 H.P. two-phase generator has been running in the station of the Pittsfield Electric Company supplying about 40 H. P. of lights and about 40 H. P. of motors (seven in number, in sizes of from 10 H. P. down), in practical use without a hitch or accident of any kind.

The Stanley-Kelly motor makes it possible for stations at comparatively small expense to add power to their lighting service, no matter where the power is located, and get all the benefits of long-distance distribution of power in connection with their lighting circuits without throwing away much of their present apparatus. It would be better in the case of a new installation to use a lower frequency, say 60 or 65 P. P. S., and it should be borne in mind that the total efficiency of the system with this lower number of alternations would be somewhat better than with 133 P. P. S., although so far as reliability of operation is concerned one is equally good with the other.

The shops of the Stanley Electric Company in Pittsfield are operated throughout by these machines which are apparently giving great satisfaction. The motors start with a good torque, and come up to normal speed as quickly as a direct current machine, and the absence of a commutator or any parts requiring adjustment makes them extremely handy to operate. The heating of the fields in these motors is also very slight, and a burn-out is almost impossible even with a heavy overload. The accompanying diagram shows the general plan for distribution of incandescent and arc lights and power on the same circuit which is being practically demonstrated in Pittsfield.

The area over which power can be economically distributed from a central station in this way is greatly increased, and the cost of the lines is only a fraction of what is necessary with direct current systems.

Electricity as a Reformer.

(*From the Roanoke Times.*)

What a difference the electric lights make in the town! There is hardly a point within the semi-circle of half a mile radius south from Henry street and Salem avenue where reasonably coarse print may not be read at midnight. Little groups of three or four ladies do not hesitate now to attend the theatre without escorts. Next winter the result will be even more visible in the same direction. There have been less offences of a police character since the lights were turned on. It is even believed that it is safe for our esteemed friend, W. P. H., to again attempt the cultivation of chickens. His last herd of hens eloped with a colored party, who loved them not wisely but too well.

The Fire Hazards of Electricity.

BY CAPTAIN WILLIAM BROPHY.*

I have been requested by your secretary to prepare a short paper on the Fire Hazards of Electricity, in which I am to present the insurance side of the question. This I have attempted to do in as brief a manner as possible, as I understand the matter is to be fully discussed by gentlemen who, I have no doubt, will deal with this subject in a manner befitting its great importance.

On the introduction of the electric telegraph as a means of communication between distant points, the few wires stretched from pole to pole were not looked upon as a means of increasing the fire hazard, as their number was so few as not to be a serious hindrance to the fire department, and the cases where atmospheric electricity followed the wires to the switchboard and instruments causing small fires were so rare as to hardly attract attention. By slow degrees, as the benefits of this great invention began to be appreciated, the wires began to increase; still, while they proved a hindrance they were not looked on as a hazard to be seriously considered.

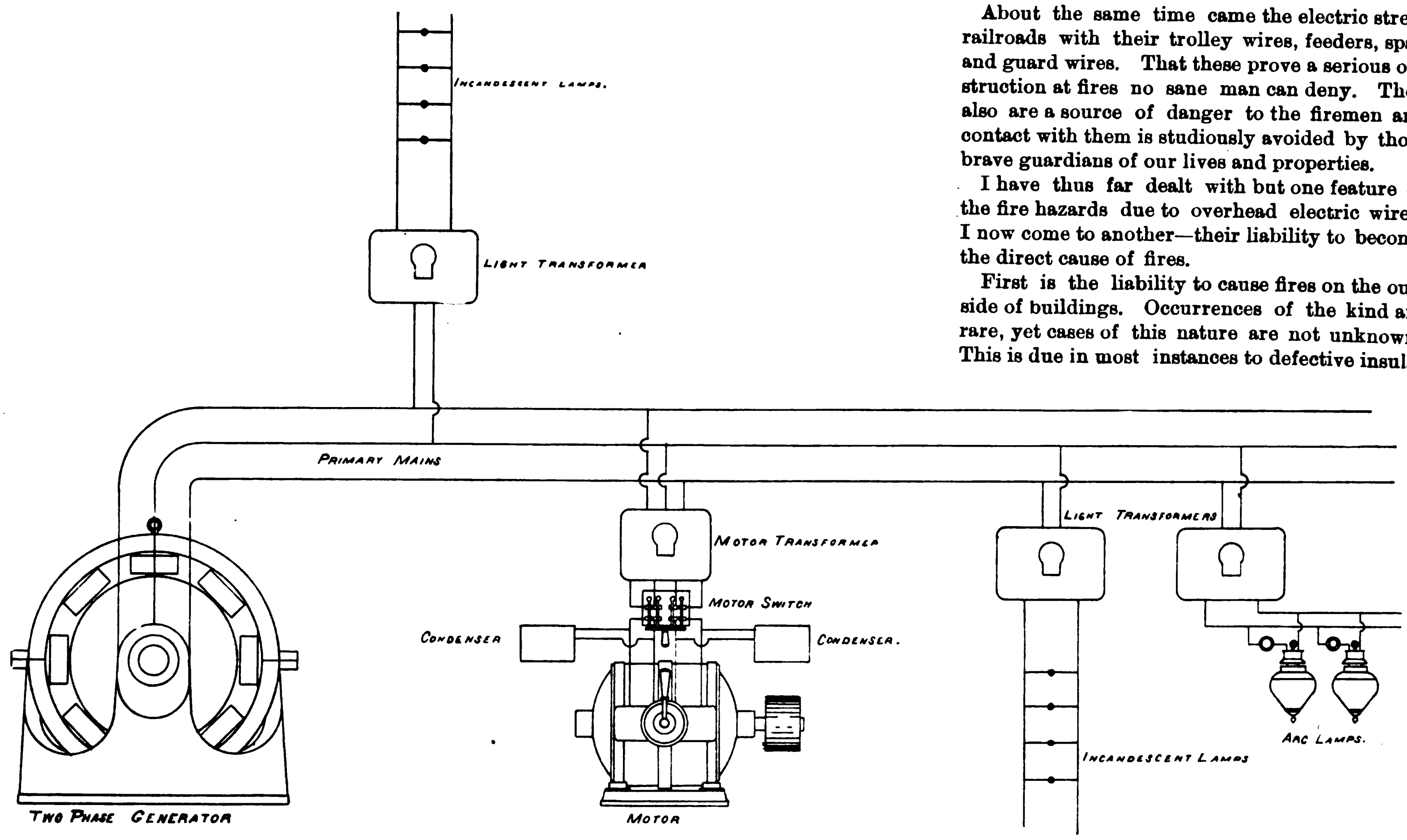


DIAGRAM OF CONNECTIONS FOR TWO-PHASE ALTERNATING SYSTEM.

Later came the dial telegraph for communicating between local points, and the stock-ticker for sending out market quotations, but these increased the number of wires only slightly.

But after the invention of the speaking telephone and the perfection of the exchange system, then the increase of aerial wires was enormous; every available spot on roof or front of buildings was eagerly seized on by the busy linemen, often without due regard to the rights of owners or occupants. Lines of poles sprang up at all points, sometimes during the hours of night, and met the astonished gaze of the law-abiding citizens for the first time as they wended their way to their places of business. The location of these intruders was not always selected with a view to the comfort or convenience of these same good people, and often their protests were met by that trite saying, "Well, what are you going to do about it."

With this enormous increase of electric wires the delays to the fire department became more frequent and losses by fire were often greater than need be, due to this cause; yet they did not endanger the lives of the firemen to any great extent, and were handled without fear.

Later came that new form of electric energy—the electric arc light. Gradually it worked its way into public favor and gradually its power for mischief to the fire underwriters and owners of property became manifest by reaching the pockets of both. This was inevitable owing to the first crude methods resorted to for the transmission of this new form of energy. The existing forms of insulation were not equal to the task of confining this greatly increased force within bounds, and in fact no other people in the world but our own would have permitted the introduction of an element fraught with such possibilities of danger to life and property with no real means for keeping it under control. But we are ever ready to take chances and assume risks in order to gain time or secure some improvement that will contribute to our comfort or add to our wealth.

With the introduction of this class of wires came another obstruction to the efforts of the firemen in extinguishing and preventing the spread of fires, and also a certain amount of demoralization in their ranks. Men who would face the flames, inhale poisonous gases, and stand beneath tottering walls without flinching, stood in wholesome dread of the arc light wires. The former elements of danger they were familiar with and could to some extent avoid them, while the latter contained hidden and to them mysterious dangers that they knew very little of. To handle such wires or come in contact with them meant injury or death. In addition to this they soon learnt that the wires they had been accustomed to handle with impunity, and remove when an obstruction, were liable to become dangerous also, and as a matter of fact firemen are justified in refusing to handle electric wires in towns or cities where an arc light plant is installed unless during the hours when it is not in operation.

Next in order came the incandescent electric light, direct or low tension system. While the wires for this system proved another obstruction they were not dangerous to life and limb; yet firemen who are not expert electricians looked upon them with mistrust. Later still came the electric power circuits. At first no greater than the usual 110 volt current was used, which is not dangerous to life or limb. Later this was increased to 220 in order to reduce the cost of conducting wire.

Next came the transformer system of electric lighting where a current of 1,000 to 2,000 volts is used in the primary conductors from dynamo to transformers. These were another obstruction and dangerous to person.

About the same time came the electric street railroads with their trolley wires, feeders, span and guard wires. That these prove a serious obstruction at fires no sane man can deny. They also are a source of danger to the firemen and contact with them is studiously avoided by those brave guardians of our lives and properties.

I have thus far dealt with but one feature of the fire hazards due to overhead electric wires. I now come to another—their liability to become the direct cause of fires.

First is the liability to cause fires on the outside of buildings. Occurrences of the kind are rare, yet cases of this nature are not unknown. This is due in most instances to defective insulation at one or more points of the circuit permitting a derived circuit through or on the surface of inflammable material and imperfect contact at binding posts and cut-out switches.

Next we come to the greatest fire hazard from the overhead wires—the danger of electrical contact between the harmless low tension and the dangerous electric light and power wires. The arc, incandescent, power, railway and alternating wires are capable of doing great damage in this way by sending currents greatly in excess of the safe carrying capacity of the smaller wires, and heating them sufficiently to cause the ignition of any inflammable substance in the immediate vicinity.

I will now consider the wires in the interior of buildings as a fire hazard, and will begin with those of the arc lighting system. For the sake of securing sufficient mechanical strength the size of wire used for this system has a much greater amount of conductivity than is necessary for safely conducting the current, so that no danger need be apprehended from overheating them. Where an abnormal amount of heat is produced in one of these circuits, it is due to imperfect joints or connections, thus introducing an excessive amount of resistance at such points. There is also more or less danger from the arc lamp, due to broken globes permitting pieces of hot carbon to drop on to inflammable goods, also from improperly trimmed lamps, which permits the burning out first of the carbons and then the metal holders. This latter will surely cause trouble in many places.

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* Read before the Society of Arts, Boston, Thursday, April 13, 1893.

Fortunately those engaged in the business of electric lighting recognize the wisdom of the practice of not concealing from view this class of wires, thus rendering the task of installing them with a reasonable amount of safety comparatively easy, and rendering their inspection less difficult.

Fire hazards from the incandescent system are confined wholly to the wires or conductors. The danger from the lamp need not be considered. Trouble can and does arise at times from the lamp socket.

I will now treat of the direct system, where a system of circuits, mains and branches are supplied from a central station from one or more dynamos delivering current into one common conductor and thence through a system of feeders to the distributing mains. The electromotive force necessary for the distribution of current in this system is not sufficient to cause serious injury by reason of shock to the nervous system, as it does not exceed 220 or 230 volts at the dynamo. But the quantity of current is sufficient to seriously burn a person under some circumstances, and would also under favorable circumstances cause serious loss by fire. The amount of current flowing from the generating station is limited only by the capacity of the dynamos and the number of lamps in use. The potential or pressure is as nearly constant as is possible to make it, but the amount of current is in proportion to the number of lamps. Whence may be asked comes the fire hazard from this system? A very natural question, and one that suggests itself to a great many people. But the fire hazard can be much greater from this than from the arc system. Hundreds of amperes of current are sent out over this system of feeders to supply lamps and motors, sufficient to melt down nearly if not all the interior wires in many buildings, if by reason of one of the many causes that suggest themselves to those familiar with the subject an abnormal flow of current takes place over them.

You may ask, how can this occur? Current flow is regulated by the electromotive force or pressure and resistance, or, if you please, friction. To supply a given number of lamps or given size of motor, a given size of wire is necessary. The filament in the lamp affords a path of very high resistance for the current. As they are connected up in multiple the greater the number of these parts are the less the total amount of resistance.

If through ignorance or motives of economy the supply wire is too small, heat is generated in the wire, and if the number of lights is sufficiently in excess of the safe carrying capacity of the wire, it can be brought to a white heat or melted even—a dangerous process near inflammable material.

If the wires are properly proportioned and through any means those of opposite polarity (positive and negative) are brought into metallic contact, a path of low resistance is then established and an excessive flow of current results with the same consequences as before.

Derived circuits established to and through the earth caused by defective insulation, even though the points of contact be widely separated, will bring about this same result.

It is true that safety fuses are brought into play to prevent occurrences of this kind, but it is not an unusual thing to find fuse wires at the junction of circuits and branches far in excess in carrying capacity of the wires they are designed to protect, and it is not unusual after the fuse wire has performed its functions by melting, to find it replaced by one whose fusing point is many times in excess of the original; and I have known cases where, after the failure of the largest fuse wire to maintain the continuity of the circuit, copper wire was substituted therefor.

I next come to the fuse blocks or bases. The earlier types were of wood, contact between wires and fuse secured under screw heads. The inevitable shrinkage of the wood destroyed the contact, and heat or a series arc was the first result, and later a fire, insignificant or of considerable magnitude according to circumstances. Too often these devices were concealed from view, thus increasing the hazard.

Next come the switches for turning on and cutting off this supply of current. When mounted on wooden bases they were capable of doing all the mischief ascribed to the wooden base cut-outs. In addition to this may be cited imperfect contacts, introducing an excessive amount of resistance and increasing the temperature to an unsafe point. The inexcusable practice of placing switches of insufficient capacity is sure to bring about the same results.

That undesirable trio, the combination fixtures for gas and electric lights, the cheap insulating joint and wood or fibre base cut-out, concealed under the metal canopy of the fixture, has been and is now another fruitful source of trouble and added fire hazard. The heat from the gas burners on a large fixture causes the fibre insulation to shrink, permitting the gas to escape, in small quantities at first, but steadily increasing in volume. The contact between the screw head and fuse is destroyed from the same cause, a slight arc established, the escaping gas ignited, the fibre in the joint burned, and a burning gas flame, limited only by the size of the pipe, is the result.

Next in order comes that twin brother in iniquity of the swinging gas jet, the so-called flexible cord, to the ends of which are suspended so many incandescent lamps. The best of this is not safe in some locations, such as show windows or any other place where it is in close proximity to inflammable goods, while the cheaper grades are positively dangerous in nearly all places. While the use of this may be admissible for suspending lamps in the usual way in buildings which in themselves are of slow burning construction, and contain little that is inflammable, the practice of fastening it to the walls or ceilings, either by means of cleats or staples, or concealing it between floors and partitions cannot be too severely condemned. Such a practice adds another to the fire hazards of electricity.

Next comes the wires for incandescent electric lighting, their character and the methods of installing them. It goes without saying that the very best of insulating covering is none too good for electric light wires. It should be water-proof in many positions, while there are cases where this is not necessary. Another desirable quality it should possess is non-inflammability, but very little of the best grades of insulation for wires possesses this desirable feature. Wires covered with any known grade of insulation, held in place by wooden cleats, add to the fire hazard to a greater or less degree, depending on their location, the distance between opposite poles, and the care with which they are placed in position. Wires that are concealed between floors, ceilings and partitions, where not supported on non-inflammable insulators, and are permitted to rest on gas, steam, water or hot-air pipes, or other conductors, dependence being placed on the covering of the wire to prevent electrical contact, add to the fire hazard. When wires of opposite polarity are run through a single hole in wooden joist, beam, stud or partition, and are laid side by side without proper means of separation, they add to the fire hazard, due to the fact that the best form of insulation has a limited life, and to the other fact that the ever-present rodent finds some forms a dainty morsel when nothing better can be had. As a result of their feast an arc may be established, and if the insulation is highly inflammable, a fire between the ceilings and partitions is rather apt to follow. Loose connections and poorly made joints are another addition to the fire hazard. Joints when improperly made and not soldered soon become a source of danger. Solder alone will not insure a perfect joint and immunity from excessive heat at this point.

The practice of enclosing two wires of a circuit covered with a high grade of insulation in an insulating tube that is itself highly inflammable is another addition to the fire hazard.

All the causes assigned for increased fire hazard to this system of electric lighting is applicable to the system known as the alternating or transformer system, with the exception of the fact that the amount of current it is possible to convey into a building is limited to the capacity of the transformer. The lamps used on this system are usually what are known as fifty volts, and the current necessary to bring them to a state of incandescence is about one ampere. A 75 light transformer then could deliver only about 75 amperes.

I have endeavored as far as possible within the limits of this paper to give most of the causes for increased fire hazards due to electricity. It is due, however, to those engaged in the various branches of electric industries and those who use electrical energy for light, power or the transmission of intelligence, to state that many of the devices I have condemned are not now manufactured, although many are still in use, and that many of the bad practices that I have condemned are not indulged in by reputable men and firms.

I firmly believe that electricity in the service of man can be rendered docile and harmless, but to point out the manner in which this desirable end can be attained is beyond the scope of this paper and the limit of the time allotted to me at this meeting. This, however, might be made the subject of another paper.

I will now close by saying that the man or firm who will take advantage of the limited knowledge of electricity possessed by the average citizen, and install electric wires in such a way as to increase the fire hazard, should be deemed guilty of a misdemeanor, and should fire result should be deemed guilty of arson. The electric lighting company who would connect its service wires and furnish current to a building unsafely wired should be deemed an accessory before the fact and punished accordingly.

It is within the power of those engaged in installing electric lights and wires and furnishing electricity for light and power to greatly reduce the fire hazard, and stop the complaints of underwriters of the increased number of fires due to electricity.

DISCUSSION.

At the conclusion of Captain Brophy's paper the Chairman called upon Mr. Parshall, of the General Electric Company, to speak on the topic. In complying with this request Mr. Parshall said that the General Electric Company had facilities for manufacturing and supplying every kind of electrical apparatus for the distribution and utilization of current. Besides supplying such apparatus they had also issued full and explicit instructions and directions to their customers and the public generally how properly to handle electrical machinery. In reference to the absorbing subject of losses by fire occurring through electricity, he could say that such loss had been proven to be not more than 1 per cent. of the entire loss. In Boston there had been several great conflagrations which had been attributed to electricity though it was not proven. In Philadelphia, St. Louis and other cities, fire losses through the electric current had been but a small fraction of 1 per cent.

Something had been said about the dangers of inside wires. It was true there might be some slight danger at times, but if only the public would show a willingness to pay a little more for electrical appliances, things could be made safe enough. Cheap work and cheap labor were a mistake in such a business.

With a view to allaying public fear as to the dangers of overhead wires, his company had all along maintained that all low potential wires should go underground. Such a change had been completed in London, Chicago and elsewhere, with gratifying results, and it would be well to insist on the change being made over here.

In connection with the subject of fire hazards, the great trouble of overhead wires was the obstacle they raised in the way of those who had to fight the fires. The supposed dangers attending the transmission of power did not exist to the extent supposed. The electric current had been found to be so useful and convenient that nowadays people forgot to use the most ordinary precautions in dealing or handling it, but the action now being taken by the various insurance corporations was stirring up public interest, and more care would be used in future. Even manufacturing and construction companies engaged in electrical work were now interested in doing the best work only. Because of the appearance and rumored dangers of electric wires, the public had become prejudiced against them. Take the reports of the various fire departments throughout the country, and it would be found that the number of fires caused by electricity did not reach 2 per cent. of the entire number. In view of what had been said and written at various times about the dangers of electricity, the different companies stood ready to do everything necessary to obviate all dangers. The interests of the people and the interests of the electrical fraternity were identical, and as public needs indicated themselves the electricians were always ready to be up and doing.

A gentleman who spoke for the New England Telephone and Telegraph Company said that his company had nearly solved the problem by placing all but a few of their wires underground. The rest would disappear shortly. Captain Brophy was asked if the introduction of electricity had increased the fire risks, to which that gentleman replied that it had not increased those risks by increasing the number of fires.

Professor Charles R. Cross, of the Massachusetts Institute of Technology, remarked that the unwillingness shown by the public to pay a fair price for electric devices had been somewhat overstated. In the early days of the business poor apparatus was too often put in, the use of which shook public confidence in the value of electric lights. Improvements, however, had been made year after year, though even to-day some poor machines were still being sold and used. After any serious conflagration the investigations disclosed that not always were the best devices used. What applied to construction work likewise applied to the machines themselves. Manufacturers had put out machines they would rather not have sold but for the public demand. Originally a current of 6 or 7 amperes was supplied and was considered sufficient; to-day a current running from 60 to 70 amperes was a common thing. When the demand was simply for everything of the very best quality, the manufacturers would be ready to meet the demand.

Col. Hewins said that it was not always the fault of the manufacturers that other than the best apparatus was supplied. The demand for cheap goods was the source of much of the evil. Several years ago the New England Electric Exchange accomplished great good by the improvements it encouraged in every department of the business, and such an organization would be of value even to-day.

Mr. T. Wright of the General Electric Company, in answer to a question from the chairman if anyone present could inform the meeting if there was known to be an efficient underground conduit in existence, said that for some time he had been working on that special thing and had found that there were many and great difficulties to be surmounted. Different styles of conduits had been experimented with, including the Bentley-Knight system, but none as yet had been found practicable. In Europe they had been somewhat more successful in such work, though even there the only conduit system that could be considered a success was the system in use in Buda-Pesth. The terrible weather of winter was the great obstacle to be overcome in this country, and it remained to be seen if that obstacle could be successfully dealt with.

Mr. Blodgett, electrical superintendent of the Boston and Albany Railroad, who presided over the meeting, closed the discussion by relating several instances in which the telegraph system of the Western Union Company had been more or less seriously affected by induced currents from electric railways operated at quite long distances from the place where the effects of these currents were noted.

A vote of thanks to Captain Brophy closed the proceedings.

The Cost of Steam Power Produced With Engines of Different Types Under Practical Conditions; with Supplement Relating to Water Power.

BY CHAS. E. EMERY, PH.D.[*]

DISCUSSION.

The President—I think the impression which many of you have received is the same as my own—of surprise that there is so little difference between the total cost of power for the different classes of steam engines. Any one who has been called upon to make a selection of a steam plant, and has received from fifteen to twenty bids from different builders, together with the claims for economy made by each, has been much in doubt as to the wisdom of a final judgment. I must confess that I myself have often been confused by the conflicting claims, and I think the paper which has been presented to-night will aid every engineer in settling these oftentimes puzzling questions.

The conclusions which Dr. Emery has reached in the matter of the use of water power in plants for the electric transmission of power is similar to that which I arrived at some time ago. Before I go into any details, however, I shall ask Professor Forbes—who I see is present, and who by reason of his experience and his present connection should be well qualified, not only to give us his views upon steam plants, but particularly upon combined hydraulic and electric plants—to say a few words upon this subject.

Prof. George Forbes—Everybody, I am sure, must appreciate what enormous importance this paper is going to be to us all. No doubt there are many others here who have been in the same position in which I have been placed in the course of the last year, who have had to make a special examination of this very question, and all those who have had to deal with the utilization of large quantities of water power, estimating the value which that water power is to those who are exploiting it, must have been forced to do what they could to estimate the value of the horse power when developed in the most economical means by steam power. I have in these investigations during the last year had the good fortune to be assisted by the experience of some of the most experienced engineers in this country, including one whom we all respect, who is mentioned by the author of this paper, Mr. Leavitt; and I would only say generally that the conclusions which have been come to by myself and those who have given me their assistance agree extremely well with the conclusions at which Dr. Emery has arrived. I must say that Dr. Emery has put the case in a much more general way and much more applicable to a great variety of circumstances that actually do exist in practice than any estimates I have ever seen of the actual cost of the horse-power, and consequently it is possible for us in any particular case that we are considering to pick out the conditions which most nearly approach what is in the case that we are studying. And while I may say that some estimates I have seen of the cost of a horse power per annum, especially on a ten hours a day service, come out a little below what Dr. Emery has produced, I must add that in those cases certain items of expenditure have been omitted, and in the cases where a lower estimate has been arrived at the compiler has been professedly trying to produce the lowest figure which the users of water power would ever have to contend against.

I would feel that it is hopeless without having given a great deal of time to prepare remarks on this paper to say anything much to the point. But I would ask the author one or two questions about it. In the first place as to the cost of the coal I noticed that the heat-producing power of the coal is assumed to be the same in all cases. Now I fancy that these tables may lead to a little misunderstanding in the minds of some. I imagine some one taking up this table and saying: "Now what will it cost us at such and such a place to produce a horse-power per annum? There is coal purchasable at this place at $2.00 per ton. There is also coal purchasable at $4.00 per ton." He will naturally say I will choose the coal at $2.00 per ton. That gives him a certain definite price on this estimate; but, of course, the slack at $2.00 per ton would only produce about one-half the heating power of coal at $4.00 per ton. In giving the price of coal it seems to me it ought to be mentioned what the calorific power of the coal is, and I would ask Dr. Emery whether he has in all these cases considered the calorific power of the coal practically the same.

I would ask Dr. Emery whether he considers that 500 horse power is a sufficiently big amount to be considered. I mean are the standing expenses of a 500 horse-power plant sufficiently divided over the power to make it fair? If you went to 10,000 horse power, for instance, would the standing charges be less in proportion to the horse power, or is 500 horse power sufficient to take up the whole of the value of the fixed expenditure? That is to say, are all the brains and all the bodies that are at work on the plant fully occupied with 500 horse power or would a larger unit modify the result?

I will not take up the time of the meeting with remarks which I feel are not of very great value, and I will only make a few remarks about the supplementary portion relating to water power. The cost of putting in the plant has been taken at probably $140 per horse power without electrical transmission. Now it seems to me it is almost an impossible thing to make a definite estimate like that, the cost of the water power applied depends so entirely upon the local conditions in the first place, and secondly upon the magnitude of them. Where you have got a large head the cost is generally very much less than where you have a very low head. When you have to dam up a river, of course the expense per horse power of the preliminary work is generally much greater than with a waterfall, and of course the cost of the actual turbines is very much greater when we have low heads than where we are using a very considerable head. Another point is that the cost per horse power in the use of water power diminishes enormously with the magnitude of the works. When you are dealing with 100,000 H. P. the cost for each horse power becomes very much less indeed. I should say that this $140 was a price that would be fair for a moderate fall and for very few thousand horse power. But when you come to larger amounts I think it would be considerably less.

The President—I wish to say a few words concerning the transmission of power by electricity over long distances with water power as the prime source of energy. I have always tried to avoid being over enthusiastic in dealing with a commercial question of this character. The habit is too common to assume, now that electric transmission is a possibility, that possession of a water power is necessarily something of a bonanza, and that all that is necessary to convert it into tangible wealth are a few electrical adjuncts. Both the economies and the possibilities in electric transmission are overstated, too many conditions are overlooked, too many possibilities of failure ignored. I made the statement some years ago that it was very questionable whether in an ordinary case transmission from a water power to a city twenty to twenty-five miles away with reconversion in a sub-station and redistribution for lighting or power purposes was an attractive commercial enterprise, and that if a man wished to distribute power in a manufacturing district he would probably do better to put in a well equipped steam plant of large size, well located with regard to railroad facilities, with supply of coal at reasonably low rates, and distributing at a constant potential of 500 to 600 volts, than he would to attempt to replace the steam plant by a system of electric transmission with water power behind it twenty miles away. I believe the general statements which Dr. Emery has given here to-night confirm this conclusion, and that we should avoid expecting to much from the transmission of power by electricity. I am not authorized to make any statement concerning the intentions of the promoters of the enterprise with which the last speaker is connected, but I believe that I am safe in saying that this great development of water power at Niagara Falls, which is so interesting from the standpoint of the hydraulic engineer, is not designed so much for transmission of power to a distance as it is for local transmission and for the local development of manufacturing industries requiring large units of power. The electric railway engineer is frequently called upon to pass upon the question whether for railroad purposes it is possible to use water powers even ten or fifteen miles away from the centres of distribution, and he cannot but appreciate the lack of sound information upon that subject, and the folly of many of the visionary assumptions made by railway managers with regard to this problem.

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[*] Read at the Seventy-fifth Meeting of the American Institute of Electrical Engineers, New York, March 21, 1893. (See ELECTRICITY, Vol. IV, No. 11.)

Prof. Forbes—Might I say, as a sequel to what you have just stated, of course the question of the cost of the work at Niagara we have worked out very fully, and I think I may say that we know what it is going to cost, both the electrical transmission to Buffalo and everything, but you will readily see that it is hardly possible for me to speak very freely about that just at the present time. But as to the question of transmission to a distance, although it is naturally the desire of those associated with it to develop the power in the immediate vicinity, in the meantime the extra cost of transmission to a distance of fifteen or twenty miles is almost insignificant. When the details of these plans are published you will be astonished to see what a very little difference that really does make when we come to the actual machinery that will be put down.

The President—Perhaps I do not make myself sufficiently clear in that matter. Take the case at Buffalo for example; let us see how electricity is used there. There are, generally speaking, the arc and incandescent light plants, the stationary power service and the railroad systems. The arc lamps run on constant current circuits with varying potential. Some of the incandescent lights probably run on alternating current circuits; others run on 110 and 220 constant potential circuits. Railway motors run in a 500 volt constant potential circuit. These various systems of distribution are distinct in themselves. They have practically but one thing in common, that is, they are driven by steam engines. The moment you leave the belt of the steam engine or its coupling and go to the dynamo the character of the transmission is changed. Now to operate these various systems from a distant source of power there is only one thing that is practically possible, that is to substitute for the boilers and engines in the several stations represented by different financial interests, or in some common station controlled by all, motors driven by the electric plant twenty miles away which is in turn driven by turbine wheels. The substitution of the secondary part of this plant is not practicable; it has a character determined by the local demands and conditions. There is undoubtedly a field for the transmission over long distances of large units of power for special purposes, and also under conditions where the cost of coal is prohibitory and where perhaps it cannot be obtained at all, but I think that from a general commercial standpoint the statement I have made will be found correct in practical experience.

I appreciate that Professor Forbes is in a somewhat delicate position in speaking of what is to be done at the Niagara plant, and perhaps I ought not to have suggested so plainly that he was somewhat better posted than most of us as to the actual cost of transmission for the distances in question and for the larger units.

Mr. Samuel McElroy—To an engineer who has been a long time in practice, a paper like this, replete with the study of a profoundly analytical mind, comes not only as a most valuable contribution to its subject matter, but as a characteristic index of the professional progress of the day.

The time when many professional men were much troubled with petty personal jealousies, and with the idea that their shop secrets were their most valuable stock for employment, has happily been changed. The advanced progress of science, keeping step with, but always in advance of, the material progress of the country, and the beneficial results of society life, have done much to improve the systems of mutual help and to broaden the standards of professional service, and the result, as one of various indications, is shown in papers which condense in a few columns a wide range of experimental and practical research and result, for the direct benefit of professional brethren.

We have then, rising above the class which is content with a low standard of work, and adds little to the general fund of information, and the class which dwells continuously in the confined atmosphere of school-boy mathematics, rapidly developing into splendid, aggressive life, the men of true professional dignity, who neglect no details which involve principles, but give principles their true rank. These are the burners of midnight oil; men who love their work for its own sake, and not for what it pays; who are too high minded to waste time in personal jealousies; students too ardent to turn aside for commonplaces, and ever ready to put their most valuable acquisitions at the service of their professional brethren, as such papers as this illustrates.

One of the specially valuable features of this paper is its careful condensation into a brief space of a wide range of experimental practice, and how a wide grasp of such practice simplifies apparently contradictory or complicated conditions every experienced engineer learns the more he learns.

In the feverish spirit of the day, which for want of just this balance of forces tends to run to excess after every new theory, very great waste of time and money is made, which better habits of concrete analysis would have corrected. We go through spasmodic public excitements often which are only spasmodic. Not so very long ago, the whole railway world was astir over the merits of the " broad gauge " railroad track, and trunk lines like the "Erie" and others must have six and seven feet gauges. Some years after, the same fever ran to a three and a-half feet gauge; and it is only lately that common sense has brought our general railway system into standard gauge, and even this the pedagogues of the profession are continually tampering with.

The question of cost of steam power in itself, and as developed by different classes of engines adopted, or now being adopted, is here carefully analyzed in its proper commercial condition. Steam power, we see here, means something more than a boiler, a cylinder and a line of shafting. It means not only boiler plant and cost, with all the accessories; not only engine plant and attachment; engine house, chimney and appurtenances; coal supply, combustion rate and cost; but other conditions are important. There are daily operation as to running time; relative engine friction; pressure economy; feed water temperature, evaporation, spare pipes and valves; repair, depreciation, supplies; interest on construction and plant; inspection, insurance, taxes, dividends, surplus power and like conditions, which enter into the general problem of use and cost, and are here carefully analyzed and tabulated.

As to these analyses, their basis of arrangement is so clearly explained that special corrections for special cases can readily be applied.

As in my own expert practice I have frequently been required to demonstrate the economy, fitness and special value of water power, if I should venture any opinion on the valuable analysis here made, of comparative steam and water power, it would be to say only this:

That it is quite certain that water falls and flows to the sea by gravity much more cheaply than coal can be mined, and is likely to outlast coal; that water power plant is far less expensive, as a rule, than that of steam, and its daily care much less expensive; that at the centres of such power, Lowell, Lawrence, Holyoke, Cohoes, etc., their common annual rental of about $20 per H. P. (ordinary mill day) has induced the most elaborate outlay of capital, and resulted in very remunerative income.

I think, therefore, that on general analysis water power does not cost as much as steam. While it must be admitted that very expensive reservoirs and other structures, as at Lowell and Lawrence, aggregate what Dr. Emery's analysis shows; yet at Lowell the "Central Pacific" mill prefers in low runs to pay $60 per H. P. for surplus water to using its own steam plant; that for somewhat large consumption of special power, $3.00 per week is a common steam power price at Lowell, Boston, New York and other places.

The estimated cost of development on the Hydraulic Tunnel of Niagara is about $2,238,750 for a capacity of 119,000 H. P., or about $10.50 per H. P., for slopewalls, cribs, races and gates, and tunnel. The rates, as published, are for 5,000 H. P. and over, $10 per H. P. per year; 4,500 H. P., $10.50; 4,000 H. P., $11, down to 300 H. P., $21. On the old Hydraulic Canal, powers have been leased as low as $4 for 600 to 1,000 H. P., and $5.30 for 250 to 300 H. P. Such leases are, of course, improperly cheap, as are, in fact, the general rates of the new tunnel.

On the Kennebec River, Maine, I found a working power, at Carritunk Falls, under 28 feet fall, of about 7,000 H. P. This river, on its upper basins, has remarkable natural reservoirs of about 229 square miles, with about six feet available storage, in a main basin of 2,860 square miles. A main dam of 80 feet controls the flow, and nature has singularly formed the races and wheel pit; so that the cost of these items is much less than that of Niagara.

In cases like this, then, the superior economy of water power must be conceded; and in pulp mills, as at Carritunk, the large quantity of water needed is also an important item of cost.

These, however, are not criticisms on the elaborate and most valuable paper of Dr. Emery; they furnish modified conditions of use, which no engineer will apprehend and appreciate more thoroughly than he.

Mr. J. F. Holloway—I read with pleasure the paper that Dr. Emery has prepared, and I want to say that I agree heartily with my friend, Mr. McElroy, in the complimentary remarks he made about the paper. The paper is one that will be of great value to mechanical as well as electrical engineers. It is evidently the result of a great deal of study and care on the part of the author, and in its result it is to some extent surprising; and yet, after all, it coincides very closely with ideas that I have had all of my life—that this is a world of compensation, that we do not get all the good things in one place without having to take some other things that are not quite so good.

The results he shows are as between the more common and the highly refined engines, and the ultimate results that are shown in his paper are not so widely different, and that will be, I think, a matter of some surprise to many, until they investigate the matter in the direction and to the extent in which Dr. Emery has investigated it. The common idea is, that to get the best results you must get the most refined mechanism, and considerable money is often spent in that direction without knowing how much in other respects the total value of the saving is brought down to the results obtained by the plainer and more common machines.

Prof. John H. Barr—I came down here this afternoon to hear the third reading of this paper. I had the privilege a short time ago of hearing a dress rehearsal of it, and read it to-day on the cars. I hope this, however, is not the final reading as it is one of the things that grows on me.

I noticed a reference to the condition of affairs at the Calumet and Hecla mines. My first engineering experience was gained at the Calumet and Hecla mine, and while I was there in a subordinate capacity and perhaps not entirely competent to judge of things, I think it quite probable, if not certain, that the conditions have by this time been so modified that a different policy might be pursued with economy, so far as distribution of power is concerned. The great work done at Calumet by Dr. Leavitt is of the highest interest to engineers, and if he has kept his eye rather constantly on columns *c* and *f* of the table given in this paper, it can be said that few men have done as much with a pound of coal as he.

The Falls of St. Anthony is cited as an exceptional case where nature has greatly favored the locality in water power; and while its water power had a very important influence in the development of the city located near it, I doubt if its present influence is as great as most people think. I believe that steam mills at other places can now compete on very fair terms with the mills on the water power at St. Anthony. The supply of water is so variable that all the more important mills have to have large steam plants—steam plants sufficient to practically run the entire mill. The interest, and all costs except running expenses, go on for this part of the plant whether the mill is run by steam or water. The cost of labor also is largely maintained whether run by steam or water, because the engineers have to be employed throughout the year in order to have them when needed. The value of land and high taxation, or rent, put these mills at a disadvantage, largely compensating the gain due to running by water part of the time.

Mr. C. O. Mailloux—In regard to the utilization of water power when used to generate electricity to transmit to a distance, there is one factor that appears to me to be of importance as affecting the question whether a given transmission scheme is financially practicable or not. I refer to accessory machinery and apparatus, particularly that needed for regulation and control, the importance and the cost of which I think are often underrated if not neglected in making estimates on the cost of machinery necessary to utilize the energy of water power by transmission to distant points. What would be the result when transmitting 5,000 horse power electrically, from a generator driven by a turbine, supposing the load was suddenly and totally relieved by the circuit being opened through a main fuse blowing out, or a break in the wire, or supposing it were suddenly thrown on without giving time for the governor to act; or again, suppose the load were constantly fluctuating as it does on most railroad circuits. It occurred to me that something would happen of interest to science and possibly the coroner also. We can hardly have fly-wheels sufficiently large to take care of these fluctuations, as they must be of enormous size.

I have always found the principal difficulty of electrical transmission projects to be to dispose of the electrical energy after it is transmitted, and especially to distribute it or deliver it to the consumer in a satisfactory manner.

Prof. Forbes—I would say that in the case of the Niagara transmission that question has been thoroughly threshed out and we have got a fly-wheel, not at all gigantic in comparison with the revolving armature, which completely takes care of that. In two seconds the regulator will have acted and the fly-wheel will have taken care of it up to that time.

The President—I think in the larger plants where five or six thousand horse power units are used there will be less difficulty possibly than is anticipated, because as a rule, where transmission from a single source of such large units to distributed work for stationary purposes there is a certain averaging up of the duty which will prevent such sharp variations of the load as have been indicated, and hence I do not think there will be so much difficulty on the large water power transmissions; still, these variations have to be guarded against and it is more difficult to meet them in a water plant than in a steam plant.

Dr. Emery—It is unfortunate that the paper is so long that few have had time to study all the points in their different bearings and relations to each other, and I am quite sorry that one whom we esteem so highly as Prof. Forbes should have received a copy only an hour before the meeting. I should have been very much pleased to have his remarks, excellent as they were, based upon a more thorough study of the paper. I quite agree with him on the point he makes in regard to the quality of the fuel. This matter should be emphasized in every way. At the same time it is not neglected in the paper. I will read Section 25, page 111, upon that point:

"In column *m* is shown the weight of water which it is assumed will be evaporated per pound of coal. The assumption is 8½ pounds, except in the last case where it has been fixed at 9½ pounds. Although 9 and 9½ pounds evaporated can be obtained under actual conditions readily with boilers of good proportion and construction, it is thought that 8½ pounds is as much as can be depended upon in average practice. It is, in fact, greater than is obtained in most cases, though less than is claimed in exceptional ones. This rate must be considered somewhat in relation to the price of coal. If cheap coal is to be used which will not give 8½ pounds evaporation, the results must be sought in the column of the table applying to coal of a higher price."

The last clause of the quotation, it will be seen, exactly covers the point made by Prof. Forbes in regard to cheaper coals. They will not give 8½ pounds evaporation. The better grades of anthracite coal of buckwheat size will rarely evaporate over 8 pounds of water from actual pressure and temperature, and for the poorer qualities 7½ pounds or even less can only be depended upon. If, therefore, such coal cost $2.00 per ton, the results in the table should be mentally interpolated between those for $2.00 and $3.00 per ton. A glance at the figures in the two columns will show that any such difference will not appreciably alter the relative performance of the different engines if the same coal be used in all cases. The absolute results for a particular engine would of course be changed.

The next question is whether or not 500 horse power is a sufficiently large unit for general consideration. Prof. Forbes did not use the term unit, but I think that will express his meaning. I used 500 horse power as being more generally applicable than a larger unit. It is in fact much larger than the average, but sufficiently large to secure maximum performance in the engine. The results would not be materially changed if we were to consider larger plants as multiples of a 500 horse power plant. The cost of fireman would not change at all, and though one engineer on watch might care for an engine of more than 500 horse power in a large plant, a chief engineer would also be employed at a higher salary, so that the labor account would not be greatly modified. The table is therefore about right for any large plant.

Prof. Forbes—For how small a plant is it right?

Dr. Emery—I do not think that the operating expenses of a steam plant of 2,500 horse power or containing several units of that size would vary from one of 500 horse power, or made up of several units of that size, sufficiently to predict in advance which would have the advantage. As already stated, one engineer on watch would take care of more horse power in large units, but the number of men required to do the overhauling on the spare engine and the salary of a chief engineer or general superintendent would balance, or more than balance, the apparent saving for attention. For electric lighting work the principal saving due to the use of 2,500 horse power or other large units would be in the cost of real estate and buildings. In New York City, for instance, the area is limited, land is high priced, and the larger units take less floor space, so that considerably more engine power can be crowded into the same space, and this may make considerable saving in first cost.

Prof. Forbes, in the short time he has had to examine the paper, has not quite understood my first remarks in relation to the cost of water power. Moreover, the preliminary statement in the supplement to the paper is necessarily incomplete and was rendered much more so in attempting to abstract it. Prof. Forbes says: "The cost of putting in the plant has been taken at probably $140 per horse power without electrical transmission." I wished to be understood that $140 per horse power was about the maximum amount that could be expended to develop a water power on a 10-hour basis in competition with steam, and I showed that the expenditures on the Merrimac had reached this sum and that if they could be recalled they would not now be warranted. It was not intended to intimate that water power could not frequently be developed for a less sum.

It will be observed that I have not attempted to discuss the details of electrical transmission. President Sprague has pointed out the nature of the difficulties. I, however, desire to call attention to the fact that the method I have adopted is the proper one. The total cost of plant to deliver the power from the waterfall to the work to be done, which I typify as a jack-shaft, cannot, in competition with steam and cheap coal, greatly exceed $140 per horse power on a 10-hour basis and $200 and upward per horse power on a 24-hour basis. This cost of plant includes, first, the original investment in the general development of the water power which to the consumer may appear as rental charged by the water power company; second, the cost of installing turbines and dynamos to generate the electric current; third, the cost of the electric line, and, fourth, the cost of the motors which turn the wheels, or the illustrative jack-shaft, at the point of delivery. *The motor must be included in the cost*, as then only is the result comparable with steam power on the basis shown in the table. The comparison is independent of the work done by such jack-shafts, as in either case it can be employed in generating electric current at lower tension for general distribution, or utilized directly to operate large mills or manufactories.

I trust that further discussions may be sent in by manufacturers and engineers to whom the paper has been sent, and will be specially obliged for any information tending in particular cases or under particular conditions to modify the statements as to costs and prices given in the paper as a basis for comparison. I have been assured this evening by the operating superintendent of an electric station, who does not wish to rise, that my estimates of the cost of supplies, repairs and renewals is too low to apply to high speed engines of large size operating electric plants. This is an important point which I hope will be fully elaborated by those at liberty to talk freely on the subject, as it may show the desirability of using engines of fairly slow speed rather than the cheaper ones running at high speeds compared with their size. Engines of the old slow speed type are now run much faster than formerly, and it may be that a compromise class of engine will soon be designed to which neither of the common names can be applied, which will be cheaper than the slow speed engine and yet not run so rapidly as to cause the difficulties which some have experienced with certain types of high speed engines.

The President—I had intended to point out, which I will now do very briefly, that it is most important in considering the transmission of power by electricity from original water power plants that the conditions of construction under least cost should be considered. Some few years ago I prepared a paper which was read before the Franklin Institute which brought up that question. The conditions were given for continuous current transmission, although they would probably need to be modified for alternating current transmission, and I presume the same general laws will hold.

Removal Notice.

After May 1, Mr. George Cutter, and his large line of specialties, will be found at 851-855 The Rookery, Chicago. An increased business has rendered larger quarters a necessity.

Captain William Brophy.

This gentleman, whose portrait we herewith publish, is entitled to rank as one of the best known and most highly esteemed men in this country. For many years he has been identified with the insurance interests, and at the present time is electrical engineer and inspector for the Associated Factory Mutual Insurance Companies whose headquarters are in Boston.

Ever since the introduction of electric lighting and power on a commercial basis, Captain Brophy has occupied a similar position, and it is no exaggeration to say that there are few men in the country better equipped with practical knowledge of every branch of the electrical business, while as an insurance expert he has no superior.

CAPTAIN WILLIAM BROPHY.

In the pursuance of his business and the discharge of his responsible duties he has had to travel all over the United States, and it is doubtful if there is a large electric lighting or power plant anywhere which he has not visited, inspected and reported upon.

In connection with that whilom useful organization, the New England Electric Exchange, which did such valuable work a few years ago, Captain Brophy was one of the moving spirits. He aided in its foundation, and took an active part in its administration to the end of its career.

Many of the young men to-day occupying responsible positions as superintendents and managers of central stations or isolated plants are deeply indebted to Captain Brophy for the valuable assistance they have from time to time received from him in the way of instruction and encouragement, for he has a sincere love for young men who are capable and ambitious, and we know of many who can testify to the kindly manner in which they have been helped over difficulties, had problems solved for them, by this veteran worker in the two important fields of electricity and insurance, while investors, capitalists and property owners everywhere esteem him highly for the valuable assistance he has always rendered in bringing about reforms and improvements in the art and practice of installing electrical apparatus of every kind so as to secure the highest efficiency and economy in service with a minimum of risk to life and property.

Captain Brophy has a very happy faculty of lucidly presenting statistics, arguments and explanations pertaining to his business. He has read many excellent papers at electric light, power, street-railway and insurance conventions, which are entitled to rank in their published form among the most valuable contributions to the literature of electricity and insurance. In the present issue of our journal will be found his latest utterance on "Fire Hazards of Electric Lighting," a paper which was read before the Boston Society of Arts on Thursday evening, 13th inst., and evoked an interesting discussion of the subject now engaging so much public attention.

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European Lighting Practice.

Mr. W. S. Barstow, of the Brooklyn Edison Company, who has lately returned from an extended trip abroad, taken in company with Mr. C. L. Edgar, of the Boston Edison Company, for the purpose of making a thorough inspection of British and Continental central station practice, has kindly consented to prepare a series of articles for ELECTRICITY embodying the results of his investigations.

Mr. Barstow is widely known as a progressive central station manager. Many of the ideas which he has gathered will be put into practice in the new Pearl street station of the Brooklyn company which is now building.

It is high time for central station men throughout the country to realize that the Europeans have passed us in many points, not so much perhaps in the main features of the apparatus as in details, which make either for economy or waste as they are properly or improperly arranged. With competition growing sharper each year, and with dozens and scores of cities all but ready to build municipal plants, the course of wisdom for central station men is to do everything possible to reduce the cost of current to themselves, and to lose no chance of gaining practical information, such as Mr. Barstow's articles are sure to contain. It is in this way that the municipal plant craze may be soonest disposed of, and the business of selling current at a profit be put upon a solid footing.

* * *

Figures and Words.

In another column will be found a thesis on the above subject to which we are pleased to give special prominence. It should be clipped out and pasted up in a conspicuous place in every electrical laboratory in this country.

Mathematical errors in the electrical science have been numerous, all-pervasive and hard to kill. They have delayed the progress of the art, have been the cause of many fruitless hours of laboratory research, and to-day are the direct cause of the non-success of many kinds of apparatus. Capitalists who have backed the inventions of men who are mathematicians only have invariably lost money until the services of the man who was something more than a mathematician were enlisted.

The expression, "hard-headed men who have not been educated out of their common sense," is worthy to rank with the brightest pearls of language.

It is far from our purpose to urge that mathematical formulas and deductions are useless, and should be discarded. They are essential in their proper place, but they must, in order to be of value, include every factor entering into the problem considered. In many cases deductions have been drawn from mathematical solutions involving a large number of independent variables although such a solution is an acknowledged impossibility. In others there exists a certain amount of empiricism and for the purpose of deduction they are worse than useless—they are pernicious. Having once made their appearance in a reputable technical work, they are accepted as correct by succeeding writers, and are quoted as authority for years after the practical worker has proved their fallacy.

Mr. Edison has said that in his experience whatever has been proved to be impossible by the mathematical authorities has been the easiest invention to produce.

While this is perhaps an exaggeration, more than one instance could be cited in support.

Mathematicians who have been long enough out of college to test in actual experience the deductions which they were taught to believe in as containing the very essence of truth have had their idols broken, their faith shattered, because of the mistaken applications or fatal omissions in their calculations.

While it would indeed be sacrilege to say anything "disrespectful concerning the multiplication table," it should be used as the wise physician uses his formula of drugs—with great discrimination. And as in many cases the physician renounces drugs, and recommends pure food and wholesome exercise, so in electrical work mathematics should often be laid on the shelf and common sense be given full swing.

* * *

Alternating Current Distribution.

The advantages which are offered by the alternating current for transmission over long distances are so obvious that this system has become thoroughly established in central station work in spite of the drawback which it has felt from the lack of a satisfactory motor for existing lines. At present the multiphase systems seem to point to the solution of this question, and considerable work in this field is being done both in this country and abroad. Elsewhere will be found a description of such a system which is being operated in Pittsfield, Mass., from which both lighting and power are run on the same circuits.

The motor business has grown to be a large factor in central station work and is especially desirable as it falls during the day run when the dynamos are only called upon to operate a few lamps. The load diagrams of the average central station show that the chief output of current is confined to perhaps five or six hours a day, and during the remaining time probably not over ten or fifteen per cent. of the capacity of the station is utilized and the efficiency of the system is considerably reduced.

Besides this, the distances which can be economically reached by direct currents of the pressures ordinarily used for lighting are limited by the cost of copper to five or six miles, so that to supply power by direct currents beyond that distance requires special machines and separate circuits.

The multiphase alternating current can be used for lighting alone as well as the ordinary single-phase current, and is specially adapted to power transmission from central station as this can be run on the same circuits with the lamps without introducing any serious complications.

In the plant mentioned above, the two-phase current has been chosen as the most simple of the multiphase type, and because the two outside wires of the system may be connected at the switchboard and used as one wire if it is desired to throw the circuit onto a single-phase machine.

The weight of wire necessary for this system is also considerably less than that used in the ordinary single-phase system for the same load and drop.

The transformers for lighting should be divided about evenly between the two sides of the system, but are not necessarily exactly balanced, as a difference of load does not affect the regulation. It is for this reason more easily operated and less troublesome than the three-wire system.

The present transformers in use for lighting can be used by breaking one of the connections and making connection to the third wire. Where motors are needed, a special transformer is put up with connections made to all three wires.

* * *

The Situation Up to Date. The victory of the Columbia Lamp Company at St. Louis is far-reaching in its effect on the general business. It means the breaking down of the Trust's lamp monopoly before it was fairly established.

The evidence introduced was of so conclusive a character, it seems unlikely that it will be ignored by Eastern judges when motion is made to reopen the factories which have been closed under proper bonds for the protection of the owners of the Edison patent.

Judge Hallett's decision places the independent interests in as strong a position as they have ever occupied, and with the overwhelming sentiment of the community at large in favor of dealing with independent concerns in preference to a Trust, the downfall of the Electric Trust is practically settled.

The publication of a vague and unsatisfactory statement of its condition has unsettled the confidence of its Boston backers, and General Electric's stock on Saturday last touched the lowest point since the organization of the company. With the tide of business turning steadily away from the Trust, a reduction of the dividend rate must soon be announced.

The General Electric Company will soon be compelled to assume its proper place in the field —merely that of one company among many, striving to sell its own goods. Its claims to exclusive rights are already a laughing-stock.

The outlook is bright for honest business methods, and very dark for Monopoly with its ten-year contracts.

* * *

If the money which has been spent in the attempt to sustain the Edison lamp patent had been spent in perfecting the Edison lamp, central station men and consumers would not have had so vital an interest in the production of non-infringing lamps, or in upsetting the Edison claims.

* * *

If Brother De Camp, of Philadelphia, is confronted with a municipal plant by-and-by, we wonder if he will be able to discover the reason why such a move on the part of the city became a necessity? The news from Detroit points a moral to every combine in the lighting business. It should be heeded. And the Detroit combine was fairness itself compared with the Philadelphia Trust.

Burst the hewgags, split the drums;
Lo, the day of justice comes!

* * *

The Columbia Lamp Company put up their money and made their fight, almost unaided, and against the judgment of nine out of ten men in the trade. Mr. Rhothamel led the forlorn hope, and he has won.

* * *

It will be in order now for the Buckeye Company to announce that they have resumed the manufacture of incandescent lamps and are ready to take orders and make shipments.

* * *

We salute Messrs. Peale & Packard. They held the fort like old soldiers.

* * *

Monopoly has a pain in the back.

* * *

The pirate Bernstein and Thomson-Houston lamp factories may now continue unmolested.

* * *

If Columbia lamps are lawfully made in St. Louis, why can they not be lawfully sold in New York or Philadelphia?

* * *

" O frabjous day, calloo, callay ! "

Trolley Patents Issued.

" Will Astonish the Public."

An inspired Associated Press despatch from Washington reads as follows :

"It will probably astonish the public to learn that, although thousands of trolley electric cars are in operation throughout the United States, and have been for several years, the question as to who was actually the inventor of the trolley is one which has been a subject for contention and litigation before the Patent Office for several years, and that during this period several claimants for this honor have been contesting for the issuance of patents thereon for which applications were made long ago.

"The question as to who was actually the inventor has at last been practically settled by the issuance to the Thomson-Houston Electric Company, as assignee of Chas. J. Van Depoele, of two broad foundation patents covering the trailing trolley, so-called, which is what is known in connection with electric railways as the trolley. The General Electric Company, into which the Thomson-Houston Company was merged something like a year ago, will become owners of these patents, the possession of which, with other patents upon the same device previously granted to Chas. J. Van Depoele and assigned to the Thomson-Houston Company, will practically give them control of the use of the trolley throughout the United States, and the issuance of patents to them is considered a great victory for the General Electric Company, and one from which must result increased earnings to the company."

It will indeed astonish the public when they learn that all these statements are correct. But they have not yet learned it.

It usually takes further proceedings than the *issuance* of a patent to establish fundamental claims, and still further proceedings to exact royalties.

One thing, however, that does not astonish the public is, that the General Electric people are making a desperate effort to steady up a tottering stock market.

The despatch above mentioned also states that Mr. Van Depoele " had become a comparatively rich man *through the generosity* of the Thomson-Houston Electric Company." This is, indeed, astonishing.

Trolley Magnates in Town.

John A. Seely, the head of the firm of John A. Seely & Company, railway constructors and trolley road equippers, of New York, and Edwin S. Perot, Cornelius Gallagher and James P. McQuade, of the National Construction Company, New York, who are also officers of the Norristown Passenger Railway Company, are in town to-day on business connected with the trolley.—*Norristown (Pa.) Times.*

Detroit Electrical Works.

Final Attempt to Raise Money.

The secretary of the Detroit Electrical Works, Mr. Joseph E. Lockwood, has sent out to the stockholders a detailed statement of the present financial status of the company, and suggesting three or four plans for raising money.

Our advices from Detroit are to the effect that nothing short of a receivership can re-establish confidence and pull the company out of the hole into which it has been dragged by the incompetency of the present management.

Appreciative Employees.

F. S. Terry Banqueted.

A very pleasant surprise was given to Mr. F. S. Terry, of the Ansonia Electric Company, at Chicago, on the 19th inst., by the heads of the various departments under him. The surprise consisted in a banquet at the Union League Club Rooms and the presentation of a very handsome gold embossed morocco autograph album, containing the individual signatures of the donors.

The Hon. George B. Shaw presided as toastmaster, and in a very neat speech presented the gift.

The event was occasioned by Mr. Terry informing his employees that each one would be given two weeks vacation and every Saturday afternoon to see the World's Fair.

Among the invited guests were John R. Fletcher, J. B. Wallace and B. F. Freist.

The Trust in Philadelphia.

The Legislative Committee appointed to investigate the Electric Light Trust in Philadelphia was in session last week, and proceeded with the examination of witnesses. All the members of the committee were present, Major Samuel A. Losch, of Schuylkill County, presiding.

There were many interesting developments in the testimony, showing how companies had been frozen out and the city territory parcelled out to avoid all competition.

The committee has not yet completed its report.

The Chicago Consolidation.

The Chicago Edison Company and the Chicago Arc Light and Power Company have taken formal legal action to confirm the consolidation of the two companies. The consolidation was practically concluded some three months ago. The new company will be known as the Chicago Edison Company and will have the same officers as the old company by the same name, but will be managed by C. H. Wilmerding, former manager of the Chicago Arc Light and Power Company.

A Clean Bill of Health.

The Statement Was Correct.

(Boston Special in Wall Street Papers.)

" In view of the appearance of a *scarlet-colored pamphlet* on General Electric written in the interest of bears on the property, it may be well to state that some time ago the board of directors constituted Messrs. Henry L. Higginson and T. Jefferson Coolidge, Jr , of Boston, and H. McK. Twombly and C. H. Coster, of New York, a committee on accounts, and it is this committee that has had full charge of the General Electric accounting, and they have devoted a great deal of their time to the subject and have placed the General Electric bookkeeping upon a most conservative basis."

The case must indeed be desperate when Mr. Coffin will allow a statement of this nature to be made with official sanction.

The time was when Boston believed Mr. Coffin. How long is it since it became necessary for four of his business associates to guarantee that Mr. Coffin had told the truth ?

Grosvenor P. Lowrey.

Grosvenor Porter Lowrey, senior member of the firm of Lowrey, Stone & Auerlach, was striken with apoplexy shortly after 6 o'clock on Thursday night last at his home, 121 Madison avenue, New York City, and died at 9:30 o'clock that night. Mr. Lowrey came of an old Dutch family, and was born in North Egremont, Mass. After receiving a common school education, he studied law under Andrew H. Reeder, at Lafayette College, and was admitted to the bar in 1854. Kansas was made a Territory in 1854, and Mr. Reeder was appointed its first Governor by President Pierce. Mr. Lowrey became Gov. Reeder's private secretary, and accompanied him to Kansas. It was at the beginning of the struggle which resulted in Kansas becoming a free State. Gov. Reeder and Mr. Lowrey were Free State men. During the temporary triumph of their opponents they and many other Free State men were indicted for treason, and they fled from the State in 1856. Returning to the East, Mr. Lowrey engaged actively in the support of John C. Fremont, then running for the Presidency. During the session of the New York Legislature in 1856-7 he was the Albany correspondent of the New York *Evening Post*, and in the following spring he settled in this city as a lawyer, entering the firm of Porter, Lowrey, Soren & Stone. Ex-Judge John K. Porter was the head of this firm for many years.

In the course of his career Mr. Lowrey had been the legal adviser of many great corporations, among them being Wells, Fargo & Company, the Western Union Telegraph Company, the Gilbert Elevated Railroad and its successor, the Metropolitan Elevated Railroad Company, the B. & O. Railroad Company, the B. & O. Telegraph Company and the United States Express Company. He became acquainted with T. A. Edison through his connection with the Western Union Company.

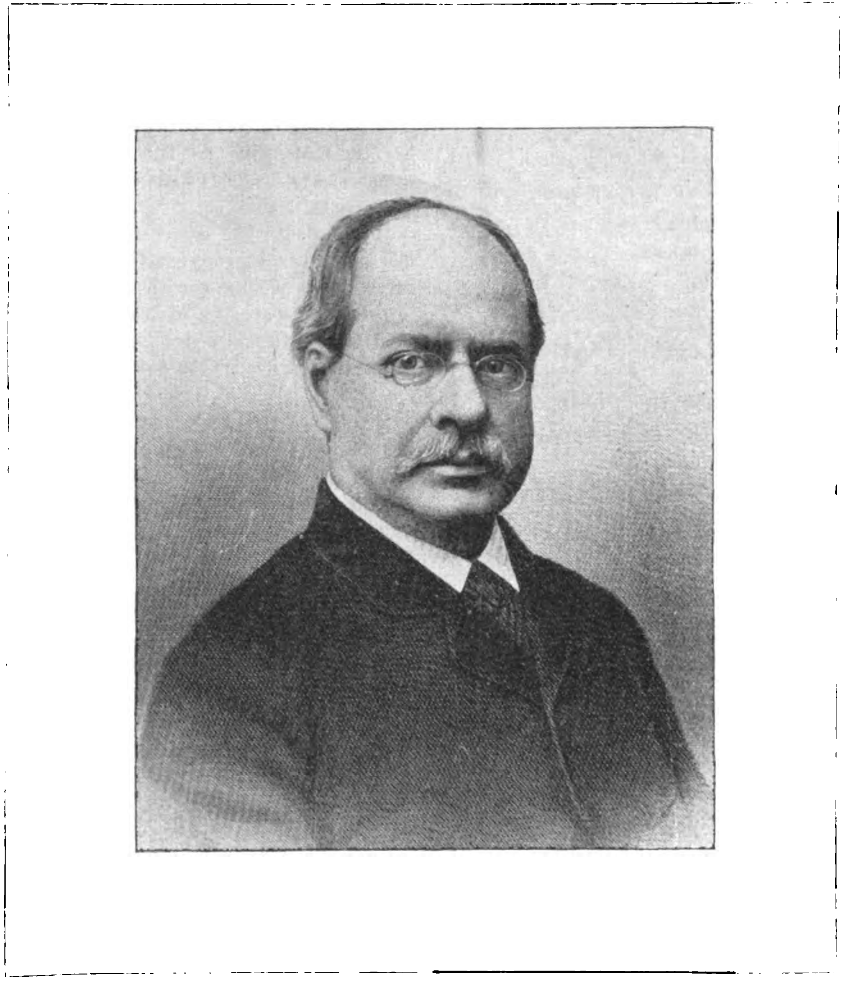
He was associated with Allan G. Thurman as counsel for the United States Government in its unsuccessful effort to break the Bell telephone monopoly's patents a few years ago, and did all the legal work in connection with the establishment of the New York City and Northern Railroad.

He wrote considerably upon professional subjects. One of his pamphlets, "English Neutrality," relating to the Alabama and other Confederate cruisers built in English ports, was the first of the inquiries into British responsibility in this matter which led to the award of damages.

The news of his death was announced in the U. S. Circuit Court by Elihu Root, and the court adjourned in respect to his memory, as did also several of the other courts in session in this city.

Mr. Lowrey was one of the original incorporators of the Edison Electric Light Company, in 1878, and a member of the first Board of Directors. He was up to the day of his death the mainstay of the Edison interests in their legal proceedings, and had won several strongly contested cases involving the validity of the Edison patents. His strength as an advocate in these cases was perhaps due, more than to any other reason, to his unwavering faith in Mr. Edison and his work.

Mr. Lowrey was a man of charming personality in social life, and maintained not only the respect but the admiration of those who were honored by association with him.



Grosvenor P. Lowrey.

The Rutland Electric Light Company, of Rutland, Vt., has secured a perpetual injunction restraining the Marble City Company from erecting its poles or stringing its wires so as to interfere in any manner with the poles and wires of the plaintiff company. The decree of the court, which also provides for the appointment of a master to determine the amount of damage sustained by the Rutland Electric Light Company by the Marble City Company's infringement on their rights and property, has been confirmed, with an order for removal of all conflicting wires and poles of the Marble City Company, by the Supreme Court of Vermont, Chief Justice James M. Tyler presiding.

Figures and Words.

(*From the New York Sun.*)

Arithmetic will have its praises chanted in a Mathematic Congress at Chicago louder than ever before in this country. With united breath the International Statistical Association and the American Economic Association will hold sessions for seven days, with many foreign statisticians of eminence to help them. Much will be said by these men of figures as to the ways in which statistics should be gathered. Albeit we should say nothing disrespectful concerning the multiplication table, we trust that as to the common sense needful in using that instrument something will be spoken in this notable convocation.

Once upon a time there dwelt in Yorkshire a schoolmaster under whose care was a boy apparently so dull as to be the butt of his class. In the teasing of that boy the master was mean enough to join. Calling the urchin to him one morning he said: "Tommy Jones, I have a very simple question in arithmetic for you, and dull as you are I think you can answer it." "Yes, please, sir." "At the baker's near by they sell penny buns, don't they?" "Yes, please, sir." "How much would two of them come to?" "Dunno, please, sir." "You don't know, you little donkey; aren't two penny buns always tuppence?" "No please, sir; they—sell—'em—two—for—three—ha'pence—when—the're—stale." And the flogging which threatened Tommy Jones was omitted.

If in regard to a minor article of diet it be necessary to take account in one's arithmetic of a perturbing fact such as staleness, how much more needful is it that we should proceed cautiously, circumspectly, tentatively, when the objects of examination are the perplexities of finance, commerce, and social betterment? The official statistician of Scotland found the death rate among unmarried men to be exceedingly high. Therefore, said he, arguing for the establishment of families, bachelorhood is more destructive to life than the most insalubrious trades, or than residence in the most unwholesome houses or districts. This man's heart was in the right place, no doubt, but his eyes saw only a little of the evidence before him. He failed to observe that men of extremely bad health or habits, or sunk in direst poverty, rarely aspire to the wedded state; and that, if one courts a girl, he is exposed to a very natural rejection. Their liability to premature death is the cause and not the consequence of their singleness.

Pitfalls of another sort spread before him who holds figures so close to his eyes that he cannot see facts a little further off.

To come to the case of honest labor: we are told by the census returns, and truly, that wages are higher now than a generation ago, while in the main a dollar buys as much as it did then. But as to how much more the workman wants to-day than he did thirty or forty years ago, we are uninformed. What schedule, however ample in width or minute in interrogation, can seize upon all the facts required to prove or disprove, statistically, the policy of protection or prohibition? Mr. Carroll D. Wright, Commissioner of Labor at Washington, has seen the task attempted many times; he is fond of saying: "Figures won't lie, but liars will figure;" and no less a man than the Rev. Edward Everett Hale is wont to give the noun, lies, a grammatical comparison thus: "Positive, lies; comparative, damned lies; superlative, statistics." Because calculation is legitimately applied in many ways, let us not imagine its conquered empire to be universal.

As with figures, so with words. Speech is one of the faculties which difference man from brute; it is the handmaid of reason. And yet language brings with it liability to a copious source of error; we are ever prone to overestimate the proportion of thought which can be put into words.

Among hard-headed men who have not been educated out of their common sense there has always been a conviction that the logicians overrate the importance of what can be definitely argued about; that, as theorists can never take account of all the facts, no theory should be held with other than a loose hand. Such men may not be learned, but they are wise, for they never gloss over a difficulty with a verbal simplification. They may carry in their memories a scanty store of the guesses and assumptions of other men, but they allow for their ignorance, and so judge much more soundly than if they supposed part of the evidence in the case to be the whole. Something of a spirit of restraint is felt in every court of justice worthy of the name. To law is added equity; and jurists who declare legal procedure in important fields to be beyond improvement well know that there remains the old difficulty of getting truly at the facts. In endeavoring to probe into the play of motive the just Judge finds that motive has its chemistry as well as its mechanics. There are times and places when and where two and two make not four, but five and a quarter.

Investigators of the resources of the human brain are constantly coming upon proof that the wealth which the mind consciously holds is a trifle compared with the treasures it unconsciously possesses. The one is an islet in the sea, the other broad and substantial as an engirdled continent. Science never does worthier service than where, as here, it points beyond the horizon of the known to the depths where words and figures lose themselves in the welter of mystery. Then does she become the mother of a reverence profounder than was ever inspired by microscope or analysis; for she proclaims that beyond their range on every hand stretches the Infinite.

General Electric's First Annual Report.

SECOND PAPER.

A Comparison Showing the Net Results of Eight Months' Business from the Company's Own Figures.

On May 31, 1892, the General Electric Company made application to the New York Stock Exchange to list its common and preferred stock.

A statement was filed on that date, signed by C. A. Coffin, president, and A. S. Beves, treasurer, presumably showing the condition of the Edison General, Thomson-Houston, and Thomson-Houston International Companies at the time of their consolidation into the General Electric Company. These three companies are designated in the present annual report of the General Electric Company as the Underlying Companies.

The annual statement, printed in ELECTRICITY last week, did not show the volume of business for the eight months, or the running expenses. The flat assertion appears, however, that the net profits of the business for the eight months were $3,356,593.10.

A comparison of the two statements, the one filed at the Stock Exchange on the underlying companies May 31, 1892, and the annual statement of the General Electric, shows a totally different result.

Such comparison is the only method for arriving at the actual results.

The following table shows the assets and liabilities of the three underlying companies as they appeared on May 31, 1892, and of the General Electric Company January 31, 1893. The table is compiled from the company's own figures on the different dates mentioned.

This comparison and its deductions are correct.

	Reports of Edison General, T.-H. and T.-H. Int. Cos. filed at N. Y. Stock Exchange, May 31, 1892.		Report of General Electric Co. published Jan. 31, 1893.		
ASSETS AVAILABLE.					
Store room stock	$6,471,441.06		$4,975,760.67 *I*		
Unfinished work in factory	1,183,555.76				
Accounts receivable	8,942,711.65		7,078,879.15 857,244.17 *I*		
Cash	2.752.047.95		3.871.033 58		
Notes	2,825.552.61		5,151,950.64		
Consignment account	72,301.40		8.896.71 *I*		
New inventories, additional			2.076.502.62		
New work in progress, additional			2,207,982.75		
Total assets available		$22,247,610.43		$26,207,750.89	Inc. $3,960,140.46
ASSETS UNAVAILABLE.					
Real estate, Edison Building, N. Y., and other R. E.			$298,726.74		
Patents	$670,905.51		7,628,520.39 *I*		
Plant, tools and machinery, office furniture and fixtures	7,113,654.06		4,199,762.62 *I*		
Laboratory account	73.846.78				
Liquidation account	166,311.43				
Thomson-Houston International Co.	1,121,072.84		1.212.000.00 *I*		
Miscellaneous stocks, sub-cos., etc.	14,181,586.50		9,173 251.87 2.500.000.00 *I*		
United Elec. Security Co's. stock			1,234.870.00		
Manufacturing and other co's. stock			1,580,216.00		
Total assets unavailable		23,326.876.62		27,826,847.62	Inc. 4,499,971.00
Total assets		$45,574,487.05		$54,034,598.51	Inc. $8,460,111.46
LIABILITIES.					
Guarantee account	$200,000.00				
Capital stock	24,970,300.00		$44,663,800.00		
Notes	7,956,808.32		4.554.347.68 3,099,624.92 *I*		
Open accounts	1,112.844.86		691,871.32		
Allowance for depreciation	686.032.91				
Mortgage on real estate	266.200.00				
Dividends unpaid	301.606.00				
Thomson-Houston International Co.	802,098.42				
Total liabilities		36,295,890.53		53,009,643.92	Inc. 16,713,753.41
Surplus after paying dividends		$9,278,596.51		$1,024,954.59	Dec. $8,253,641.95

Decrease in surplus in 8 months	**$8,253,641.95**
Less dividends and interest paid	**2,331,638.51**
Net decrease in surplus for 8 months	**$5,922,003.44**

Items marked *I* taken together represent the investment account of $18,262,060.24.

We defy the controller of the company, or the Accounting Committee, to show any other result from their own figures.

The comparison was made by an accountant of high standing in his profession, a man with no interest in the respective companies nor in ELECTRICITY.

Its accuracy cannot be denied.

In view of this condition of affairs, it is pertinent to inquire, Has the General Electric Company been paying dividends from the sale of stock?

In the Stock Exchange statement the Thomson-Houston patents are valued at **$838,854.29**. In the annual report these same patents are carried at **$3,389,352.07**. Have they increased three millions in value in eight months?

The General Electric Company commenced business May 31, 1892, with $100,000 in cash, of which they paid for expenses $215 and for franchise tax $25,000, leaving cash on hand May 31, 1892, $74,785 and $33,871,500 in stocks of the Edison and Thomson-Houston Companies, for which stock of the General Electric Company was issued.

Now, in the statement of the underlying companies there appear two items, aggregating $16,301,809.76, which, according to the report, were made up of moneys advanced to the Edison and Thomson-Houston Companies and of an arbitrary guarantee against those companies' notes. In other words, this sum of $16,301,809.76 was at one time a liability of the two underlying companies. This liability, so the report states, was wiped out by the General Electric Company, and the amount was deducted from the purchase price of the two underlying companies. How was it wiped out? With only $74,785 of actual cash on hand, how were over sixteen millions of debts paid?

This is a system of bookkeeping which needs explanation.

"The Windsor Hotel party that has been successful in its operations in the general market, has now directed its attention to General Electric, and claims that the stock will be 'put through its facings,' the same as have all others that have shown vulnerability. The buying by Drexel, Morgan & Company apparently has availed nothing, and General Electric, it is said, will sell at 75 this summer.—*N. Y. Mercury.*

Personal.

Mr. H. J. Wendorff, who has been for a long time at the head of the storerooms of the Brush Company, Cleveland, has been appointed Purchasing Agent in place of Mr. L. W. Bradley, who resigned some time ago.

Mr. Wm. Hazelton, 3d, who has been connected with the Short Electric Railway Company for some years, and whose headquarters are in Cleveland, Ohio, has been appointed the Assistant General Manager of the company.

Mr. W. A. Jackson has been chosen as President of the Electric Lighting Commission of Detroit.

Mr. Morris Mead, Superintendent of the Bureau of Electricity of Pittsburg, has received the appointment from Director-General Davis as Assistant Chief of the Electrical Department of the World's Fair.

Dr. F. A. C. Perrine, of Boston, was a visitor in New York last week.

Electric Lighting on French Railways.

The Northern Railway of Paris has recently adopted electric lighting on some of its cars, and twenty-seven first, second and third class coaches have been wired for incandescent lamps. The current is supplied from a battery of accumulators placed under each car, each cell having a capacity of 113 ampere hours. The lamps used consume three watts per candle power and this efficiency limits their life to about 300 hours. They are 30 volt lamps of 10, 8 and 6 candle power according to the cars on which they are used.

The current is carried to the lamps by means of insulated cables and connected by three zinc clips, and switches are attached at the end of the cars for controlling the lights and making connections for charging the accumulators.

The cost of fitting up the coaches is given at $150 and the experiments so far have shown about 10 per cent. less expense than was the case with the oil lamps formerly used.

A Transformation.

Preparations have been completed by which the Telluride, Col., Electric Light Company will hereafter receive power from the San Miguel Consolidated Light Company from their power station at Rives, a distance of twelve miles.

This is perhaps the first instance on record where a Westinghouse system has been called upon to furnish current to an Edison system and with satisfactory results.

"Herr Heinrich Goebel, hoch, hoiero!"
J. W. ORR N.Y.

THE INDEPENDENT BIRD.

The Columbia Lamp Co. Wins.

Goebel's Claims More Fully Established.

An Injunction Denied.

Judge Hallett, of the United States Circuit Court, has refused to grant an injunction against the Columbia Lamp Company at St. Louis.

The final hearing in the suit for a preliminary injunction, brought by the Edison Electric Light Company et al. vs. the Columbia Incandescent Lamp Company, was begun on April 11th and closed on the 14th.

The Columbia Company contended for the prior claims of Henry Goebel, the defense which was first introduced by the Beacon Company at Boston, and with which our readers are generally familiar.

The Beacon Company lost their case through their inability for lack of time to fully substantiate the claims made as to the dates when certain lamps were made by Goebel.

The Columbia Company, with the same able counsel, Messrs. Witter & Kenyon of this city, have worked industriously since the Boston case closed, and seem to have established beyond question the identity of the various exhibits, and to have proved that Goebel's lamps were of sufficient merit to invalidate the Edison lamp patent.

Judge Hallett has held that the evidence is "sufficient probably to invalidate the patent."

The decision is one of supreme importance at this time, and is a thorough and complete victory for the independent element in the trade.

There will be no lamp monopoly.

No one will be compelled in order to get lamps to buy his entire apparatus of the General Electric Company.

Central station men can once again use their own judgment in the purchase of lamps. They will no longer be forced to buy the poorest lamp on the market.

The conclusive proof introduced by the Columbia Company will no doubt be introduced successfully to re-open some of the closed factories, and there will at least be no further interference with the Ohio companies and others not proceeded against so far.

We congratulate the Columbia Company and the trade at large on the result, and the brighter outlook it has produced.

Following is Judge Hallett's decision in full:

THE DECISION.

In the Circuit Court of the United States for the Eastern Division of the Eastern Judicial District of Missouri.

Edison Electric Light Company et al. vs. Columbia Incandescent Lamp Company et al.

Complainants allege infringement of letters patent, No. 223,898, issued to Thomas A. Edison, January 27, 1880, for an improved electric lamp. This patent came under the consideration of the Circuit Court of the Southern District of New York in the case of the Edison Electric Light Company against the United States Electric Lighting Company (47 Fed. Rep. 454), and was held to be for a lamp "consisting essentially of a filamentary carbon burner, hermetically sealed in a glass vacuum chamber." So understood, it is the incandescent lamp in common use, and no question is presented in this record as to the character of respondents' manufacture. The defence to the bill and to the motion for preliminary injunction now under consideration is want of novelty in the Edison patent. Respondents aver that an incandescent lamp, different in form, but in all essential features the same as that now in general use, was made as early as 1854 by Henry Goebel, of New York City, and that it was used by him in various ways and at different times for many years thereafter. It will not be necessary to describe this lamp at length, as it has the same constituents as the Edison lamp. We are at present more concerned with the struggle between the contending forces on the one side to maintain and on the other to disprove the existence and use of the lamp anterior to the date of the Edison invention. A large mass of testimony in the form of affidavits is offered by each party on the question of fact, which to consider at length would be a tiresome and unprofitable task.

The principal objection urged by complainant against the Goebel invention is that it has an impossible date; no man could make it in the time and manner assigned to it; the incandescent lamp is the product of several auxiliary arts not likely to fall within the compass of a single mind; as an achievement of science the lamp is a matter of progressive steps, some of which must be made by the world at large before others can be taken by any one. This is no more than to say that no man can outrun his competitors to any great length in the field of scientific investigation—a proposition which has no support in reason or experience. There seems to be no reason for saying that Goebel could not reach in 1854 a point attained by Edison in 1879 unless, as was said by the dissenting justices in the telephone case: "It is regarded as incredible that so great a discovery should have been made by the plain mechanic and not by an eminent scientist and inventor."

In so far, however, as it may be shown that the methods adopted by Goebel were not equal to the results obtained, the evidence should receive the most careful consideration. On this point it appears that Goebel has recently made several lamps of the form used with the material and tools formerly used by him. These lamps were tested by men of experience and skill in such matters, and they were found to be reasonably effective. They are not so good as the lamps in common use, but they can be operated, and they give reasonable service in time and capacity of light. So that in this way we have prima facie proof of Goebel's ability to make lamps in the way he claims to have made them before the time of Edison's invention.

It is said that Goebel is involved in contradictions and misstatements of fact, due to the lapsing memory of old age or to untruthfulness. Be it so; he does not appear to be an adventurer or an impostor. It is not reasonable to believe that he made the story related in his affidavit and did not make the lamp he has described. Whatever may be said as to Goebel's veracity, he is supported at many points by witnesses of good repute, who speak with precision and apparently with deliberation. As already suggested, it is not necessary or profitable to go over the testimony at length with a view to determine the relative value and weight of every part. It is enough to say that there is a fair preponderance of testimony in support of the Goebel claim.

There is not the measure of proof demanded by defendant's counsel, who maintain that the court should require proof of the fact beyond reasonable doubt. This degree of certainty is not often attained upon testimony in the form of affidavits, where the issue is contested, and it is not reasonable to demand such certainty as to the defense. Complainants must show a clear right in support of a preliminary writ, and a defense which puts the case in doubt is sufficient to defeat the application. It is also contended that the decree of the Circuit Court of New York against the United States Electric Lighting Company sustaining the patent, which decree has been confirmed in the Court of Appeals of the Second Circuit, is conclusive of complainant's right to the writ for which they now ask. No doubt is entertained as to the conclusive effect of that decree here and elsewhere as to all matters in issue in that cause. For although respondent was not a party to that litigation, the court would not on a preliminary motion consider any matter which passed to judgment in that suit. The Goebel defense was not made in that suit, and therefore the case has not the authority on this motion which has been ascribed to it. Another suit by the complainants against the Beacon Vacuum Pump and Electrical Company, in the Circuit Court for the District of Massachusetts, is in a different attitude. In that suit the Goebel defense was made, and upon motion for preliminary injunction recently heard and allowed it was overruled. It is contended that the ruling in that case should be recognized and followed as a precedent in respect to the present motion, and perhaps if the issue, the testimony and the situation of the parties appeared to be the same in both cases such result might follow, more from the persuasive effect of the opinion of another court on the same matter than from any notion of authority ascribed for such opinion. In courts of equal jurisdiction proceeding concurrently in the investigation of the same subject, the right and duty of each to exercise independent judgment cannot be denied. That they should in the end reach the same result is greatly to be desired, but one cannot become an echo to the other for that praiseworthy purpose. In this instance the consequences to flow from diverse opinions are not regarded as serious. In the Massachusetts Circuit, and here as well, the motion is interlocutory; and in each case the ruling may well enough stand upon the situation of the parties. And we have much additional testimony to that upon which the court acted in the

Beacon case, so that upon all points I do not feel compelled to accept the opinion of the court in that case.

The ruling of the court, however, in the Beacon case suggests the propriety of taking security from respondents for observing the decree in case complainants shall ultimately prevail in this suit. There are other considerations which should have weight in that direction. It was suggested by complainants' counsel that respondent is a concern of small capital, and that it was made so with intent to avoid responsibility in respect to the infringement now alleged against it. This was not denied and I suppose we may take it to be true. The retort was in the form of a charge against complainant that it used its monopoly of electric lamps to control the sale of all kinds of electric machinery and apparatus. This charge also passed without denial, and it is not difficult to conceive of circumstances in which it would be necessary to ascertain whether it is true. Referring only to the charge against respondent of insufficient capital and assets, the duty of the court is plain to provide for the contingency of a decision against it. I need not refer to the possible effect of cross-examination in the case of a multitude of witnesses. What now seems plain enough may altogether disappear, and new facts may come to the surface under that crucial test.

The injunction will, therefore, be refused if the respondents will give a bond in the sum of $20,000 conditioned for the payment of such sums (it any) as may be decreed in favor of complainants on the final hearing of this cause. The bond to be filed with the clerk of the court, and to be approved by the clerk, or by a judge of the court within twenty days from this day.

HIS NAME WAS MONOPOLY BEFORE HE WAS LICKED.

Detroit Lighting Matters.

Practical Discussion Before the Council Committee.

A Municipal Plant Probable.

The committee on public lighting of the city of Detroit recently met to consider the question of a municipal plant. Three members of the new lighting commission, Messrs. Hudson, Butzel and Jackson, attended the meeting, as did also Mayor Pingree, Aldermen Vernor and Scovel, Frank B. Rae and the representatives of several large electric companies.

Mr. Rae made some explanations in regard to his estimates,* and a candid reply to the criticisms of ELECTRICITY, which leaves nothing more to be said on that score:

"The figures were obtained from manufacturers of apparatus, and a number of letters have been written to the Mayor and several to myself, stating that the manufacturers of apparatus are willing to undertake the construction, both of the steam plant and of the electrical plant, under this estimate. In the cost of maintenance, by advice of some of the gentlemen downstairs, the question of taxes and cost of water were left out. They were left out upon advice, because it was not at all probable that the taxes upon the present plant will be lost to the city, and the cost of water in the operation of a plant of this kind would cost the city nothing in any event. If the plant were to be located on the water front, as I think it should be, the water would be entirely free to them, as it would be to any other manufactory so located. If they took water from the city, I presume they would hardly be chargeable with any rate for that—simply supplying it from pumps which the city maintains at one station instead of those they would maintain at another station."

The Detroit Electric Light and Power Company did not appear by representative, but sent in a communication, closing as follows:

"Our experience of three years in public lighting has been costly. We know from experience what it takes to run a plant in Detroit, but it appears that the guess of men interested in foisting a plant on the city has been taken as evidence, and cold facts entirely ignored. Hence we deem it a waste of time to attempt an explanation before your honorable committee."

Letters from Messrs. Campbell & Zell and Fairbanks, Morse & Company, of Chicago, were read, in which both firms agreed to undertake the contract for the steam plant within Mr. Rae's estimates.

Alderman Hudson thought Mr. Rae's estimate for the purchase of real estate too low. Discussion brought out the fact that the city might build on its own land.

Mr. Young, representing the Western Electric Company, said that he had looked over the estimates prepared by Mr. Rae and would have no hesitation in furnishing a first class plant, up to standard in every way, for the amount stated in the estimate.

Mr. Cook, a representative of the Westinghouse Company, said:

"The class of machinery which we manufacture would be such as is covered by his estimates Nos. 1 and 2, and I can say that his estimates for the apparatus are certainly ample. As far as the cost of maintenance goes, it can be shaded. We can furnish lamps which will burn for three nights with one trimming. With that class of lamps about a dozen or thirteen men would take care of the trimming. I should consider Mr. Rae's estimates all right."

Mr. Long, representing Westinghouse, Church, Kerr & Company, stated that his company had done a great deal of work in Detroit, and knew about the expenses of doing the work there in the way of masonry and contingent work outside of the mere cost of the apparatus. He was free to say that Mr. Rae's estimates fully cover the very best class of work that could possibly be put in

At a meeting of Council on the 19th, the Commission was authorized to advertise for bids for a complete plant, and also to advertise for bids for lighting the city on a three-year contract by the present system.

A Successful Storage Battery.

Trial of the Waddell-Entz Company's Apparatus on the Second Avenue Line.

A Satisfactory Exhibition.

The first public exhibition of the street-railway storage battery apparatus of the Waddell-Entz Company took place on the Second Avenue line, this city, on Friday, April 21.

The test derived importance from the fact that ten cars similarly equipped are stored at one of the stations of the Second Avenue Company, and also for the reason that it is proposed to operate the road altogether with electric cars of the same design.

The claims of the inventors seem to be fully borne out by this test. In the first place, there was no buzzing, so common in many storage-battery cars; the action of the motors was almost noiseless. Another feature was the extreme ease with which the cars could be stopped. No brake was used, there being simply a reversal of the motor. The cars can be brought to a standstill within the length of the car from a speed of fourteen miles an hour. In this sudden stopping there is no waste of power. On the contrary, the momentum converts the motor into a dynamo, and there is a positive storing up of energy. The car can be run backward as well as forward.

The cars can run thirty miles without re-charging the batteries. The batteries themselves weigh but 2,000 pounds each, two being placed on each car.

The electric plant which has just been completed at 127th street and Second avenue consists of two 100-horse-power safety boilers, two automatic engines of 75-horse power, and two 75-horse power dynamos. From the dynamos the current is led by switchboards on the battery floors. On the second floor is a large electric crane. By a touch two batteries weighing 4,000 pounds are lifted and then lowered to the first floor, where they are transferred to the cars. The old batteries can be removed and newly charged ones put in the cars within two minutes.

The system is the invention of the Waddell-Entz Electric Company, and the entire plant, including dynamos, motors, etc., was made at their works at Bridgeport, Conn. The motors and portions of the apparatus are similar to those put in many public buildings throughout the country.

It is expected that by June 1 the Second Avenue line from Ninety-sixth street north will be exclusively operated by electric cars, and a little later the system will be adopted for the entire line.

The car left the power house at 127th street and Second avenue at 4:27 P. M., and made the run to 96th street with one trailer. The latter was taken off there, and the return trip was made at the rate of ten miles an hour.

In addition to the representatives of the electrical and daily papers, there were present Mr. George S. Hart, the president, and other officials of the Second Avenue road; Mr. Skitt, superintendent of the Fourth Avenue line; Messrs. Knauth, Waddell, Entz, Foot, Machado and Whitman of the Waddell-Entz Company, and several gentlemen from other cities.

Electrical men and the public generally will await further developments in regard to this system with a great deal of interest.

World's Fair Notes.

Two of the five coronas which are to be the principal feature in lighting the large Manufacturing Building were tried for the first time last Wednesday. The initial test was a satisfactory one in every respect, and it confirmed the judgment of the engineers engaged in the work as regards the number of lights for each circle and also the height to which coronas should be elevated above the floor to give an equitable distribution of light.

The official exhibit of the German Government has arrived and is being installed under the direction of Wilhelm Dohn, who formerly occupied the position of secretary of the chief Post Office of Germany. The exhibit will consist of models of the apparatus, both telephone and telegraph, which has been used since the introduction of these instruments into the Post Office service and up to the present time.

A novel exhibit is to be made in the Electricity Building by a Parisian company, consisting of a night scene on Champs Elysee. The miniature thoroughfare will be brilliantly illuminated by small incandescent lamps, and a number of small automatic figures will be introduced which have never before been exhibited in this country.

The space formerly assigned to the Detroit Electrical Works in the Electricity Building has been given to the Westinghouse Electric Company, in which they will be able to make a more creditable display of their apparatus.

The first serious accident which can be credited to the electrical apparatus used at the World's Fair grounds occurred last week. Walter Lanhan, an electric wireman, while engaged in fixing the wires in a conduit, carelessly touched one of the main feeders and was instantly killed.

Among the standing committees announced by President Higinbotham, to act during the coming year, the following gentlemen were named on Electricity: R. C. Clowry, chairman; C. K. G. Billings, C. H. Wacker, C. L. Hutchinson, Mark L. Crawford.

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*See ELECTRICITY, Vol. IV, No. 12, p. 162.

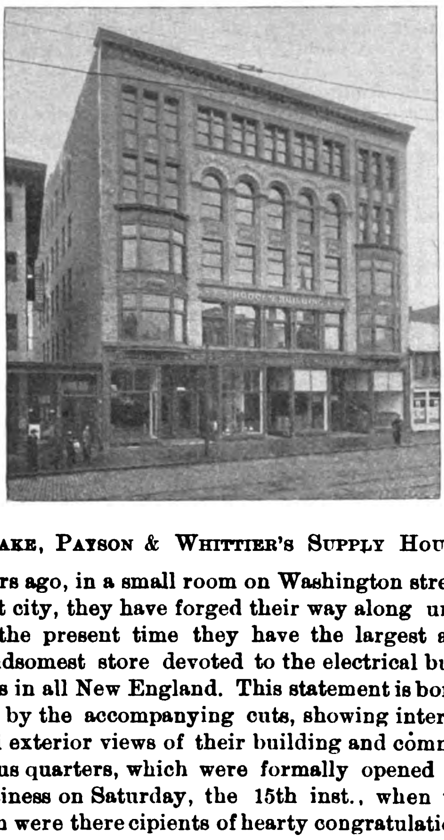
A Successful Trio.

Drake, Payson and Whittier.

Three years ago a trio of young men formed a partnership and went into the business of electrical and constructing engineering in the city of Providence, R. I. They were possessed of ability, experience and aptitude; these, combined with a large amount of energy, push and determination, well fitted them for entertaining the assurance that they were certain to achieve success in their business. They have already achieved a full measure of prosperity, and this article is an outline of what they are doing to increase their business.

Each member of this trio enjoys a wide circle of acquaintance in the State of Rhode Island, and it has always been a pleasure to friends and neighbors alike to encourage these young men by entrusting to them contracts, both large and small, knowing that the work would invariably be well done; and first class work, combined with fair and square dealings, is the secret of all they have accomplished.

The men we thus write of constitute the firm of Drake, Payson & Whittier, constructing electrical engineers and dealers in all kinds of electrical supplies, Providence, R. I.


DRAKE, PAYSON & WHITTIER'S SUPPLY HOUSE.

Commencing business, as we have stated, three years ago, in a small room on Washington street, that city, they have forged their way along until at the present time they have the largest and handsomest store devoted to the electrical business in all New England. This statement is borne out by the accompanying cuts, showing interior and exterior views of their building and commodious quarters, which were formally opened for business on Saturday, the 15th inst., when the firm were the recipients of hearty congratulations from friends, neighbors and customers from New York and all parts of New England.

The building this firm occupies is known as the Hodges Block, being 170-172 Weyhosset street. Here, in the basement, is stored an immense stock of lighting and railway supplies of every conceivable description. Here, too, is the brass finishing department and factory proper. At the remote back of the basement are two 150 H. P. boilers to be used for operating an isolated plant for lighting the entire square of which the Hodges Building forms part.

The ground or street floor is the show and sales room, which is, without doubt, the largest, handsomest and best lighted electrical salesroom in New England. It has a double front, the show windows of immense panes of plate glass being splendidly adapted for displaying apparatus to great advantage.

On entering the double doors the entire right section of the room is seen to be devoted to electrical supplies in general, consisting of bells, push buttons, annunciators, battery cells, carbons, zincs, shades, porcelain goods and electric heaters. In the window on this side are displayed the lighter goods, such as incandescent lamps, globes, wall brackets, push buttons, etc. Reaching along the floor are handsome counters and glass show cases, all filled with choice goods, while the wall is hidden away behind rows upon rows of shelves, drawers and lockers, filled with electrical merchandise.

The left side of the room accommodates, from the ceiling, a large and handsome display of gas, electric and combination fixtures of most artistic design and finish, many of them being selected from the stocks of the Mitchell, Vance Company of New York, who enjoy so wide a reputation for high grade goods of this character.

Extending right along the wall of this section has been erected a switchboard fully equipped with switches, cut-outs, rheostats, lightning arresters and other controlling devices, coupled up with dynamos and motors, installed on a raised platform in position for running at will, that intending purchasers may have actual demonstration of the working of the apparatus or machine they contemplate buying.

At the opening there were no less than fourteen dynamos and motors in position, ranging from a 100-light United States dynamo belted to a 15 H. P. Eddy motor, down to a $\frac{1}{8}$-inch H. P. motor, Eddy type, the display including Eddy, Thomson-Houston, United States and other machines.

Over the switchboard was arranged a handsome display of fan motors including the Meston alternating motor, Perret, Holtzer-Cabot and Clyde types, also some Eddy 500 volt fan motors—altogether making a handsome display and with enough variety for the most fastidious buyer to select from.

Towards the further end of the room on the left side has been built and appropriately fitted up a large dark room, from the ceiling and walls of which are suspended sample brackets and electroliers of most chaste and elegant design. The room is wired and equipped with switches and cut-outs, so that when a purchaser desires to see what will be the effect of the lighting to be done by the fixtures he is about to invest in, he can step into this dark room and have current turned on at once, so there need be no disappointment after he gets his house equipped.

Down the centre of the store are ranged handsome and massive show stands on which are displayed an endless variety of etched, plain and tinted glass globes, shades and reflectors, chiefly made by the well known Phœnix Glass Company, Pittsburg.

The accountant's office, bookkeeper's room and private offices of the principals occupy the rear end of the store, being partitioned off from the show room by polished partition walls, the various offices being comfortably furnished and equipped with all modern conveniences. This floor is 123 feet long by 30 feet wide.

As we have already stated, the formal opening of these new quarters took place on Saturday, April 15, and notwithstanding the down-pour of cold rain which fell all day long, the opening was a thorough success.

About 2,000 invitations of a unique electrical character were sent out for the housewarming; and judging from the unending stream of callers and the crowds that thronged the store, took possession of the offices and struggled to look into the mysteries and beauties of the dark room, it was clear that most of the two thousand invitations were accepted.

The handsome plate glass windows were made doubly attractive by having their sills covered with green plush carpets, on which were placed pots containing tropical palms and other beautiful exotics. The floral display also included a magnificent design of a horseshoe at the base of which was the word "Success," from Pettingell-Andrews Company, Boston; another one with the letters "D. P. & W." was presented by the employees of the firm as an expression of hearty good wishes for the continued and increased prosperity of their employers. There were other floral presents in addition.

The other window contained a miniature engine of the Greene type, which was belted to a $\frac{1}{2}$-inch H. P. Eddy motor.

As the shades of evening descended all the lights in the big store were turned on with most brilliant results, for everybody was attracted by the unusual brilliancy, and while inside the hosts of invited guests leisurely strolled round examining the innumerable devices and having their various uses and methods of working explained to them, the crowds on the sidewalk took in the gay and brilliant sight with astonishment, surprise and evident pleasure.

Among the visitors who had come from near and far to extend congratulations were representative electrical men from New York, Boston, Hartford, Windsor, Bridgeport, Ansonia, Providence, Worcester, Springfield—in fact from all over New England, including many of the leading citizens of Providence. During the evening light refreshments were served, and before the hour arrived for closing the informal reception the air throughout the large building became redolent with the aromas from innumerable choice Havanas.

The day was indeed a red letter day for Messrs. Drake, Payson & Whittier. These young men have not only deserved success, they have achieved it; and now with their large and handsome supply store, many good contracts on their books, many more pending, and the best wishes of every one to encourage them, they have settled down to do profitable work.

Bids Wanted.

The Chester Light, Water and Ice Company is now receiving bids on a Central Lighting Station, to be constructed at once at Chester, Illinois. Proposals on the entire work, or any part of it, will be received until May 15, by Wm. H. Bryan, Mechanical and Electrical Engineer, 56 Turner Building, St. Louis, where plans and specifications may be seen. The plant will consist of one 35 light arc machine and two 500 light, 2,000 volt alternators, with engines, boilers, etc.

General News.

What is Going on in the Electrical World.

Winchester, Ill.—The electric light plant in this place was destroyed by fire on the 13th inst. Loss $5,000.

Reynoldsville, Pa.—The people here are discussing the question of purchasing an electric light plant for the town.

Norwalk, Ohio—A company is being formed here to manufacture a new electric heater, the invention of W. J. Bowen.

Waukegan, Ill.—An electric railway to connect Waukegan with South Waukegan is to be built by Morris, Ganse & Company.

Springfield, Ill.—Senator Thiebe's bill allowing cities and villages to maintain electric plants and furnish light, heat and power has passed the Senate.

Homestead, Pa.—In the 33-inch mill of the Carnegie Company here, the tables and other machinery are now moved by electricity, recently introduced.

Richmond, Va.—There is now a trolley line to Seven Pines, the scene of one of the great battles of the war and only a short distance from the National Cemetery.

Orange, N. J.—The council has granted the Cross-Town and Bloomfield Railway Company permission to change its motive power to the overhead trolley system.

Bowie, Tex.—A company has been organized to erect and operate a telephone line between Bowie and Jacksboro. It will also probably have a branch line to Post Oak.

Cleveland, Ohio.—The consolidation of four out of the five electric street railway companies of this city is now all but complete, and a large increase in capitalization is to follow.

Scranton, Pa.—The plant of the Wightman Electric Manufacturing Company, against which executions were issued amounting to $74,066.66, will be sold by the sheriff on the 27th inst.

Kingston, Can.—The Kingston Street Railway Company has applied to the Ontario Legislature for permission to change the motive power of its road to electricity and to extend its lines.

Boston, Mass.—The trustees of Thomson-Houston securities, series D, have declared a semi annual dividend of 25 cents per share, payable May 1, 1893, to shareholders of record April 22, 1893.

McKeesport, Pa.—The electric light company, recently burned out, are re-establishing their business as fast as possible. The company intend to introduce the Westinghouse alternating current system.

St. Louis, Mo.—John Scullin, the manager of several street railways in St. Louis, has become interested in the storage-battery system of the Standard Electrical Company of Detroit, and will give it a trial on one of the roads here with a view to its adoption if it proves a success.

Wilmington, Del.—The Wilmington and New Castle Electric Railway Company have elected these officers: President, Dr. Howard Ogle; vice-president, James B. Toman; secretary and treasurer, Harry H. Billany. This organization will stand until the stockholders' meeting July 1st.

Canandaigua, N. Y.—The Canandaigua Electric Railway Company having obtained the franchise of the Canandaigua Street Railway Company, will begin at once to make such changes as they deem necessary in the line and its equipment. They will get motive power from the local electric light plant.

Montreal, Can.—The council of the municipality of Pointe aux Trembles has granted a thirty years' franchise to the Corriveau-Williams syndicate to operate an electric railway and electric light system in the municipality. It is a suburb of Montreal and considered the prettiest location on the island.

Northampton, Mass.—A large interest in the Northampton Street Railway has been sold to three Springfield men. John Olmstead, A. E. Smith and N. D. Winter, and the directory has been reorganized so as to take them in, some of the old members resigning. The work of equipping the road with electricity will begin immediately.

Gallatin, Tenn.—The purchase of the Gallatin and Nashville turnpike by a syndicate of capitalists, who intend to use it for a proposed electric railway, has been made public. The length of the road is twenty-six miles. Among the stockholders of the purchasing company are Horatio Berry, George Seawright and Robert Groves, of Hendersonville.

Fort Wayne, Ind.—Almost every new house being built here this spring is wired for electrical illumination. The Jenny Electric Light Company, which has now 7,000 incandescent lamps burning in the city, intends putting in new machinery and otherwise improving its plant. The company expects to have 10,000 incandescent lamps burning next fall.

Hagerstown, Md.—The street commissioners have awarded the contract for lighting the streets for five years to Rodgers, Shanley & Company, of New York, with the condition that the contractors construct the street railway and operate it in connection with the lighting. The Schuyler Electric Company, who own the present electric light plant, and whose bid was lower, will contest the action of the commissioners.

Brooklyn, N. Y.—The Brooklyn, Bath and West End Railroad has filed with the State Railroad Commission an application for a change of motive power from steam to electricity on the present line of the steam railroad, and also on the spur or branch from New Utrecht to connect with the tracks of the South Brooklyn Railroad and Terminal Company.

Yonkers, N. Y.—The new building of the Otis Electric Company is completed, and the machinery is being put in preparatory to commencing work. It is expected that everything will be in readiness before June 1. The new building will be devoted to the manufacture of electric motors.—The Yonkers Electric Railroad Company has completed its Mt. Vernon line.

Eden, Pa.—At the annual meeting of the Langhorne Electric Light and Power Company, held here, the following directors were elected: Allen R. Mitchell, Thomas Duffield, J. Howard Marshall, P. M. Minster, Edward Townsend, John Rue, David J. Matlack. All were members of the old board, except Edward Townsend, who was elected in place of George L. Garsed.

Newark, N. J.—The Suburban Traction Company, the newly formed organization which proposes to construct and operate an extensive system of cable and electric railroads in Essex and Passaic Counties, has elected the following board of directors: Frank W. Child, A. P. Foster, John L. Seward, George Spottiswoode, T. W. Foster, James Eustis, and W. P. Pritchard. F. W. Child has been chosen as president, A. P. Foster as treasurer, and A. W. Kissam as secretary of the company.

Toronto, Can.—The Canadian General Electric Company, which recently received the town franchise for an electric street railway, has amalgamated with the Peterboro and Ashburnham Railway Company, under the charter of the latter, for the purpose of constructing and operating the road. The officers elected were: T. E. Bradburn, president; Frederic Nicholls, vice-president; directors, H. P. Dwight, T. G. Hazlitt, A. Stevenson, E. H. D. Hall, Wm. Walsh and A. P. Poussette.

Hartford, Conn. — The Hartford Electric Light Company has been authorized by the Legislature to increase its stock to $500,000.—The "Electric bill" now before the Legislature is creating dissatisfaction among the people, as it is likely, if it passes, to put a stop to electric railway building in the State. Strong objection is made against the sections giving the railroad commissioners power over the corporations, and especially against the sections prohibiting the carriage of freight and the substantial paralleling of steam roads.

Cincinnati, O.—George B. Keefer, a Cincinnati capitalist, has organized the Put-in-Bay and Southwestern Electric Railway Company for the construction of an electric railway from Findlay, through Fostoria to the lake. The objective point of the line is understood to be Toledo, and it will be equipped for both freight and passengers.—The Mt. Adams electric is to be extended to Oakley, and the belt road round from Eastern avenue to Mt. Lookout, to Hyde Park, and down town, is said to be assured.

Grand Rapids, Mich.—The West Michigan Electric Company has commenced work on the dams for the water power at Lowell, which is to be used for transmitting electric power, and which power it is proposed to retail in this city for light manufacturing and other purposes. The dams are to furnish 3,000 horse power, which will be generated through the medium of horizontal water wheels. E. F. Sweet, A. C. Sekell and John E. More are local stockholders. The others are C. J. Church of Greenville and C. A. Church and Dr. McDaniel of Lowell.

Boston Notes.

The consolidation of New England electric street railways continues to take place. This time the Haverhill & Groveland Street Railway, the Merrimac Valley Company of Lawrence, and the Lowell, Lawrence and Haverhill Company have become one. Each company will retain its own name but all will henceforth be under one management. Extensions on a large scale will now be made, and extensive car and repair shops will be erected in Haverhill immediately.

The Taunton Street Railway Company has secured authority for double tracking its system and will go ahead at once.

North Attleboro, Mass., after deferring the matter until the experiment had been successfully made by some other town, now seems as if it would like to adopt the Municipal Lighting Act, 1891, and erect a municipal lighting plant. A sum of $50,000 has been appropriated for that purpose.

Next to the plain, ungarnished statements of facts about the first annual report of the General Electric Company which appeared in the last issue of ELECTRICITY, the full and searching analysis of the same document which was published in last Saturday's *Commercial Bulletin* has created most interest in Boston electrical and money circles. That the bankers, speculators and business men of the country generally regard with interest these articles and believe their statements is proven by the turn General Electric stocks have taken downwards, until at present writing common stock is below par.

The bridge which crosses the mouth of what is called Weymouth Fore river at Quincy Point is being widened to make room for the electric car track that is to be laid across it, thereby connecting the Quincy and Weymouth electric railway systems.

Probably the handsomest if not the largest switchboard ever made in New England was shipped from the works of the W. S. Hill Electric Company, Boston, last week, to the Narragansett Electric Light Station, Providence, R. I. It was of white Italian marble with massive brass fittings.

Though enjoined against making any of its popular and efficient lamps, the Beacon Vacuum Pump and Electrical Company of this city is not by any means allowing itself to be idle, and its past enterprise and success are bearing fruit even now. The Beacon system of exhausting lamp bulbs has attracted universal attention, and its foreign patents are being eagerly sought after by capitalists and others. Among the most recent visitors to the Beacon factory were Herr Alexander Von Babo and Dr. Siemens, representing the Siemens-Halske Electric Company. This rich corporation is negotiating with a view to purchasing some of the European patents on the Beacon Vacuum Pump. Incidentally it may be stated in this connection that some time ago ten Beacon lamps were placed in service at a certain place in Canada and burnt for no less than 5,420 hours each before they had to be replaced by new lamps.

The New Sunbeam Lamp.

The new Sunbeam Incandescent Lamp, which has several times received mention in ELECTRICITY, and has been for some weeks looked forward to, is now ready for the market, as is announced in the advertisement of the Ansonia Electric Company of Chicago (formerly the Electrical Supply Company), who will have the Western agency for this lamp. Already large numbers of orders are being received by the Ansonia Electric Company, and every mail brings letters from their old lamp customers, expressing satisfaction at the prospect of their being able to obtain lamps that can be used with some satisfaction and not be compelled to burn lamps that are every day proving more unsatisfactory to their customers.

We have had an opportunity to examine some of the new Sunbeam lamps, and they give every evidence of not only being equal in quality to the old lamps, but fully substantiate the claims of superiority which are made for them. There seems to be no doubt whatever but that this lamp is clearly around the Edison patents. It is not all glass, does not contain inleading wires nor does it have a vacuum. Even the shape of the globe has been changed. The appearance of this lamp just at this time will prove to the General Electric Company a serious obstacle to the realization of its purpose to obtain control of the electric lighting industry. We have learned of several other new lamps that may shortly be expected to appear on the market, and altogether it seems not improbable that the immense amount of experimental work which in the incandescent lamp field has been recently carried on will result, as it has in this case, in the production of a superior lamp, and will confer a lasting benefit on the industry.

The United Electric Improvement Company.

The above is the official title by which the Heisler Electric Company of Philadelphia will hereafter be known to the public.

The United Electric Improvement Company is a protege of the United Gas Improvement Company, a corporation whose financial strength and progressive methods are well known.

The new corporation will immodiately commence the erection of new and commodious factory buildings convenient to the Pennsylvania and Philadelphia and Reading Railroads at Germantown Junction. The factory will be equipped with additional tools and all modern accessories for the manufacture of all kinds of electrical equipment and will continue the manufacture of the Improved Heisler System of Long Distance Series Apparatus. It is also their settled policy to vigorously push after their share of the general electrical business, and with the proposed increase in facilities they expect to render a good account of themselves in the field of competition.

The former officials of the Heisler Company retain their positions in the new company, Mr. Walter F. Smith being general manager and Benj. F. Tingley secretary.

The United Electric Improvement Company will, we are confident, prove a formidable competitor to the Trust in Philadelphia.

The Logan Storage Battery.

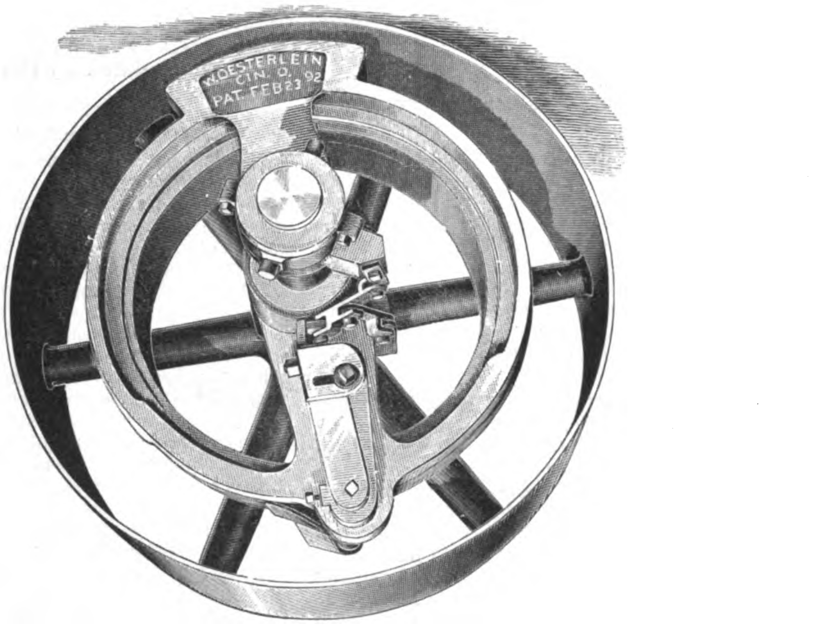
Mr J. W. Johnson, representing the Standard Electrical Company of Detroit, owning the Logan storage battery patents, has recently been in St. Louis, and reports the closing of three important contracts for the use of the Logan battery for lighting and motive power purposes. One of these contracts is for the equipment of three cars on one of the St. Louis street-railway lines.

Mr. Johnson is an enthusiast on the subject of the Logan battery and says:

> "We have solved the problem of a perfect storage battery. I will guarantee to construct a battery which shall not weigh more than a locomotive with its tender and supply of water and coal, which will pull a train of cars from St. Louis to Chicago in one-third less time than does a steam locomotive, and on one-third less cost of fuel for generating the electricity. And at the same time we dispense with all cinders and smoke and with the hissing of steam and puffing of the exhaust."

A Friction Clutch Pulley.

The accompanying cut shows a device that is being manufactured by W. Oesterlein, engineer, Cincinnati, O. and meeting with a very ready demand wherever such apparatus is used. In designing this device the inventor aimed at producing a clutch that should have the largest possible friction surface, clutching the pulley with equal pressure all around, controlled by one lever, and easily adjusted with one screw. The clutch ring, which, as will be seen, is carried on the arms of the pulley, is surrounded by a band whose friction face is composed of hard wood blocks. The ends of the band are pivoted to short arms on the end of a bolt, so that a slight turn of the latter on its axis, draws the ends of the band toward each other, causing it to grip the ring, a slight turn the other way loosening it. This bolt passes through a lug at the top of the ring, as shown in the cut, and to its outer end is secured by a set screw a lever which projects towards the centre of the pulley. Mounted on the lever is an adjuster provided with a cross slot, so that it may be moved across the face of the lever and held in any desired position by a set screw. The lower end of the adjuster is connected by a toggle-joint to the sliding collar on the shaft. As shown in the cut, the collar is drawn away from the hub so that the motion of the toggle shifting the lever to the left releases the clutch. When the collar is moved toward the hub, the long link of the toggle takes a position at right angles to the axis of the shaft, forcing the lever to the right, and causing the friction band to grip the clutch with a force determined by the position of the adjuster on the face of the lever. By loosening the set screw in the adjuster, a slight shifting of the latter will take up or compensate for any wear on the clutch. It will readily be appreciated that the principles adopted in its construction render this clutch one of the most efficient on the market, and it is not surprising that it is being so generally used in electric light and power stations throughout the country.



A Friction Clutch Pulley.

The Interior Conduit System Goes.

The best evidence that the Interior Conduit and Insulation Company's claims for their system rest on a solid foundation is found in the fact that out of all the buildings under construction in New York City since January 1st for which the architects' specifications name electrical equipment, two only are using other than the Interior Conduit system. The metal covered conduit is now generally insisted upon by architects for the best construction. It is estimated that in the remodeled residence of Cornelius Vanderbilt, at Fifty-seventh street and Fifth avenue, 100,000 feet of brass-covered Interior Conduit will be used by the Tucker Electrical Construction Company which has the work on hand.

The Cutter Push Button Switches.

Mr. Charles D. Shain, 136 Liberty street, New York, sends out the following notice in regard to the latest addition to his line of good things:

"The selling department of the Cutter Electrical Manufacturing Company, Philadelphia, in this vicinity, has been placed in our hands.

"It affords us pleasure to present to your consideration the Cutter Push Button Switches.

"We have all read many newspaper articles about 'touching the button and the light appeared,' but there has never been until now a practical Push Button Switch—in fact all switches have had some other kind of movement, and have been more or less unsightly and disappointing.

"The Cutter Push Switch is unique in design, beautiful in finish, electrically and mechanically perfect. There is nothing in sight but an ornamental face plate, set flush with the surface of the wall.

"The prices are quite reasonable, and it will afford us pleasure to quote you upon receipt of information as to your wants. We have a neat catalogue and price list, which we will send on application. Specifications of architects, engineers and others should call for these switches."

Will Keep Open House.

The Railway Equipment Company of Chicago, Mr. W. R. Mason general manager, sends out the following invitation to World's Fair tourists:

> Assuming that it is your intention to visit the World's Columbian Exposition, and realizing that you will be pleased while here to meet others interested in the operation of street railways, we have thought it might be a convenience for us to open a directory of visitors to the Fair.
>
> As it will probably be also a convenience for you to meet your friends at a central and accessible point, we would be pleased to have you send to us the names of those of your company who expect to be in Chicago at that time, giving also the date of arrival and, if possible, the hotel or apartments where you may be found. As soon after arrival as convenient, we would suggest that you call and register at our office, which is in perhaps the most convenient and prominent location in the city.
>
> Our office is directly opposite the new Art Gallery, where the World's Fair Congress will be held, and is almost directly opposite the main depot for World's Fair trains. We shall certainly take pleasure in extending every courtesy to our friends during the six months, and we trust you will make our office your headquarters, and, if desired, have your mail addressed in our care. In the meantime we shall be pleased to furnish any information needed, as well as to attend to any matters connected with your visit to the Fair.

INCORPORATIONS.

The South Waukegan Electric Railway Company, Shields, Lake County, Ill. Capital stock, $100,000. Incorporators: Franklin W. Ganse, Calvin Dicky and Bryan Y. Craig.

The Indiana Natural and Illuminating Gas Company, of Indianapolis. Capital stock, $1,000,000. Incorporators: C. F. Diederich, E. J. Jerzmanowski, J. H. Benedict, A. W. Brady, Samuel Thorne, A. B. Proal and John R. Pearson. The objects of the company are to prospect and bore for natural gas and to produce artificial gas and electricity for light, heat and power.

A certificate of incorporation has been granted the company which intends to construct the Ellicott City and Clarkville branch of the proposed electric railway from Baltimore to Ellicott City. The capital stock is $200,000. Incorporators: State Senator John G. Rogers, Harper Carroll, John F. McMullen, John L. Clark and John H. Owings. The directors named are the first four of the incorporators and Messrs. Frederick Bausman, of Glenelg, Howard County; George Yakel, Van Courtlandt Homans, N. Winslow Williams and Henry W. Williams, of Baltimore, Md.

Mount Vernon Electric Light Company, of Mount Vernon, Ill. Capital stock, $20,000. Incorporators: Allen C. Tanner, George W. Evans and Wayland S. Arnold.

The Abatis Electric Manufacturing Company, at Chicago. Capital stock, $50,000. Incorporators: A. R. Hussey, Nelson Erickson and William Newman. Organized for the manufacture of electrical appliances.

The General Electric and Improvement Company, at Trenton, N. J. Capital stock, $500,000. The company will begin business with $3,000, divided into thirty shares as follows: Louis A. Chandler, 28; Charles N. King, 1; Wm. J. Turner, 1. It is supposed that the company is organized for the purpose of acquiring an interest in certain telephone and electric-light companies.

The Delaware and Schuylkill Railway Company of Philadelphia. Incorporators: Harry C. Forest, Robert A. Welsh, Robert Libberton, A. H. Harley, William L. Martin, William Hill. The company is to build and operate trolley railway lines in certain specified streets in Philadelphia and Germantown.

The Montana Electric Company, Butte, Mont. Capital stock, $50,000. Incorporators: John O'Rourke, G. T. Schmelzel, S. B. Smith, W. F. Jackson, V. E. Poissant and C. L. Smith. The company proposes to do a general electric business in the State with headquarters at Butte.

The Put-in-Bay and Southwestern Electric Railroad Company, at Columbus, Ohio. Capital stock, $3,000,000. Incorporators: George B. Kerper, J. K. Tillotson, J. B. Foraker, August Fabel and C. A. Gordon, all of Cincinnati, with the exception of Mr Tillotson. The object of the company is alleged to be to build an electric railway from Findlay through Fostoria, and eventually to Toledo.

The Beecher Single Rail Company of Buffalo, N. Y. Capital, $400,000. Directors: Charles A. Seaver and Lina Beecher of Batavia, Guy C. Hardesty and Alfred J. Hibbard of Buffalo, and George W. Sikes of Lakeview. The company's purpose is to manufacture all kinds of electric motive power, locomotives, railroad and street cars, gas and compressed air motors.

The Salmon City Electric Light and Water Company, Salmon City, Idaho. Capital stock, $40,000. Directors: E. C. Johnson, president; William F. Boxwell, Jr., secretary and treasurer; Ed. Mingle, vice-president; John R. Stout and John J. Egan. The object of the company is to furnish Salmon City with water and light.

ELECTRICAL PATENT RECORD.

Letters Patent Issued April 18, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

495,615. Cross-Over Switch for Electric Railways. Frank B. Rae, Detroit, Mich., assignor to the Detroit Electrical Works, same place. Filed April 11, 1891.

495,674. Rail-Circuit-Closing Contact. Friedrich von Hefner-Alteneck, Berlin, Germany, assignor to Siemens & Halske, same place. Filed Jan. 18, 1893.

495,692. Trolley-Wire Finder. Charles G. Cleminshaw and William H. Bradt, Troy, N. Y. Filed June 22, 1892.

495,695. Electric-Railway Trolley. William Duncan, Allegheny, Pa. Filed July 20, 1891.

495,940. Electric Trolley. Jeannot W. Kenevel, Chicago, Ill. Filed March 26, 1892.

ELECTRIC LIGHTS AND APPLIANCES.

495,601. Electric-Arc Lamp. Frederick T. Schmidt, Bradford, England. Filed Aug. 24, 1892

495,620. Incandescent Electric Lamp. Eugene W. Applegate, Chicago, Ill., assignor to the Applegate Electric Light and Power Company, same place. Filed Jan. 8, 1893.

495,648. Electric-Arc Lamp. William A. Turbayne, Detroit, Mich., assignor, by mesne assignments, to the Turbayne-Tamblyn Company, same place. Filed July 1, 1892.

495,676. Electric Lamp. Tobias Hudson, Baltimore, Md., assignor of one-half to John F. Weyler and Robert S. Weisenfield, same place. Filed Oct. 7, 1892.

495,772. Electric-Arc Lamp. Ernest E. Beauvalet and Leon C. Beauvalet, Paris, France. Filed July 11, 1892.

495,932. Electric-Lighting System. Henry Edmunds, Jr., London, England, assignor of nine-tenths to Albert Sechrist, Denver, Colo. Filed Oct 19, 1892.

495,951. Incandescent Electric-Lamp Holder. Leroy C. Whitney, Jr., Milwaukee, Wis. Filed Dec. 10, 1892.

DYNAMOS AND MOTORS.

495,538. Dynamo-Electric Machine. Thomas L. Willson, Brooklyn, N. Y. Filed March 8, 1890.

495,547. Combined Electric Motor and Driven Machine. Rodolphus Fuller, Detroit, Mich. Filed March 31, 1892.

495,561. Commutator for Dynamo-Electric Machines or Motors. Buchanan S. Paterson, Gateshead, England, assignor to Clarke, Chapman & Company same place. Filed Aug. 16, 1892.

495,562. Field-Magnet. Frank A. Perret, Springfield, Mass., assignor to the Elektron Manufacturing Company of New York. Filed Oct. 28, 1892.

495,941. Electric Motor or Generator. William Koedding, St. Louis, Mo., assignor of one-half to Edmund Verstraete, same place. Filed Sept. 21, 1891.

BATTERIES.

495,638. Secondary Battery. Leslie B. Rowley, Ashland, Wis. Filed Sept. 23, 1892.

TELEPHONE AND TELEGRAPH APPARATUS.

495,744. Method of Indicating Telegraphic Messages. Joseph Levi, New York, N. Y. Filed Jan. 16, 1893.

MISCELLANEOUS.

495,552. Insulator. Louis Hills, New York, N. Y. Filed Aug. 22, 1892.

495,564. Electrical Bell. Henry B. Porter, New York, N. Y. Filed Oct. 26, 1891.

495,582. Ground Generator of Electricity. Michael Emme, Oakland, Cal. Filed Aug. 29, 1892.

495,587. Ship's Log. Charles F. Holt, New London, Conn., assignor of one-half to William S. Starr, same place. Filed July 25, 1892.

495,600. Electrolytic Apparatus. Gustaf O. Rennerfelt, Stockholm, Sweden. Filed Sept. 30, 1890.

495,608. Magnetic Ore-Separator. George G. Crosby, New York, N. Y., assignor, by direct and mesne assignments, to the Magnetic Ore Milling Company of West Virginia. Filed Jan 27, 1892.

495,626. Electric Welder for Wire-Fence Machines. John D. Curtis, Worcester, Mass. Filed Nov. 2, 1892.

495,637. Process of Extracting Zinc by Electrolysis. Johannes Pfleger, Frankfort-on-the-Main, Germany. Filed Aug. 23, 1892.

495,714. Lightning-Arrester. Elihu Thomson, Lynn, Mass, assignor to the Thomson-Houston Electric Company of Connecticut. Filed Aug. 5, 1889.

495,738. Electric Rotary Drilling-Machine. Robert M. Jones, Salt Lake City, Utah. Filed June 30, 1892.

495,782. Electric Shoe-Sole. Rufus F. Carnes, Winfield, Ala. Filed Dec. 22, 1892.

495,853. Lightning-Arrester. Elihu Thomson, Swampscott, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Feb. 15, 1892.

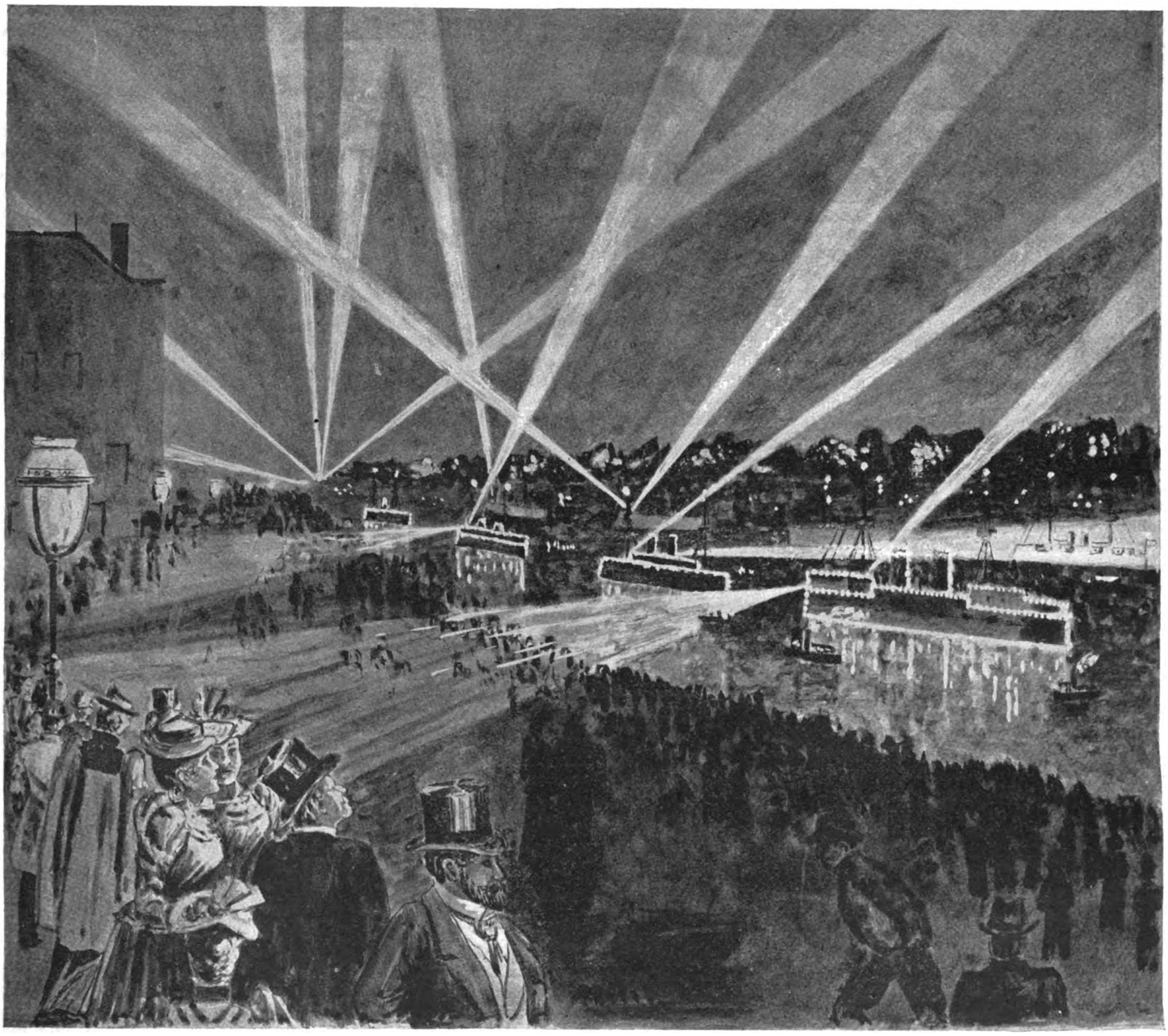
495,861. Electric Belt. George F. Webb, Cleveland Ohio. Filed Dec. 16, 1892.

495,913. Danger-Signal for Railway-Crossings. James S. Savage, Jr., Detroit, Mich., assignor of twenty-seven one-hundredths to George Farnsworth, same place. Filed June 4, 1891. Renewed March 27, 1893.

495,929. Electric Cigar-Lighter. William Carter and Charles E. Willey, Louisville, Ky. Filed July 18, 1892.

ELECTRICITY.

Vol. IV. New York. MAY 3, 1893. Chicago. No. 16



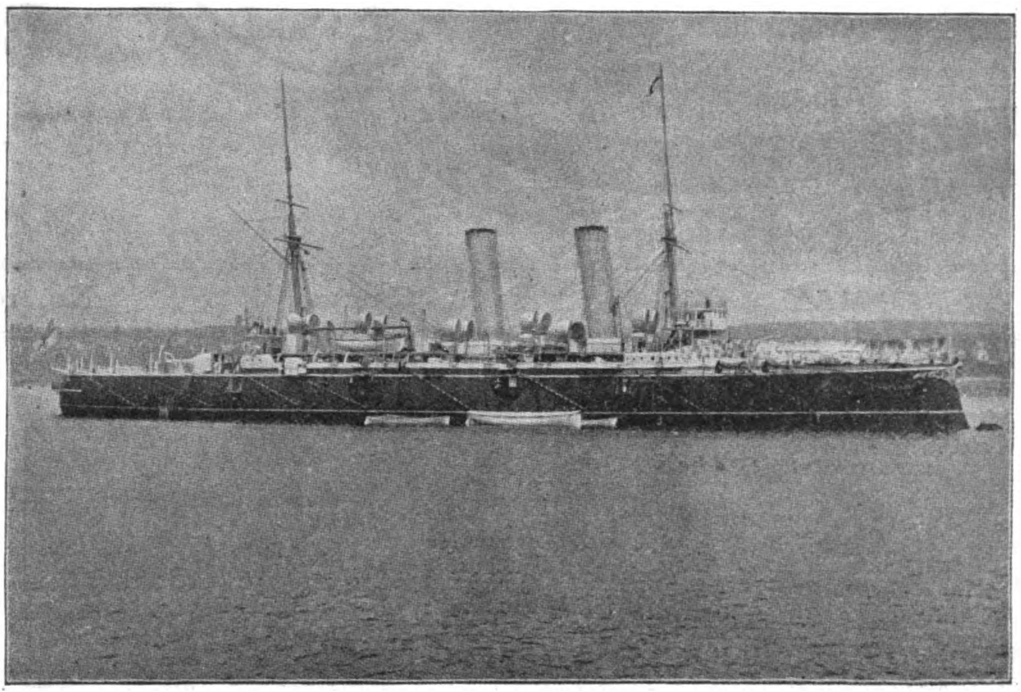
EXHIBITION OF SEARCH-LIGHTS, NORTH RIVER, NEW YORK. (See Page 210.)

Electricity in the Naval Review.

Some Equipments on Board the Men-of-War.

The Night Display in the Hudson River.

Everywhere Columbus! It is the sole topic. The air is redolent with the name. The news-stands are piled with a mass of literature and cheap prints of "Caravels," "Voyages" and "Landings." The newspapers, the magazines and the weeklies devote column after column to historical research dating and antedating 1492. The navies of the civilized world are concentrated at one station to do honor to the name, and even the postage stamps have been altered to accord with the spirit of the hour.



British Cruiser Blake.

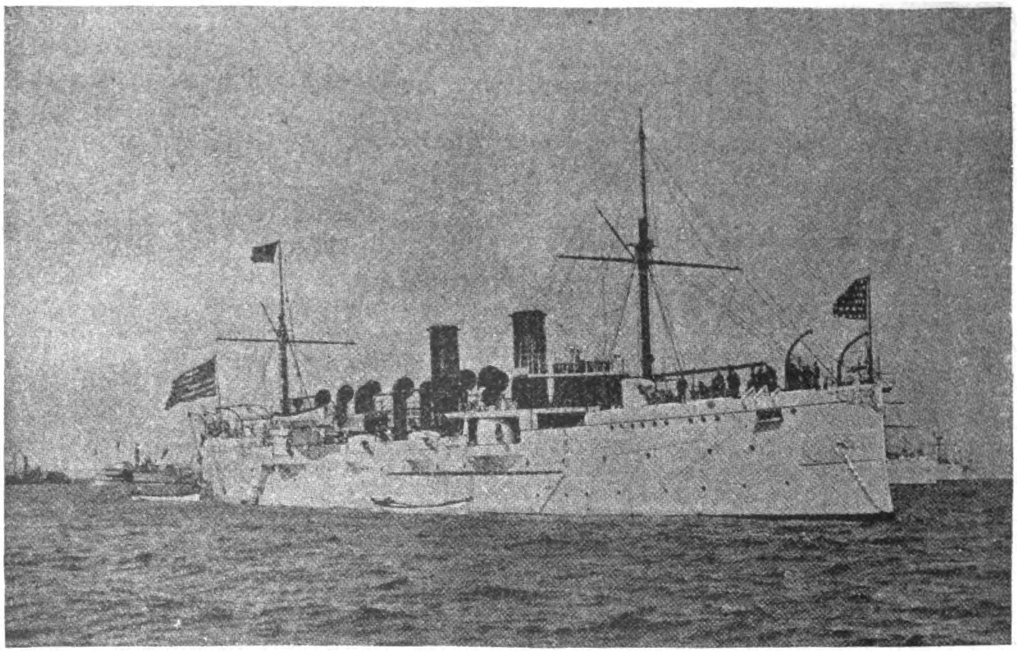
The point of view, at this late day, is concerned more with what the achievement has developed into rather than with the achievement itself. It is to be doubted whether the slightest fraction of the multitude that will visit the just opening Exhibition will devote more than a passing thought to the intrepid navigator of which it is in honor. The past is relegated to the limbo of forgotten achievement and only to be resurrected on special occasions like the present, when all is Columbus and caravel and anticipation.

Nothing more forcibly exemplifies this proposition than the demonstration which has taken place during the past week in and around New York City and its harbor. Thirty-five ships of the great navies of the world constitute as inspiring a pageant as we may hope to see in our generation. Only once has it been approached in an attempt to outdo former spectacles, and that on the occasion of the Queen's Jubilee at Spithead, Eng., some few years ago. In the present instance no expense or energy has been spared to make the affair a success, and strange as it may seem it has not turned out a fizzle as is generally the case.

The assemblage at Hampton Roads was accomplished by this complex squadron of evolution without more than a minimum of set-back. Great Britain, Russia, France, Italy, Germany, Spain, Brazil, Holland, Argentina and the United States each was represented by its most typical exemplification of modern naval construction. Dipped in the waters of that other early navigator, Hendrick Hudson's, "Great North River," they stretch in two formidable lines for the length of forty-eight city blocks.

At the top of the line the fantastic looking caravels rock and rear their eccentric hulks to the motion of the tide and illustrate forcibly the enormous advance which has been made in nautical architecture during the last four hundred years.

This is the keynote on which the intelligent observer will most dwell as he contemplates and compares the formidable appearance of the modern vessel with the almost "junk" of other days. After the first inspection of the old tub itself his eye lights on a piece of "heavy" ordnance which it is said is one used by Columbus on his first memorable voyage. The approved method of securing the cylinder to its carriage by means of hemp is noticeable. The guns of the present time are capable of covering distances, producing results, and in such an infinitesimally small period of time as to lead us to think that perfection must surely be reached. Yet this old gun in its time was considered a masterpiece.



United States Cruiser Philadelphia.

Heading the two lines are the Philadelphia (U. S.) and the Blake (British). As modern battle-ships go they are good examples of what is latest in all that pertains to improvement in men-of-war.

The most interesting portion of a ship's equipment is of course its guns. The modern gun is a most intricate piece of mechanism and naturally involves a considerable amount of manipulation. The guns of a ship's battery are divided into groups called gun divisions. A subaltern, usually an ensign or junior lieutenant, is always placed in charge of each gun. Depending on the ship's equipment its guns may be fired by individual electrical circuits attached to the gun, or they may be controlled entirely from the "conning" tower.

The latter method is employed on several of the present vessels but is rapidly falling into disuse. The conning tower is on the fore part of the upper deck and is a protected observatory from which every motion of the vessel or action on board of her may be controlled.

THE CONNING TOWER OF A MAN-OF-WAR.

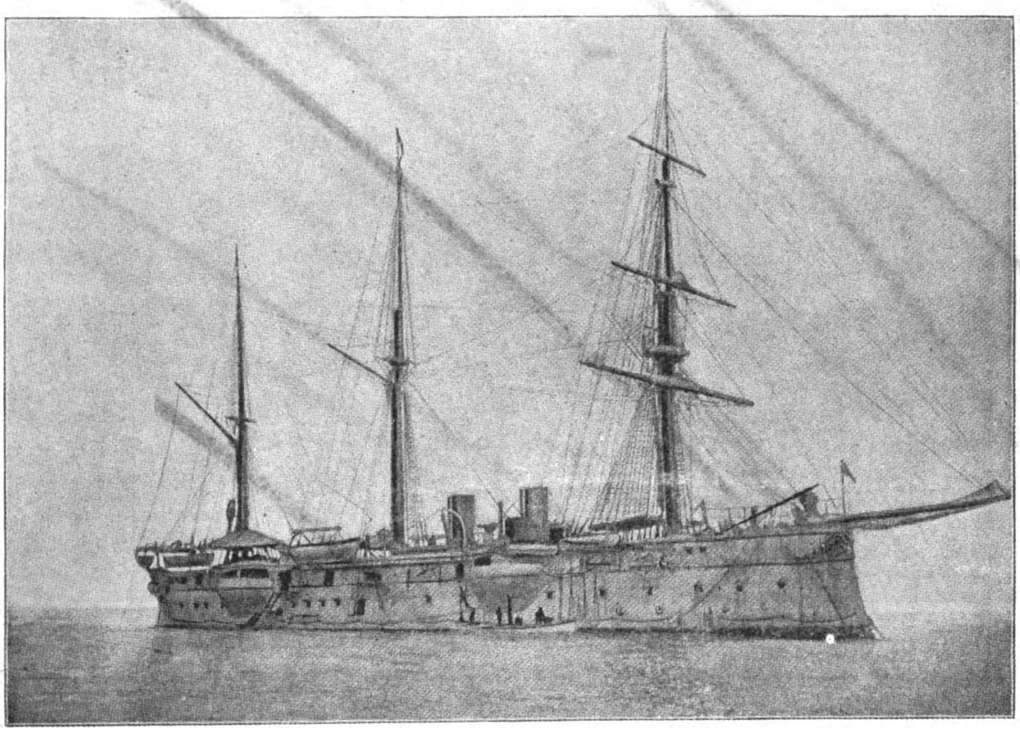
In the conning tower the commander of the vessel can with a mere touch of the button bring within his control any desired order of movement on the part of officers, men, or apparatus on board. It is, therefore, the central station from which everything is directed. Electric circuits abound everywhere—in fact, they do so all over the vessel, but here in particular do they loom up in vast array. On board the Blake the steering apparatus is guaranteed an absolute amount of accuracy by the apparatus known as the helm telegraph. As it is peculiar to the Blake alone it will bear description. The instrument consists of a dial with division in degrees marked on the face of it. A handle controlling a bar at the back has also a pointer which indicates the number of degrees. A similar instrument is situated aft in the steering department, and the construction of each is such that the working of one reproduces a similar effect on the other. The helm itself, also by another telegraph of a similar nature, records its exact movement in the conning tower. The commander may thus have absolute and instant command of the vessel's movements and yet be in a position to take note of the enemy's movements. Elliott Bros., London, are the makers and installed the apparatus.

Although every provision is made aboard the Blake for the explosion of the ordnance at a given signal from the conning tower, they do not believe in causing a universal explosion by a circuit from that point. The reason is manifest and logical. It is patent that the individual gunner is in the best position to determine the sight, range, and precise moment a shot is to be delivered. The exigencies of battle, smoke, mist, and other details, make it extremely difficult to determine the effectiveness of a broadside regulated from a position where the difficulties cannot be so apparent.

The guns on the Blake are now fired from individual circuits worked by the officer in charge of the gun station.

From the conning station it is possible to control the helm, the guns, the search-lights, torpedoes, etc., as well as the engine rooms, cabins, etc., thus instituting a perfect system of intercommunication which is as efficient as it is intricate. The compass box (Lord Kelvin's standard) is lighted by the current—16 C. P.

On board the Blake are three Siemens compound wound dynamos, 80 volts each and 450 amperes, any one of which is capable of carrying the total ship's load irrespective of the search-lights. Two of these dynamos are far down below the surface of the water, and so entirely out of harm's way. The other is in a compartment protected but yet not impregnable to an enemy's shot. If, however, it should occur that any one dynamo should be damaged in action, the load can very easily be carried by either of the other two. The dynamos are direct coupled and Brotherhood engines are used. Siemens ammeters and Carden voltmeters are used. These dynamos furnish current for the 100 C. P. incandescent lamps which are used in signaling, also for 100 50 C. P. incandescent lamps used for lighting the coal bunkers. The internal lighting arrangement of the ship is very efficiently disposed. Six hundred 16 C. P. lamps are distributed in the most desirable spots on board. Each illuminating lamp is protected from injury by a semi-sphere of thick glass which has its own protection of wire netting. Every available space when it could not be used for anything else seems to contain some kind of electrical equipment. The yard and arm group for lighting the coal bunkers is run by the upper dynamo. That is the one on the main deck. It stands in an enclosure of its own surrounded by six-inch walls of steel, which are enough to turn aside the effects of any ordinary explosion which may happen in its vicinity during action.



SPANISH CRUISER NAVARRA.

This isolation of the departments is the prevailing arrangement of the Blake's equipment. Each large gun, controlled by an elaborate system of tubing and wiring from the conning tower, is capable of being thoroughly isolated within its own inclosure of six-inch steel wall. This wall serves the double purpose of protecting from within and without. A shell entering through a port-hole might explode and kill every one in the compartment but the effect would be localized and end in that room, whereas in the old days of open or communicating compartments, or where there was no compartment at all, a single shell might wreck a whole deck.

Directly in front of the conning tower stands the large 9.2 gun with its elaborate settings and fittings. This gun is operated by a local circuit, the safety devices on which are numerous, as indeed they have to be. They consist in making absolute breaks in the circuit by uncoupling in two or more places the twin cable which passes from the internal mechanism of the gun to the hand of the gun captain. In manipulating the machinery of the piece all the connections must be uncoupled in order to allow any freedom of movement. In sighting and aiming the gun the ordinary large gun-sights are used during the daylight, but at night their places are taken by tiny incandescent lamps which stand out of the gloom with a distinctness that admits of no misunderstanding their position or object.

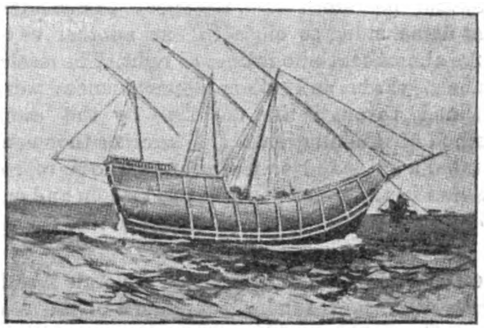
Down some fifteen feet or so below the water-line the torpedoes lie. The action of the shell is of course due to compressed air, but this is released by the electric current. The action is simple. A press button operates an electro-magnet which releases a heavy ball weight which in its turn relieves the mechanism of the torpedo itself.

Part of the equipment of the ship, and a most important feature, are its five search lights; 25,000 candle power is the estimated concentration of each beacon. Search-lights, except in power, differ very little on different men-of-war. There is the ordinary arc arrangement with a condensing lens and reflector, and a small blind to prevent any "direct" rays from escaping.

Every lamp used on board the British fleet, for the Blake is typical of the equipment of the rest, with a few improvements added, is of the Swan pattern, and every lamp has its protecting switch and cut-out. All wires are lead covered, and each individual lead is painted a different color, for the purpose of selection and repair.

All the fine instruments on board were made by Elliott Bros., of London, and they include a Wheatstone bridge with a 1,000 ohm galvanometer, a Thompson reflecting galvanometer for sensitive work, balancing cables, etc., etc.

The Blake is typical of what to expect on the modern man-of-war. The types of the different nations differ very little materially from each other. The latest improvement, except in cases where exclusive control or where secrecy is maintained, is pretty sure to be adopted and installed by the contractors when in their power, or by the Government when it assumes control. On the Philadelphia, the pride of the United States Navy at present, we find installed the Edison system, with only the difference which the different fittings produce. Further down stream the Newark illustrates the cosmopolitanism of equipment by her furnishings being found of the same make in many instances as the Blake's.



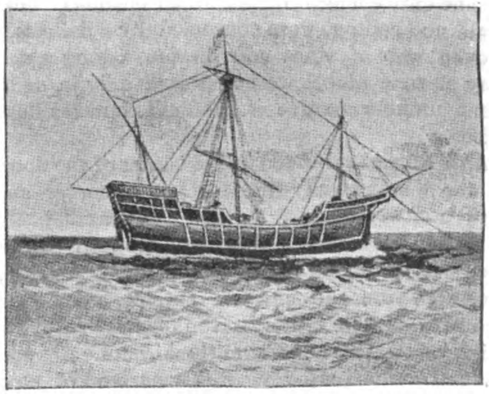
NINA (FAC-SIMILE OF THE COLUMBUS CARAVEL).

One point which obtains on board the United States cruisers, and is worthy of comment, is the Ardois system of signaling. The arrangement consists in having rows of lanterns swung from the mast-head to the deck. The lantern is made to show two colors—red and white—and by alternate flashes and combinations of colored lights the different messages are transmitted. Each lantern is a cylinder of glass one-half of whose length is red and the other half white. An incandescent lamp is placed at each end, and they are worked by a keyboard from below. As each end is illuminated the corresponding color is made to gleam white or red through the darkness.

Such a congregation of modern naval talent will be with us but a few days longer, and it but remains to describe what was one of the most beautiful sights coupled with one of the most brilliant engineering feats it has been our pleasure to witness.

On Thursday last the President passed through the lines of the combined squadron to the saluting of guns and the shrieking and crowing of whistles. The daylight manifestations closed, and it was announced that the various vessels would engage in exhibitions of search-lights and Ardois signaling.

But the waiting crowds that thronged the river banks were treated to a far finer spectacle than they could have possibly anticipated. In all directions the search-lights were found darting their beams, which, mounting in many cases to the low-lying clouds, were broken, and finally lost in the strata and super-strata of vapor. The Ardois system, with its alternating red and white gleams, could be seen flashing along the



PINTA (FAC-SIMILE OF THE COLUMBUS CARAVEL).

American squadron over towards the Jersey shore. The grandest sight of all, however, was the illumination of the British men-of-war.

The Blake, Australia, Magicienne and Tartar were found decked in a perfect framework of flame. The grim black lines of the craft were outlined against the darkness by row on row of incandescent lamps which followed the shape of the vessel and made a flame picture not easily to be forgotten. All along the hulls, both at the rails and the water's edge, the specks of incandescent flame clung so close to one another as to make almost continuous lines of light. The masts, funnels, yards and other appurtenances were outlined through the darkness by the same method of illumination, and altogether they constituted a glare and an iridescence whose reproduction in the water beneath was broken and cut up by the rippling waves till it looked like a mass of liquid fire.

Of course all this was a quite separate installation from the ordinary equipment of the vessels. The cables and lamps which composed the temporary display were imported from England, but their arrival was delayed to such an extent that two hours before the time for the exhibition to begin not a line or a lamp was installed. Although a temporary construction, the work was of the most thorough character, and the result was certainly a credit to the ingenuity and dispatch of its promoters.

Approximately estimated, 4,000 Swan lamps (16 C. P. and 80 V.) were used in the decoration of the four vessels. Twin wire cables were used with nineteen wires in each cable. The lamps were placed at intervals of three feet apart, and the installation was divided into sections of fifty lamps. The length of the cable on each vessel approximated 3,000 yards.

Altogether the display as viewed from the river bank was grand, and was the most imposing sight in the day's events, illustrating as it did how important a part electricity has come to play in modern naval display, and intimating the possibility of still greater accomplishment in the future.

The Columbian Ball.

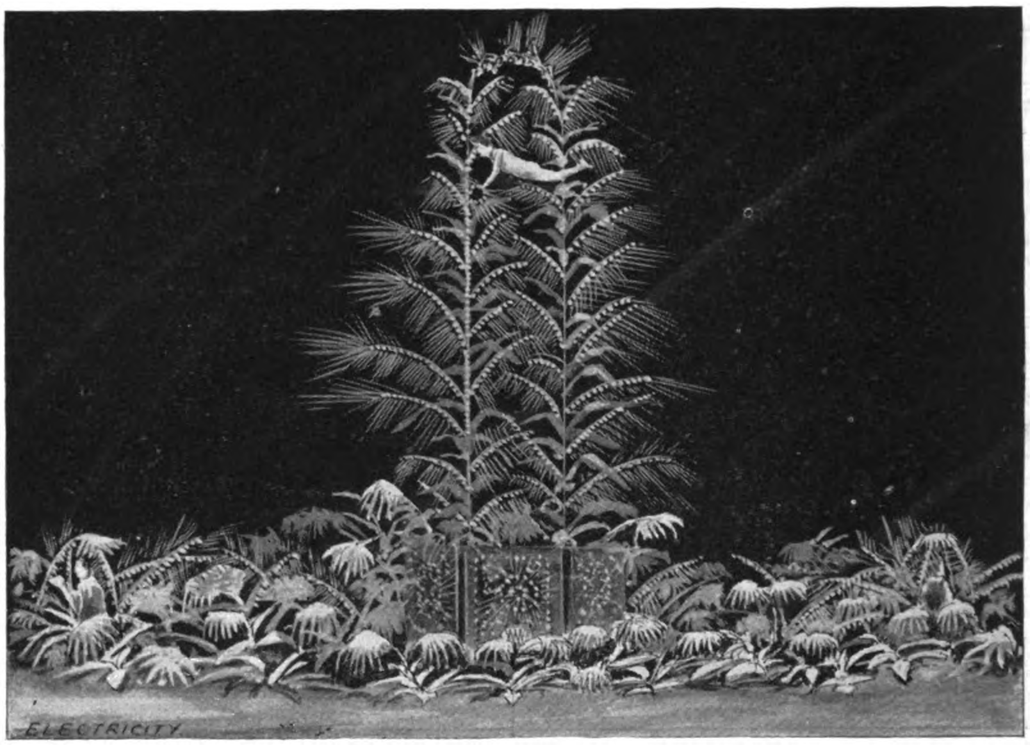
All the World Represented, and the Most Striking Decorative Effects Were Produced by Electricity.

On the night of the 27th, following the display on the river, New York gave a ball at the Madison Square Garden, at which representatives of nearly all nations danced and were happy.

The Garden was transformed by the unstinted use of textures, flowers, plants and electric lights into a fairy land. There was expenditure of money without stint, and the result was so harmonious as to baffle any attempt at description.

The entire length of the broad entrance, both walls and ceiling, were concealed by a delicately woven web of vines and flowers among which tiny electric globes were scattered only in sufficient number to give a subdued but brilliant effect.

A grove was arranged in the center of the floor. It was about twenty-five feet in diameter and made a most attractive feature. It was composed of palms, rose bushes, lilies and tropical plants, each one having an electric light by it. A pretty arch rose from the centre. Its sides were studded with electric lights in the form of sprays of lilies of the valley. From the keystone was suspended a silver cupid bearing a garland of electric lights in its hand. By the arch stood a curious Japanese figure holding a wheel of electric lights which by a peculiar mechanism were constantly twinkling and changing color, giving the appearance from a short distance of a revolving hoop.



ELECTRICAL DECORATIONS AT THE COLUMBIAN BALL.

The Distribution of Power by Alternate-Current Motors.

BY ALBION T. SNELL.*

Multiphase alternate-current working, although demonstrated at the Frankfort Exhibition, has not yet found favor either in England or America; but on the Continent the Drehstrom has been used with success for several important schemes, and larger applications lie in the near future. It has been pointed out, with justice, that multiphase alternate currents offer no real advantage in comparison with single-phase ones for merely the transmission, as distinguished from the distribution, of power. It is, perhaps, for distribution proper, i. e., where a number of motors, varying in size and lying over an extended area, have to be supplied from a common and probably distant source of power, that the multiphase systems find their field of usefulness.

The object of this paper is to discuss the various alternate-current motors now in the market, and, perhaps, to see how far they lend themselves to a system of distribution in which the principal conditions of supply may be stated as follows: 1. The pressure in the transmission mains must be as high as possible. 2. The pressure must be maintained fairly constant at the centre of distribution. 3. The pressure at the motor and lamp terminals must be comparatively low; and 4. The system must admit of lighting all over the area of distribution by the use of proper converters. These points are by no means easy to obtain even singly, and when they must be concurrent the difficulty is much enhanced.

1. SINGLE-PHASE SYNCHRONOUS ALTERNATE-CURRENT MOTORS.

Single-phase synchronous alternate-current motors have been used since the memorable experiments at the North Foreland in 1884, but comparatively little progress has been made in their application to general commercial purposes; and the reason for this probably lies in the fact that the synchronous system is practically limited to a single pair of machines, for the starting of the motor by auxiliary power is not a prohibitive objection with one large machine, although out of the question with a number. On the other hand, the high efficiency of synchronous motors and their perfect regulation of speed with varying loads renders them especially suitable for a variety of purposes; and no efforts have been wanting on the part of scientists and engineers to place a self-starting single-phase motor in the market, but hitherto without success. It will serve no useful end to describe in detail all the various attempts, but the limiting conditions may be best gauged by a consideration of the difficulties involved, and by a few typical examples showing the directions in which solutions have been tried.

The following peculiarities are found in alternate-current working with single-phase synchronous generators and motors: (*a*) The dynamos are always separately excited. (*b*) The motors are usually separately excited in order to save the complication of commutators. (*c*) The motors must be raised approximately to the speed of synchronism before the dynamo circuit can be closed. (*d*) The torque on any motor must not exceed a certain value or the machine will stop. (*e*) The current lags behind the pressure by an angle which is a maximum when the motor is running light; and there may be a relatively large idle current, which, though representing little energy at the motor, causes a serious loss in the supply mains and dynamo armature. (*f*) Motors must be designed not only with reference to the pressure of supply, but also with regard to the frequency of the current, and hence are only suitable for working on particular circuits; and (*g*) Alternate motors, excited by either a direct or by a single-phase alternating current, have dead points in each period of alternation.

The earliest attempt to meet these conditions was by laminating the field magnets of an ordinary direct-current motor and modifying the winding so as to make the self-induction as small as possible. The results were not successful. With shunt windings it is found to be practically impossible to excite the magnets excepting with large currents and few turns of wire, and even then, owing to the difference of phase between the field and armature currents, the torque is insignificant compared with the current used, and the dead points may involve difficulties. The series winding is better, but still useless for commercial requirements; for though by carefully adjusting the windings it is possible to obtain a smaller lag, the weight output is still very small and the dead points remain.

The loss by hysteresis in each case is so great as to be probably prohibitive, even neglecting the other objections. The crux is the frequency. This would, most likely, have to be reduced to something of the order of 20 ∿ per second, and such a current would be useless for lighting, and would largely increase the difficulty from dead points. Indeed, from this aspect the frequency should be high, and the armature heavy enough to act as a flywheel. The author has made a number of experiments in this direction, and finds that the eye can easily detect 30 ∿ per second, and he believes from this cause it would not be expedient to work at less than from 40 to 45 ∿.

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*Paper read before the Institution of Electrical Engineers, London.

Another method involves the transformer principle, but is really only applicable to small machines. It originated with Mr. Jacobi, when one of the author's assistants, and a few motors were designed by them conjointly. With this type the armature is wound in the usual way, drum or cylinder, and has a collector of the ordinary type. The field cores are laminated and wound with two windings, one of which is coupled to the supply mains, and the other connected across the armature terminals, thus forming a secondary circuit. Such a motor gives a considerable torque, is self-starting, and has probably an efficiency of 60 per cent. in one horse power machines. It has dead points in each alternation undoubtedly, but they are not very apparent. The chief difficulty is that owing to the configuration of the iron of both field and armature, and the air gap, the number of lines of force passing through the two circuits is not the same; and, moreover, there is a considerable lag between the primary pressure and current. And also, which is equally important, the primary and secondary currents are not in phase. With small armatures having few turns per coil the sparking is little, the best results being obtained when the axis of the armature field is at 90 degrees, or thereabouts, to that due to the exciting current. The armatures may advantageously be wound with two circuits, so as to avoid short-circuiting coils beneath the brushes.

2. USE OF CONDENSERS.

The next step in alternate-motor design was the attempt to balance the self-induction of the shunt-wound field magnets by a condenser, placed in series with the windings. If the condenser be correctly chosen for the frequency and the capacity of the circuit, its E. M. F. will theoretically be equal and opposite to the counter E. M. F. of the magnets, and so the exciting current will only have to be driven against the ohmic resistance of the winding, and moreover the pressure and the field current will be in phase. The armature has but small self-induction, and so its current will be also nearly in phase with the field current, and the maximum magnetism in field and armature will occur at approximately the same instant of time. Therefore the energy absorbed by the motor can be very nearly gauged by the product of the number of volts and amperes. In practice, owing to the armature reactions, the condenser will most likely not exactly counteract the counter E. M. F. at all loads. And again, even assuming such machines to be commercially practicable, they would only be suitable for one periodic time. If condensers were applied to series-wound motors, they would be coupled in shunt to the field windings; but the objections above mentioned are equally applicable. A most important point to be noticed in connection with condensers used in this manner is the relatively high pressure which might occur at the field terminals owing to fluctuations in the current. This difficulty can be obviated by arranging the condenser and windings in sections, but such a plan is open to objection on the score of complication. Messrs. Hutin and Leblanc have recently patented several modifications of designs involving condensers.

An interesting modification of the shunt-wound single-phase motor has been designed by Messrs. Stanley and Kelly. It is well recognized that the lag of the armature current does not coincide with that of the field current in an ordinary shunt-wound motor supplied with an alternating current, and hence the torque is not proportional to the armature current, but has a maximum for some particular value which must be determined experimentally for each machine. To meet this difficulty these gentlemen place a condenser in series with the shunt coils; and put short-circuited coils in recesses cut in the pole-pieces. These coils carry currents induced by and therefore proportional to the armature current, but always in such a direction as to tend to decrease the self-induction of the armature coils, and consequently the lag of its current also. The arrangement has the disadvantage of raising the interpolar resistance, and is likely to cause serious distortion in the main field.

It has also been proposed to supply the idle currents prevailing with alternate-current working by suitable condensers placed across the supply mains, preferably at the transformer substations.

3. SPLIT-CURRENT ROTARY-FIELD MOTORS.

Another attempt has been made in the direction of splitting the main current into two separate branches with phase differences of 90 degs., and so producing a bi-phase rotary magnetic field, the armature circuit being closed on itself, or through an external resistance, and carrying a current induced by the revolving field. In principle this machine is similar to a Tesla motor supplied with two separate currents, one of them lagging 90 degs. If a current be divided into two circuits with different coefficients of self-induction, the current in one will lag behind that in the other; and if the one circuit have no self-induction but capacity, and the other have relatively a large self-induction, then the phase difference can be made as near 90 degs. as desired. Such a machine has been designed by Messrs. Hutin and Leblanc, but the author does not know how far it has been successful in practice. The points gained by this arrangement, however, mark a considerable advance in the design of alternate motors for use off ordinary supply mains. The motor is self starting; non-synchronous; if stopped through overloading, will start again as soon as the excess of load is removed; and is self-exciting. But it appears to be still far from perfect; for, owing to the armature reaction on the field, it is difficult to see how the current, in the circuit containing the condenser, can be self-adjusting for varying loads with a fixed pressure of supply; and consequently the output of such a motor will probably be less than that of a Tesla one with two independent currents. The difficulties attending the condenser are precisely the same as those previously referred to with the synchronous type of motor.

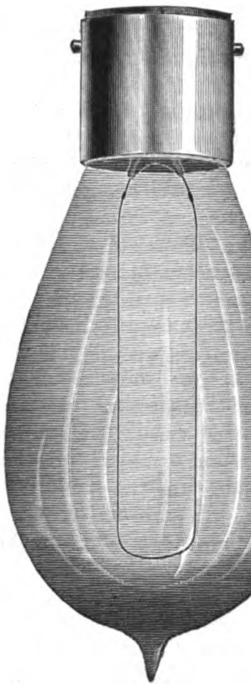
Messrs. Stanley and Kelly have recently devised a quadrature motor which presents some interesting features. In one of the circuits is placed a solenoid with low ohmic resistance but large self-induction; and in the other circuit is a series of secondary batteries which have capacity, and therefore act as a condenser. The result arrived at is a lag of 45 degs. in the current of the inductive circuit, and a corresponding advance in the capacity branch, the result being a total difference of phase of about 90 degs. between the two currents. The battery does not need to have large storage capacity; and as the number of plates is arranged so as just to prevent electrolysis there will be no "forming." But lead plates used in this manner in diluted sulphuric acid rapidly sulphate, and hence are likely to give trouble. Iron plates in caustic soda are also rapidly affected, and even carbon soon crumbles away. Platinum seems to be the only reliable material, and this at its present price is too costly.

(To be continued.)

The "Novak" Lamp.

At last the sitting hen has left her nest and her callow brood are all alive and picking.

The curiosity to know just what the chicks would look like when hatched has been unprecedented, so to allay this curiosity we herewith present a cut of one of the new arrivals, and furnish a brief description of the little bird whose tuneful notes, or, to be more accurate, brilliant rays, are destined to illuminate the footsteps of the troubled ones out of the condition of chaos which the recent litigation, up to a certain date, had evolved.



THE "NOVAK" LAMP.

To enter upon this description then, we may say that the "Novak" lamp may be styled a gas lamp, having no vacuum, and entirely different from any other lamp now on the market. That it is no experiment but a practical lamp of high efficiency is proven by the fact that numbers of them have actually been in constant use since December last. Blackening of the bulb in this new lamp is impossible, while its efficiency and life are equal to any lamp made. One advantageous feature of it is that it will maintain its initial efficiency throughout its entire life, having the same candle power to the very last.

Patents have been granted on this new lamp which the most eminent experts in the country agree in pronouncing free in any single detail from infringing any existing patent.

It is being made now by the Waring Electric Company at its factory, which has a capacity of 5,000 lamps a day. Messrs. Claflin & Kimball, Boston, are general selling agents, and not only is this firm receiving orders by every mail, but heavy shipments are being made from the factory every day.

Electric Rapid Transit.

It is reported that the New York, Canadian Pacific and Hudson Docking and Terminal Company, which intends to construct a road from Ogdensburg through the States of New York and New Jersey to the Newark and New York bays, has under advisement a proposition from the General Electric Company to equip the line with electric locomotives which are to haul the trains at the rate of 100 miles an hour.

A part of the plan is that the General Electric Company is to furnish electric light to all the cities and towns through which the railroad passes and also furnish power to manufactories.

Electricity in Agriculture.[*]

Influence of the Electric Current Upon Vegetation.

The influence of atmospheric electricity in the propagation of plant life has long since been recognized. Attempts, however, to solve the problem of the exact relations existing between this natural force and the growth of plants have been numerous, it is true, but invariably futile. The ill success attending these efforts naturally turned the attention of scientific agriculturists to another quarter—to the possibility of experimenting with batteries. Widely differing results have been published, and it has followed that neither the favorable nor the unfavorable influence can be said to have been clearly established. So far as the German experiments go, the substance of most of them shows results decidedly adverse to electricity—at least to its employment as a practical factor.

As early as 1859 one Helmert conducted a series of experiments with pine-tree seeds, peas, and lettuce. At one end of the planted area a plate of copper was sunk into the soil and at the other end one of zinc. The plates were then connected with an exposed copper wire. This method of introducing the current, I may say in passing, is usual. A more even and early germination of the pine seeds followed, though no acceleration in growth was perceptible. The peas and lettuce showed the beneficial effects in healthier leaves and blossoms and in improved fruit.

About two years later Fichtner, in exactly the same way, obtained the most brilliant results, as the following table shows:

Variety.	Yield of fruit per Austrian Joch.[*]		Straw.	
	Usual culture.	Galvanic culture.	Usual culture.	Galvanic culture.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Barley.........	2,048.2	2,935.2	3,290.7	5,187.8
Peas...........	2,523 3	3,085.4	3,349.1	4,407.7
Summer wheat	1,482.8	2,317.3	4,778	4,839.2
Buckwheat....	425.7	967.3	5,782.9	6.771.1

[*] 1 Austrian Joch = 1.422 acres.

The increase in the yield by electrical culture was from 16 to 127 per cent. higher than by ordinary culture. This experiment, however, was not considered of much value, because the ground electrized was laid with so-called air-drains, which had a favorable influence on the moisture of the soil, while the ground in an ordinary state of cultivation was not so drained. In order to observe the power of electricity to resolve the component parts of the soil, two samples of the latter were taken, one of which was subjected to an electrical stream for two weeks and the other left untouched. At the end of the time mentioned 100 grams of each sample were mixed with 1,000 cubic centimeters of water, and it was found that 0.135 gram of the electrized earth and 0.085 gram of the non-electrized soil were soluble.

Blondeau experimented with an induction, instead of a constant stream, and noted marked effects upon seeds and fruits. The latter ripened earlier, and apples, pears and peaches at once mellowed under the influence of the current. Pea, bean and wheat seeds were soaked in water to give them conductibility, then subjected to an induction stream lasting several minutes, and afterwards sown in selected garden soil. These seeds germinated much earlier than the others. Further, the growth of the plants was quicker, and their leaves and stalks stronger and of a darker green.

More recently (1882) Tschinkel called attention to the propitious influence of electricity upon plant growth. His tests showed a difference of from six to eight days in favor of the germination of seeds planted in soil through which the electric current had circulated. The plants also had a quicker and healthier growth. The observations of the experimenter led him to attribute the favorable influence of electricity to the decomposition of the salts and other component parts of the soil.

On the other hand, Prof. Wollny, of the Royal Technischen Hochschule, in Munich, obtained results of a distinctly different character. Dr. Wollny has collected in various publications most of the investigations that have been made, and his interest in the subject led him to conduct an independent series of experiments at the time of the International Exposition at Munich.[*] For this purpose two wooden boxes with glass covers were taken; they were 20 centimeters high, of like width, and 80 centimeters long. They were first filled with a like quantity of moist and carefully prepared garden soil. Next, at both ends of one box a zinc plate was sunk deep into the earth and connected with the pole of a battery consisting of 10 Meidinger elements. Further, both boxes were sown crosswise with a great variety of seeds—radish, barley, wheat, mustard, sunflower, etc.—and in such a way that the rows and plants were at equal distance. The plants under the influence of the electric current sprang up later and showed a much more uneven and feebler growth.

Perhaps the first experiments to be undertaken on a really extensive scale were those conducted by Prof. Holdefleisz in the summer of 1884 on the Wangern farm, near Breslau, and reported in the *Magdeburger Zeitung* the following year by Prof. Märcker.[†] Two theories are tenable to account for the influence of electricity: (1) Electricity affects plant growth in much the same way as other natural forces, as light and warmth; (2) it acts as a solvent and decomposes the component parts of the soil, especially salts, thereby enriching it. This influence may be established in two ways—the positive and negative. With regard to the negative method, if the electric forces in the atmosphere are beneficial to plant growth, it follows that an abnormal and unfavorable change would at once be perceptible if electricity alone of the natural forces could be excluded. The French agricultural chemist Grandeau succeeded in accomplishing this by means of an ingeniously contrived iron cage. The other natural forces were, of course, left in full play. The result was that the plants, deprived of their natural electricity, were very backward in their growth. The positive method —adopted in the Wangern farm experiment—consists, as would be implied, in the introduction of electricity by artificial means.

Prof. Holdefleisz had already observed the favorable influence of electricity on plants isolated in boxes with glass tops, but had very grave doubts as to whether it could be employed to advantage in the open field. In order to make the test, a beet-sugar field was selected with the plants already above the ground and in an even state of cultivation. The rows were planted from east to west. Copper plates 50 by 80 centimeters were sunk to a depth of 50 centimeters and in such a manner as to cover the width of two rows. The plates of each pair were 56 centimeters apart and connected through insulated wires with the positive and negative poles of a battery of 14 Meidinger elements. In still other rows electricity was generated without a battery. Copper and zinc plates were in the manner above described placed at a distance of 33 meters from each other and connected with wire. In order to increase the strength of the current, pairs of copper-zinc plates riveted together were sunk at regular distances between the two end plates, so that the following order was preserved: Copper, zinc, copper, zinc, etc. The same plan was followed with a field of potatoes. The experiment began on May 20 and was continued uninterruptedly the entire season. The following observations were taken:

The existence of the current could be detected during the entire summer.

With the aid of a delicate electrometer, the presence of the electric current could be established in the parcels between each pair of plates.

The rows with the battery plates did not differ during growth from those of other fields.

On the other hand, the rows with zinc and copper plates began about ten days after the commencement of the experiment to have a fresher and healthier appearance in comparison with the average of the other fields. This appearance continued as long as the tops were growing; from the middle of July, however, no further difference could be seen.

The crop grown under the influence of the battery current was in no way unusual, either in quantity or quality.

The yield of those rows with the copper and zinc plates showed a marked increase—15 per cent. in beets and 24 per cent. in potatoes.

No difference in quality was in any case demonstrated. The percentage of sugar contents fluctuated from 14.3 to 14.5; the average starch contents of the potatoes was 21.5 per cent.

The experimenter, while not regarding the test with copper and zinc plates as conclusive, considered it significant in view of the largely increased yield, and also as practical in view of the trivial cost of the necessary apparatus.

Prof. Holdefleisz's experiment was followed with great interest. One immediate result was to induce Oberamtmann Braune, of Biendorf, to undertake a series of tests along the same lines.[*] Seven rows of beets already above the ground were selected, each row 56 meters long. The two outside rows right and left were subjected to electrical influences in precisely the same manner described in the Holdefleisz experiment. A simple current generated by copper-zinc plates was applied to the two outside rows on one side and a 14-Meidinger-battery current to the two outside rows on the other. The battery was buried in a substantial wooden box to the same depth as the plates (65 centimeters). The three inside rows were left neutral. The experiment began on June 3, and was continued until the crop was harvested. No perceptible variation in the growth of the leaves or in the general appearance of the plants was at any time remarked.

The crop began to be harvested on October 26 and was at once analyzed with the following results:

Description.	Weight of beets per morgen.[*]	Polarization.			
		Brix	Sugar	Non-sugar	Quotient
	Centners[†]				
Simple current.	230	18	15.3	2.7	85.6
Battery current	235	17.9	15.5	1.4	86.6
Without electricity........	210	16.7	15	1.7	89.7

[*] 1 morgen = 0.63 acres. [†] 1 centner = 112 pounds.

These results in general confirmed those of Prof. Holdefleisz, both as regards quantity and quality. There was an increase in the yield of those rows subjected to the electric current—20 centners in the rows where copper and zinc plates were used and 25 centners where the battery was employed. On the other hand, with reference to the quality, the slight increase of 0.5 and 0.3

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[*] Report from Commercial Agent Washburn, of Magdeburg.

[*] E. Wollny. Ueber die Anwendung der Elektricität bei der Pflanzenkultur. Munich, 1883. Theodor Ackermann. P. 28.

[†] *Magdeburger Zeitung*, 1885, No. 207.

[*] *Magdeburg Zeitung*, 1885, No. 539.

per cent. in the sugar contents was regarded as too small to have any significance whatever.

But by far the most exhaustive experiments of all have been conducted by Prof. Wollny, whose special work in this field has already been referred to. The first of his series of tests took place in 1883 and was conducted on a rather limited scale.* Five garden plots were selected, each 4 meters long and 1 meter wide. There was a space of 1.2 meters between the plots, and they were all cut off from each other by planks sunk to the depth of 25 centimeters. Zinc plates were sunk to the same depth at each end of the three plots and connected with batteries by means of copper wires. In plot IV two copper and zinc plates were connected by a copper wire 1.5 meters above the soil; plot V was left untouched. A constant current was kept up from first to last. It was regulated by a galvanometer, and whenever the stream began to grow weaker the elements were renewed. This happened every three or four weeks. The current generated by the copper and zinc plates was weak compared with the others. The soil was everywhere in the same state of cultivation, and was composed of a calcareous sand 24 centimeters deep and resting on a vein of limestone. Further, each plot was divided into four sections and planted on May 2 with summer rye, beans, rape seed and potatoes.

In this manner each variety came under all the influences at work. The length of time taken in the germination of the seeds is shown in the following table:

Description.	Number of kernels.									
	May—									Total.
	7	8	9	10	11	12	13	14	15	
Summer rye:										
Induction stream	35	..	1	..	2	1	..	1	..	40
6 Meidinger elements	35	..	..	1	..	3	1	..	1	41
3 Meidinger elements	37	2	1	..	1	..	..	..	..	41
Copper-zinc stream	41	..	..	..	..	..	..	..	..	41
Without electricity	36	..	..	1	2	..	1	..	..	40
Beans:										
Induction stream	6	27	8	..	..	..	..	..	1	42
6 Meidinger elements	14	18	6	1	..	..	1	..	..	40
3 Meidinger elements	7	23	10	1	..	..	..	..	..	41
Copper-zinc stream	6	21	10	4	1	..	..	..	..	42
Without electricity	5	19	9	5	..	1	..	1	..	40
Rape seed:										
Induction stream	36	..	..	..	..	..	..	..	..	36
6 Meidinger elements	36	..	..	1	..	1	2	..	..	40
3 Meidinger elements	37	1	..	2	..	1	..	1	..	42
Copper-zinc stream	34	..	3	..	..	..	..	..	..	37
Without electricity	36	..	..	..	..	..	..	..	..	36

No variation in the germination of the seeds or in the growth of the plants was observed, and in almost every case the yield of those plants affected by electricity was considerably under the normal crop. The potatoes alone, grown in the sections where the copper-zinc stream was applied, showed an increase of 6 per cent. in the quantity and a slight improvement in the quality. This demonstrated evidently that the limit to which electricity might be applied with favorable results had been exceeded, and pointed to the advisability of using weaker currents by a repetition of the experiments.

The tests were next continued in 1886 and 1887. The plots selected were larger than those taken for the trial of 1883. Four rows were reserved, each 16 meters long, 2 meters wide, and separated from each other by a distance of 1.2 meters. Each row was divided into eight sections of 4 square meters. The soil, which was in part artificially built, had a depth of 30 centimeters and rested on a limestone foundation. It was harrowed in the spring of 1885 and again in the spring of 1886. Each section was fertilized with 200 grams of guano in 1886 and 400 grams in 1887. The manner of establishing the electric current was the same as before described. A different variety was planted in each one of the eight sections of the four rows and in corresponding sections. Weeds were carefully kept out. The strength of the current was ascertained every fortnight by means of the galvanometer, and the stream renewed whenever necessary. The copper-zinc current was very weak, the needle never registering at maximum more than 3° or 4°, while the Meidinger-battery current was somewhat stronger (12° maximum). This last was much weaker than in 1883. As in the preceding experiments, the germination and growth were alike.

Convinced by the results obtained from these experiments that the direct influence of electricity upon plant life was at best negative, and in most cases harmful, Prof. Wollny next turned his attention to an investigation of the indirect effects, i. e., the decomposition of the organic and inorganic substances of the soil. A given quantity of soil, selected with due care, was put into U-shaped glass tubes and subjected to various complicated processes. The proportion of carbonic acid generated in all the tubes, whether electrized or not, was well-nigh constant and pointed to the conclusion that the organic properties of the soil were in no way affected by the induction or galvanic stream. The experiment was continued long enough to furnish data with which to generalize.

So, too, with regard to the solubility of mineral properties, the tests made showed very little variation. The results are less reliable because of the difficulties surrounding the experiment. The soil was put into glass cylinders, and, after the conclusion of the experiment, upon analysis of 1,000 parts of dry soil, the following proportions were found to be soluble:

Description.	Kali.	Ammonia.	Phosphoric acid.	Spirits of niter.
Electrized	0.040	0.006	0.008	1.068
Non-electrized	0.085	0.010	0.015	0.077

To sum up, then, the question of the propitious or unpropitious influence of the induction or galvanic stream upon plant life has found in Germany, up to the present moment, no real practical solution; nor is one believed to be easily possible. While it is true that some few isolated experiments have been highly favorable to electricity, those conducted on the most extensive scale have resulted in very indifferent success. For the rest, it is evident that the obstacles in the way of locating with any exactness the point where the favorable influence stops and the unfavorable begins are too great, and a practical regulation of the current is scarcely to be hoped for.

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[*] E. Wollny. Forschungen auf dem Gebiete der Agrikulturphysik. Heidelberg, 1888. Carl Winter, Vol. XI, p. 94.

An Argument for Municipalization.

Dislike the fact as we may, the fact remains that we are rapidly traveling along the "checker'd paths" leading to complete municipalization—whether the roads run uphill or down we leave it to experts to prophesy and events to decide. The Glasgow Corporation, not content with having municipalized the water, gas and electricity supply, now contemplate applying to the Postmaster-General for a license "to supply the community with an efficient telephone service." A municipal telephone service is an experiment worthy of a trial—north of the Tweed. Even in the far East, local authorities have caught the infection. At the last meeting of the rate-payers of the foreign settlement north of the Yang-king-pang, a resolution in favor of buying out the local electric lighting company was carried by two votes, a majority having apparently been obtained by the Yang-king-pang argument that as there was a municipal *abattoir* there ought also to be a municipal central lighting station.—*Electrician*, London.

Frequency in Transformers.

Some years ago there was a very unprofitable discussion, says *Industries*, as to the relation between the dimensions and output of a dynamo. Professors multiplied the linear dimensions of phantom dynamos by *n*, and found the output was various fractional powers of *n* times that of the original phantom before they had tampered with it. The discrepancies were numerous, but they were all due to electricians assuming different conditions. The dynamos might be compared if designed so as to give the same efficiency, or the same final temperature. The copper might be run at the same current density, or the magnets at the same induction. If the same induction were employed, the armature of the large machine, when enlarged to scale, had too many ampere turns, and so on. Then again, the larger machine could not reasonably be expected to run at the same speed, so it had to go either with the same factor of safety or the same peripheral speed. Hence there were so many ways of comparing the machines that the results of the calculations did not agree.

We are now threatened with a similar pseudo-scientific epidemic with regard to transformers and frequencies. Mr. Steinmetz calculates that the output of a transformer varies as the three-eighth power of the frequency. Obviously, if a transformer of a given size is to be re-designed with the same weights of iron and copper for, let us say, increase of frequency, it may be designed to give an increased load at the same efficiency, or with the same percentage drop, or with the same total rise of temperature, or with the same light load efficiency, and it will have a different output in each case. Again, there is no reason why in the comparison we should adhere to the same weights of copper and iron. We might vary them, keeping the total weight or total cost the same. We thus have at once pointed out twelve different laws of the relation between the output and frequency of a transformer. If other comparisons are made, such as the same bulk with different weights of copper and iron, and if allowance is made for the relatively smaller volume of insulation on a high-frequency transformer, we obtain still more laws. It is therefore sincerely to be hoped the unpractical electrician will not flood the technical press with calculations as to the relations of output and frequency. He has so far spared us the discussion of the output of a phantom curve of sines for a transformer whose dimensions have been multiplied by *n*. Such calculations are quite useless.

A New Application of Photography.

Perhaps the most recent application of photography which has come to play quite an important part in scientific work is a registering device for recording a continuous reading of station voltmeters.

The apparatus is described as follows: An incandescent lamp is arranged so that the rays of light which emanate from the glowing filament are directed in a parallel sense upon a narrow slit, before which is placed the needle of the voltmeter. Obviously, in moving across this illuminated slit, the needle obscures the light and the shadow is then recorded upon the sensitized paper as a white image upon a dark ground (the image of the illuminated slit). By an ordinary clockwork mechanism the sensitized paper, which is rolled upon a drum, is caused to move at a regular rate, and the intervals of time are recorded upon it photographically at the same time as it receives the shadows of the moving needle.

Among the bills signed by Governor Flower last week was one authorizing a village to contract with electric light companies in an amount not exceeding 2½ mills for every dollar of taxable property within such village each year.

ELECTRICITY.

The Popular Electrical Journal.

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Candle Power of Arc Lamps. The conventional manner of rating arc lamps at present in vogue has been the foundation of numerous law suits and continual disputes between central station managers and customers, and is again called to mind by the recent candle power tests made in Buffalo by the City Chemist at the instance of the Board of Public Works. In this case it was found that the average of all the lamps tested was 786 candle power and in some lamps the tests showed less than 250 candle power, which, if correctly determined, point to the folly of attempting to rate arc lamps according to a photometric standard.

Without reference to this particular case, with whose merits we are not acquainted, it is well known to electricians, though unfortunately not to the public at large, that the 2,000 candle power standard which was adopted in Paris in 1872 is an entirely arbitrary one which it is impossible for any company to realize in a literal sense with any of the systems in use to-day. It is safe to assume that not an arc lamp in use for street lighting maintains its candle power constant at any figure for more than a few minutes, and this is inevitable owing to the nature of the mechanism by which these lamps are regulated.

From the standpoint of the customer whose object is to secure a certain amount of illumination and who contracts for a lamp of a definite power a photometric standard is desirable as he pays for the light furnished and is not concerned with the amount of energy supplied to the lamp. Contracts are invariably made on the basis of the 2,000 candle power standard, and wherever an attempt to interpret this literally is made trouble is sure to ensue. Central station men are entirely aware of this discrepancy but use the term 2,000 candle power in conformity with the standard adopted by the manufacturers of arc lighting apparatus.

In all of the arc lamps in general use the amount of illumination depends upon the length of the arc between the carbon pencils when the lamp is supplied with its normal current—generally about ten amperes at forty-five volts. The arc established by this current is maintained at the expense of the carbons, especially the positive one, which is gradually consumed. To keep the length of the arc constant, various mechanisms are employed for feeding down the upper carbon, and as the consumption of the carbon is irregular, depending on the fluctuations of the current and the variation in the density of the pencils, the feeding mechanism must be controlled automatically by the current according as the resistance of the arc varies.

In principle, therefore, the regulation of arc lamps is analogous to regulation by a fly-wheel, whose action depends on a certain amount of fluctuation in the machine which it governs, and for this reason an invariable standard of candle power is unattainable. These lamps vary in their efficiency, the candle power being maintained most nearly constant in those which respond the most readily to any fluctuations.

The impracticability of the present standard has become so apparent that a new standard is to be determined by the electrical convention in Chicago this summer. The most feasible suggestion appears to be a standard number of watts supplied per lamp of a definite minimum efficiency in watts per candle power.

* * *

Electricity in Agriculture. The use of electricity in agriculture, both as a motive power for farm machinery and a means of forcing plants by its direct application to the soil, has been reported upon by all our foreign consuls for their respective districts, and the facts appear to be that beyond a few experiments its use is unknown for either purpose. The tendency to apply electricity to every conceivable operation has led to a few experiments in the direction of its application directly to the soil in which plants are raised, but in Germany, where the only systematic attempts at this are reported, the results seem to argue against it, as, aside from the expense it involves, the current in most cases proved detrimental to the plants.

The cases quoted from the report of Commercial Agent Washburn, printed elsewhere, are the only notable ones mentioned, and they show such contradictory results that it is impossible to draw any general deduction from them except the fact that the expense of applying the current in this way far exceeds any benefit derived from its use.

The driving of agricultural machinery by electric motors is equally unknown in most places, and its introduction, like that of steam for this purpose, would be worse than useless on a farm of the usual size, as the interest on the plant during the eight or nine months when it would stand idle would undoubtedly overbalance the profits earned in three or four months of use.

It is also apparent from these reports that even if cases of the beneficial effects of either the application of the current or of electric light to plant growth could be verified, the difficulty involved in its extensive application would always preclude its adoption to any practicable extent.

* * *

WE PRESENT our compliments to the *Electrical World* for its publication of a thoroughly interesting account of the proceedings in the Columbia lamp case at St. Louis a week in advance of its contemporaries. The *Electrical World* is justified in taking credit to itself for this achievement.

The public, however, has a better memory than the enthusiastic editor of our esteemed contemporary, and has not forgotten that when the Goebel defense was first introduced by the Beacon Company at Boston, when it was brand new and a genuine sensation, the *Electrical World* shared with the *Electrical Review* and the *Electrical Age* the honors of the tail end, being exactly ten days behind its more progressive contemporaries, ELECTRICITY and the *Electrical Engineer*, in printing the facts in this remarkable case. Go to.

* * *

THE truth of T. Carpenter Smith's remarks at the St. Louis Convention has been amply demonstrated by the rush of orders which are coming in to the independent lamp factories.

"Sugar If Necessary." The efforts of the Trust's central station managers in Detroit to keep their grip on that city, which have finally culminated in the arrest of Manager Fitzgerald for bribery, are related in some detail in another column.

The story brings to mind the historic telegram sent by Mr. Richard Tricky McDonald to one of his agents in Indianapolis a few years ago.

This agent's name was Smith, and he had been endeavoring to close a contract for the city lighting. A majority of the aldermanic committee had not yet been converted. He wired Mr. McDonald for instructions.

There happened to be another Smith interested in the matter—a member of the Board of Aldermen and an opponent of the Ft. Wayne scheme. It was this Smith who, by accident, received the telegram in answer from Mr. McDonald, and he failed to keep its contents secret. It read :

"Sugar If Necessary."

If the investigating committee of the Detroit Council is thorough enough, it will perhaps learn that Mr. Fitzgerald was only obeying the orders of his chief.

It is needless to point out that such methods are a disgrace to the electrical fraternity from which the trade at large must suffer.

The proceedings in Detroit are added justification for the course pursued by ELECTRICITY.

We shall continue until the policy of the General Electric Company, and its executive officers, have been entirely changed, or until it is thoroughly known to all men that it is not a representative electrical concern, and that it is in direct hostility to the honest and legitimate Electrical Industry of America.

* * *

Alternating Current Power Distribution. A paper by Mr. Albion T. Snell on the subject of the distribution of power by alternating currents is commenced in this issue and is of special interest at present, in view of the demand which exists for motors of this description and the numerous attempts which are being made to produce an efficient machine of this kind.

The paper deals at considerable length with all of the types of alternating current machines which have been put upon the market, although in most cases it must be admitted that these motors have not proved of much practical value except for very small powers. The utilization of large water powers such as the Niagara Falls project, or the consumption of coal at the coal fields, as has been proposed in England, for the distribution of power by electricity, has many points which commend it to favor, yet every long distance transmission scheme must depend upon the alternating current where powers of any considerable size are involved.

At the present time the multiphase alternating systems appear to give the most immediate promise of success, and although the simple synchronous single phase motor is capable of efficient use in many cases it has been found wanting at least in the experience of central station practice.

The only thoroughly practicable system for distant transmission must be one from which both light and power may be taken, and Mr. Snell's paper points out the difficulties which must be overcome in order to secure this result efficiently.

* * *

COLUMBUS was a daring man,
Worthy of lasting fame—
His caravel had no dynamo,
But he got there just the same.

* * *

THE CITY of Detroit is now ready for the purchase of a large outfit of electrical apparatus, and honest men will have a show.

* * *

SINCE our last issue, showing by their own figures the results of the first eight months' business of the Electric Trust, their stock has dropped to 94¼.

* * *

ELECTRICITY first opened the eyes of the officials of the city of Detroit to the fact that their city was in the hands of a grasping and thoroughly unprincipled electric lighting monopoly.

* * *

THE Mayor of Detroit to the Mayor of Syracuse: "It is *not* a very long time between bribes."

* * *

THE pages of ELECTRICITY have sparkled with TRUTH in the past eight months; and the truth is not yet half told.

* * *

MAYOR PINGREE'S Investigating Committee should understand that W. H. Fitzgerald is only a tool. If they seek the fountain head of the opposition to the will of the voters of Detroit, the Director General of the corrupt combine, they will find him not in Detroit nor in Michigan, but not fat from Fort Wayne, Indiana, U. S. A.

* * *

WE ARE informed on good authority that Messrs. Schuckert & Company, of Nuremburg, Germany, have decided to follow the example of Siemens & Halske in establishing an American branch. The arrangements are said to be completed, and the American company will be backed by millions of capital, both German and American.

* * *

WE ADVISE the officials of the Trust not to visit the Fair. The whirling of the Eddy motors will be sure to make them dizzy, and the dazzling rays from the Standard arc lamps and the Westinghouse incandescents would probably produce several cases of blind staggers.

* * *

OUR SYMPATHIES go out to the Edison licensees. Their luck is hard.

* * *

"SUGAR if necessary" has no place as a watchword in honest business.

* * *

THAT hen is off, and the fighting game cock is Novak. May he win many battles.

Personal.

Mr. K. J. Sunstrom, chief engineer Stora Kopparbergs Bergslags Aktiebolag, of Stockholm and Falun, Sweden, has just arrived in Boston, where he will devote a week in studying the machines and process of the Electrical Forging Company.

Trusts.

A Philosophical Dissertation.

There has for several years manifested itself in the commercial and manufacturing interests of this country a tendency for centralizing or concentrating their productive resources with a view of controlling the entire output of certain industries and thereby direct the public market. Such manipulations are now popularly known as combinations or trusts.

One of the most prosperous and successful enterprises of this character is the Standard Oil Trust, and there are very fair reasons for the assumption that the very success of this corporation has been an impetus for numerous attempted imitations and emulations, the aims of which, however, were not equally resultant in profit and success. Why these different results, will be seen later on.

The fundamental principle governing the idea of the modern commercial combinations or trusts is as old as the world itself, and is merely a modification, or a new and different application, of the old saw, where the individual usurps the rights and power of everyone else.

We find the principle of commercial trusts carried out in all countries ruled by an autocratic government. The Czar of Russia, for instance, is the personification of a political trust, who assumes the rights, the privileges and the power which in reality belong to his many millions of subjects.

Thus we see that the inherent principles involved in the system and methods of commercial trusts are most palpably and flagrantly opposed to the principle of Americanism; and yet inexplicable as it may seem, we find that the commercial ground of this country has been more fertile and conducive to the generation of these parasites than any other country. Owing to this fact, however, that trusts have become most prolific in an element totally foreign to their nature, it may be justly prosumed that their existence is merely transitory. They have been reared by commercial minds of a character diseased and absolutely devoid of the ethics of true morality; and while even under such conditions it may be possible to achieve commercial success, this success can only be of temporary duration. Hence we may state that American commerce is now migrating through an era of trusts, but it will be nothing more than an era, and for the reputation of our nation's commerce it is to be hoped that it will be succeeded by something more ennobling.

Enumerating all the different trusts of to-day, and looking at the list from the Standard Oil Trust to the Electric Trust, we may divide them into two classes. One comprises commercial combinations formed for the control of natural products, and the other for the control of manufactured products.

Of these two, the former kind is not so difficult to manipulate towards a successful issue as the latter. In the first place the object in view can be attained by the mere consideration of purchase price only, and hence the question of money is the chief one involved. For instance, to control the oil market the possession of the largest amount of fields of producing oil wells successfully corners the entire business. To form a lead trust, the combination which controls all or nearly all the producing lead mines is in a fair position to dictate prices.

It is similar with a copper and silver trust. A wheat trust, however, would only be permanently successful by a controllership of all the wheat-growing lands of the country.

According to the measure in which such a controllership is completed, the operations of the trust are more or less successful. Because the

Standard Oil Company owns practically all the crude oil produced in this country, its control of the market is supreme.

There have been many pleas of justification for the existence of trusts brought forward; mere discussion of such a thing is purely waste of time. You cannot wash the devil white, and even the greatest argumentative talent of modern times will not be able to produce evidence and facts to upset this truth—that the principle which assails the fundamental laws of human independence of action, and attempts individual usurpation of a force rightly belonging to all, is attacking the laws of nature, and therefore must be essentially wrong.

Supposing that there were in existence to-day the Standard Water Company, owning and controlling all the wells, rivers, lakes, in fact every drop of water in this country, does any one mean to aver that such a monopoly could justify its right of existence, even were this company to distribute the water free to the public. No! though it might be true that the water would be free to everybody, yet this freedom would only exist by the grace of the Standard Water Company, and since that corporation was controlling something which by the laws of nature should belong to all, the principle of the trust still finds its application, and it is safe to venture the assertion that under the above described condions the peotip by ulle wod arise in a bodandreak up the Standard Water Company. There is a vein of independence of action in human nature which rebels at doing certain things at the bidding of somebody else, whether it be to drink water, to buy kerosene oil, lead, copper, sugar, or electrical apparatus, and therefore any individual or organized body of individuals banded together for the purpose of compelling the distribution of any product, natural or manufactured, according to their dictation, will soon find itself undertaking a task beyond the capacity of human nature.

Viewing the formation of trusts it becomes at once evident, whether the aim is to control the natural or the manufactured product, that a successful issue can only be arrived at by obtaining possession of the source of supply, and as these sources are of larger or smaller number, in the same ratio increases or diminishes the difficulty of success. And while the range of these sources of supply in the natural product can be much easier calculated than in the manufactured product, it is also evident that in the same proportion the formation of a trust for the control of the manufactured product is much more difficult.

Take the Electric Trust, being of the most recent birth, and let us look at the many obstacles there are, insurmountable ones at that, which make it the most flimsy attempt in the history of trusts, and one which will never be any more successful than the attempt to form a drinking water trust.

The electrical industry has, in a few short years, risen to the eminence of one of the greatest fields of commercial enterprise in the world. Its sources of supply are manifold. Attracted by large profits in the business, manufactories have been established everywhere, equipped with first class electrical talent, good machinery and backed by unlimited capital. To control all these hives of industry and concentrate them under one great body would cause the cutting off of a good many bright, ingenious, energetic heads. Now these men bereft of their former fields of operation, have not lost any of their ambition, their intellectual abilities or their energy, and they will immediately look around for a field where their ability finds again the same scope it formerly enjoyed. In other words, new companies will constantly spring up, and the great Trust would again and again be confronted with fresh rivals, and while they might be insignificant at their inception, their growth is very probable. Hence we find that one source of supply to the electric industry, the ingenuity of human brains, the control of which is essential in the successful operation of the Electric Trust, it is very difficult to pürchase.

Another obstacle, and also a very formidable one, which is involved in the absorption of the smaller electric manufacturing companies, is the difficulty of inducing the owners of the smaller concerns to give up their independence and allow themselves to be subjected to the dictations of a trust. True, money talks, and most men have their price, but the smaller houses number many, and there are some of them operated by men who prefer to run their own works at a small profit rather than accept the proposition of a combination, even at the prospect of personally enriching themselves. Fortunately also for the electric industry of this country, it has a very good representation in the press, and while hitherto the voice of independence has only found its clarion notes in the columns of ELECTRICITY, that voice has nevertheless been a very strong one, and more than once have its echoes sounded like funeral dirges to the General Electric Company. That the other papers will have to follow in the wake of ELECTRICITY is merely a question of time.

Finally we come to the rock upon which the sinking ship of the electric combination is bound to shatter. This rock is the great aggregation of purchasers of electrical apparatus. The manifestation of their opposition is two-fold. The first is the spirit of independence innate in every true American who has an inborn hatred to submitting to dictation. This is a point mentioned above, and it is one of the greatest importance in this case, because the purchasers of electrical apparatus, such as the directors and managers of electric lighting plants, are most wide awake business men, men of affairs and men of financial education. Then comes the point that it does not take these men long to realize that the establishment of an electric combination controlling the manufacture of electrical apparatus will place them in a dependent position. It will not be any longer a question of buying such apparatus as suits the central station men, but of buying what the Trust chooses to sell them. It will not be any longer a question as to getting the benefit of competition, but of paying the price the Trust chooses to make. For these reasons these men are even now looking upon the machinations of the Trust with a spirit of antagonism. Many of them have openly declared that they will buy electrical apparatus from anybody in preference to purchasing from the General Electric Company, a fact which makes the opposition of the smaller manufacturing companies much easier.

Take it therefore all in all, the existence of trusts is on the decline. The trade has been awakened to the fact that competition, the soul of all business, is being attacked. The public is being aroused, and is beginning to realize that one of its dearest prerogatives, the spirit of independent action, is sought to be annihilated.

Our houses of legislation will be prompted to action, the National Government will take a hand in the pernicious activity of combinations, which cannot help but are sapping away the true greatness of our national commerce, and we may confidently look forward to an early dawn, which will show the firmament of America's commer cial sky unsullied in the clear light of fair dealing, and offering a chance for every honest enterprise.

PHILOSOPH.

COMMUNICATIONS.

No Summer Meeting.

To the Editor of ELECTRICITY.

At a meeting of the Executive Committee of this Association, held to-day at this office, it was decided that the Association would hold no convention the coming summer.

Very respectfully,
GEO. F. PORTER, Secretary.

Office of National Electric Light Association,
New York, April 27, 1893.

A Correction.

To the Editor of ELECTRICITY.

In the issue of your esteemed journal of April 19th last, referring to M. D'Arsonval's statements that criminals and lower animals are not killed by dynamic electricity, but are rather thrown into a sort of trance, you write that these views "are supported" by me in an interview appearing in the New York *Sun*. If you will kindly again refer to that interview you will see that my contention was *not* that the animal (criminal or otherwise) was not killed as D'Arsonval states, but that I knew of no way of settling the horrible doubt he has raised as to whether the subject was not actually killed upon the autopsy table by the surgeon's knife except in such cases to defer the autopsy and await the signs of death due to decomposition. I also carefully stated reasons in the interview why I believed that the abolition of consciousness was instantaneous, and death equally instantaneous.

The answer to M. D'Arsonval is a very simple one, viz., defer the autopsy until signs of putrefaction appear. This is the point I tried to emphasize.

Yours very truly.
WILLIAM J. MORTON.

The Stanley-Kelly Motor.

To the Editor of ELECTRICITY.

In connection with the article on the Stanley-Kelly motor in your issue of the 26th inst., allow us to say that throughout the development of our system we have received great aid from all our associates, and that we are indebted to them for valuable suggestions, especially so to Messrs. C. C. Chesney and W. B. Tobey.

WILLIAM STANLEY, JR.
JOHN F. KELLY.

SOCIETY NEWS.

Chicago Electric Club's New Officers.

At the annual meeting the following named officers were elected for the ensuing year:

President, J. P. Barrett; 1st vice-president, F. W. Parker; 2d vice-president, E. Baggot; 3d vice-president, F. W. Cushing; 4th vice-president, Geo. Cutter; secretary, F. L. Perry; treasurer, J. W. Johnson; managers, F. W. Horne chairman, L. A. Ferguson, S. A. Douglas, M. A. Knapp, J. W. Buckley, E. C. Ferguson, C. T. Page, A. S. Terry, Ben. Williams, L. S. Hills; membership committee, C. C. Haskins, T. G. Grier, D. G. McDougall; house committee, T. B. Badt chairman, F. E. Degenhardt, H. P. Lucas.

California Electrical Society.

At the last meeting of the California Electrical Society, held April 17, a paper was read by Mr. Geo. P. Low on "What the Electrician Finds of Interest in Southern California," illustrated by photographs.

The officers elected for the ensuing year are Geo. P. Low, president; C. O. Poole, vice-president; Max Caspari, secretary; H. T. Bestor, treasurer.

TRUST METHODS.

The Manager of one of the Trust's Central Stations Under Arrest.

BRIBERY IS CHARGED.

The Detroit Combine Appears to be Broken.

William H. Fitzgerald, Secretary and General Manager of the Detroit Electric Light and Power Company, was arrested on Tuesday, the 25th of April, on the charge of attempting to bribe an alderman.

The charge is preferred by Alderman Protiva, who claims that Mr. Fitzgerald went to his house at 5 o'clock on that day and offered him $1,000 for his vote in the Common Council on all matters pertaining to the Detroit Electric Light and Power Company.

Alderman Protiva has testified that he pretended to accept the offer, and that Mr. Fitzgerald paid him $200 in cash, and promised to pay him $200 the next day and the balance at some time in the future.

During the session of the Common Council the same evening Mayor Pingree produced the roll of bills, which he waved dramatically in the air as he told the story of Alderman Protiva's accusation. The money was that which Alderman Protiva received from Mr. Fitzgerald.

City Prosecuting Attorney Frazer has charge of the case, and says he has been watching the movements of Mr. Fitzgerald and certain aldermen for weeks with this move in view. He was well informed as to the day for the boodle to be paid out.

Readers of ELECTRICITY are familiar with the progress of events in Detroit lighting matters during the past six months.

A few years ago, when an act was passed by the Michigan Legislature enabling towns and cities to erect municipal plants, cities above a certain size were excluded through the efforts of the Fort Wayne Company.

Recently, Mayor Pingree, of Detroit, backed by large numbers of the representative business men of the city, succeeded in getting this limitation removed by the Legislature. The intention was to build a municipal plant for the city of Detroit, provided a reasonable contract could not be secured with the Detroit Electric Light and Power Company.

The final authority for proceeding with the city plant must come from the Board of Aldermen.

A resolution had been offered by Alderman Vernor, shrewdly worded, but which would have had the effect of killing the municipal plant, for which the citizens of Detroit had voted by an overwhelming majority. Mayor Pingree had vetoed this resolution. The necessary votes to override the Mayor's veto were not to be had honestly, and it is said the sum of $25,000 was to be devoted to procuring these votes.

Alderman Protiva, acting in accord with the Mayor, received Manager Fitzgerald graciously, and accepted his first instalment of $200 on the spot.

At the Council meeting later in the evening the question of the Mayor's veto came up, and it was soon apparent that something had happened. A majority was in favor of sustaining the veto, and there was a scramble among the Mayor's opponents to get their votes changed.

Mayor Pingree finally asked permission to make a few remarks, and drew from his pocket the $200 in bills which Fitzgerald had paid to Protiva three hours earlier. The money was turned over to the President of the Board, and an investigating committee was appointed.

Mr. Fitzgerald spent the night in the station-house, and was released on $5,000 bail the next day.

Prosecuting Attorney Frazer is quoted as follows:

> "I have been keeping tab on those fellows for weeks. I have been keeping track of every move they made. They commenced shoving out the boodle on the 25th. There isn't the slightest question about the money being given to Alderman Protiva. Fitzgerald said he would have given him more than the $200 if it had not been after banking hours."

To Be Reopened.

The Sunbeam Lamp Case in Court.

The Sunbeam Incandescent Lamp Company filed a motion in the United States Circuit Court at Chicago last Tuesday to dissolve the restraining order granted to the General Electric Company some time ago, prohibiting the former company from manufacturing or selling incandescent lamps.

The attorneys on both sides of the case met in Judge Grosscup's court on Thursday last, and after a short discussion the attorneys representing the General Electric Company agreed to join the Sunbeam Lamp Company in a motion to modify the restraining order to the extent of allowing the latter company, by giving a bond, to manufacture their lamps, and in return the Sunbeam Company agreed to a hearing of the case in July.

After this agreement was made the counsel for the General Electric Company telephoned their action to the chief counsel in New York, and received word in reply that they would not agree to bind their company to the arrangement made by the local counsel.

Not having filed an answer, Counselor Payne withdrew the motion. The original motion to dissolve the restraining order is, therefore, now before the court and will be heard in the course of the next ten days.

The electric light has been introduced into a new flour mill near to the supposed site of Calvary and close to the Damascus gate at Jerusalem.

Legal Notes.

The suit of James W. Bennett against the Erie Telegraph and Telephone syndicate, which has been before the courts in Massachusetts since 1886, has been finally settled. At a conference held between Mr. Bennett and a representative of the syndicate it was agreed to enter judgment for neither party. This was brought about by the agreement on the part of the syndicate that no claim would be made for damages on account of keeping the property of defendants tied up for nearly seven years. The case has cost both parties between $20,000 and $25,000. The amount obtained in the three suits had they been decided for plaintiff would, it is said, have amounted to no more than $35,000 or $40,000.

The Highlands Electric Light Company was about to put up wires in Eleventh avenue in Highlands, Col., when the Colorado Telephone Company applied for an injunction restraining the light company from using the avenue on the ground that its wires, which run along the thoroughfare, would be injured by the induction of the current from the electric light wires if placed where it was intended. The court's order was that the light company should construct its wires high enough above the telephone wires to avoid the induction.

The opinion of the court restraining the Norristown Passenger Railway Company from increasing the capital stock or using any shares of stock beyond one thousand (its original capital) by virtue of any resolution of stockholders passed on the 5th day of April, 1893, is based wholly upon the ground that a railway company is a private corporation, which, under Article XVI, Section 7, of the Constitution of Pennsylvania, "Cannot increase its stock or indebtedness without the consent of the persons holding the larger amount in value of the stock first obtained, at a meeting to be held after sixty days' notice, given in pursuance of law." Only eight days' notice of the special meeting of April 5th had been given, and therefore the court holds that the stock authorized at that meeting cannot be legally issued.

The Schuyler Electric Light Company, at present furnishing light for Hagerstown, Md., has filed a bill in court asking an injunction restraining the street commissioners from closing the new contract for lighting with the street railway projectors. The grounds for the suit are that the commissioners were going out of their jurisdiction in allowing the guarantee of a railway to influence their decision in the light contract award.

Chancellor McGill has granted an order upon the officers of the Franklin Electric Light Company of Cape May, N. J., to show cause why a receiver should not be appointed. The writ was made returnable at Trenton Tuesday of this week. The company's indebtedness is reported at about $14,000, divided as follows: Ed. D. Mullen, $3,700; J. Henry Edmunds, bond, with accrued interest, $9,000, and outstanding floating debts making up the balance. The officers of the company, as originally constituted, are: President, F. J. Melvin; secretary and treasurer, J. M. E. Hildreth; superintendent, J. E. Taylor; directors, W. B. Miller, Lafayette Miller and the officers of the company.

Marine Electric Lighting.

Electric Plant, an English electrical journal, has just issued an elaborately illustrated special number devoted to marine electric lighting and other applications of electricity to novel purposes. The descriptions relate to the English, American and French navies, passenger ships and pleasure yachts, and comprise a most interesting resumé of the numerous ways in which electricity is now utilized on shipboard.

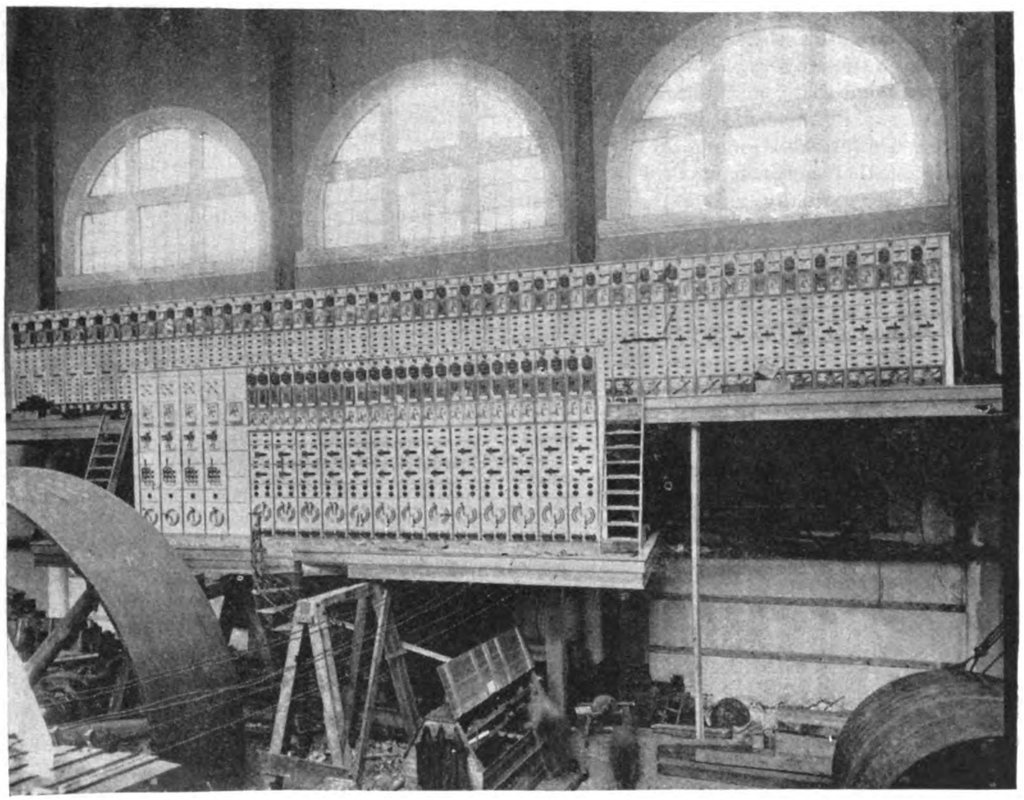
World's Fair—Department of Electricity.

In no week during the preparation of the Columbian Exposition has a greater progress been made in arranging for exhibits than during the past week.

Additional men have been put to work, and although the exhibits were not all in place on May 1st, enough laborers have been engaged to have the Exposition ready for visitors during the second week.

In the Electricity Building the General Electric Company have a portion of their exhibit in place. The generators exhibited consist of twenty-four dynamos which range in size from 300 kilowatts to ½ kilowatt machine. The Western Electric Company have a large force of men engaged in erecting their exhibit, which is located in the southeast corner of the building.

Unless some new arrangement can be made, the large search-light, about which so much has been written, will not be displayed at the fair. Director of Works Burnham decided last week that the roof of the Manufacturing and Liberal Arts Building would not sustain the weight of the apparatus necessary to operate the light. It is hoped that some arrangement will be made to build a special tower on which to mount the 20,000,000 candle power lamp.



THE MAIN SWITCHBOARD AT THE WORLD'S FAIR.

The Westinghouse switchboard, shown in the illustration, has at last been completed, and wiremen are now engaged in connecting the various circuits to their respective positions on the board. The switchboard is undoubtedly one of the finest ever built, and at the same time the largest in this country. The board is made of white marble, finely polished, and is elevated about 20 feet above the floor of the Machinery Hall. The lower part of the switchboard is 32 feet long and 11 feet high, and contains the switches for connecting the dynamos. The upper portion is 70 feet long and 10 feet high, and is used as the distributing board.

Sleepy Eye is the name of a Minnesota town which has just made a contract with the Thomson-Houston Company of St Paul for an electric light plant to cost $10,000. When they get new light, the citizens may be able to find a livelier name for their town.

BOOK NOTICES.

ALTERNATING CURRENTS OF ELECTRICITY. By GISBERT KAPP, C. E., 1893. THE W. J. JOHNSTON COMPANY, LTD., New York. Price $1.00.

The principles of alternating currents are developed in this book in a simple manner that can be followed by any reader, and the various applications are sketched in a broad and instructive way that clears away the many mysteries with which they were supposed to be surrounded. The few mathematical formulæ in the book are confined to appendixes.

The first four chapters are devoted to explaining alternating currents and their measurements, and the three succeeding ones are on the principles and design of alternating current machines and transformers. Chapter VIII is on alternating current central stations, and Chapter IX is on the parallel coupling of alternators.

The remaining chapters treat of various forms of alternating motors, especial attention being paid to the explanation and discussion of multiphase motors. This subject is treated so clearly that the reader is enabled to form as clear an idea of these new forms of motors as of the simpler continuous current machines.

The treatment throughout is thoroughly practical, and the data and discussion on the design and construction of apparatus will be found useful to the electrician and designer.

ENGINE ROOM CHAT. By ROBERT GRIMSHAW, M. E. PRACTICAL PUBLISHING COMPANY, 21 Park Row, New York. Price $1.00.

This book consists of a collection of paragraphs concerning the work of engineers and firemen of steam plants, written in a popular style, and contains some good advice as to the duties of this class of workers.

A number of these sketches have appeared in the *Engineering Magazine*, *Dixie* and elsewhere, and others appear for the first time in the present volume.

The book will be mailed, post paid, by the publishers on receipt of price.

The World's Fair Opened.

President Cleveland Presses the Button which Starts the Wheels in Machinery Hall.

Over a Hundred Thousand People Present.

Four Weeks More of Work to Put the Exhibits in Perfect Order.

While the exhibits at the World's Fair are by no means in perfect readiness, the formal ceremonies of the opening took place according to the original programme on Monday last, in the presence of upwards of one hundred thousand people.

After the playing of the "Columbian March," prayer was offered by the Rev. W. N. Milburn, the blind Chaplain of the United States Senate.

Following this came the reading of W. A. Croffut's poem, "The Prophecy," by Miss Jessie Couthoui, and the address of Director-General Davis.

President Cleveland then spoke as follows:

"I am here to join my fellow-citizens in the congratulations which befit this occasion. Surrounded by the stupendous results of American enterprise and activity, and in view of magnificent evidences of American skill and intelligence we need not fear that these congratulations will be exaggerated. We stand to-day in the presence of the oldest nations of the world, point to the great achievements we here exhibit, asking no allowance on the score of youth. The enthusiasm with which we contemplate our work intensifies the warmth of the greeting we extend to those who have come from foreign lands to illustrate with us the growth and progress of human endeavor in the direction of a higher civilization.

"We who believe that popular education and the stimulation of the best impulses of our citizens lead the way to a realization of the National destiny which our faith promises, gladly welcome the opportunity here afforded us to see the results accomplished by efforts which have been exerted longer than ours in the field of man's improvement, while in appreciative return we exhibit the unparalleled advancement and wonderful accomplishments of a young nation, and present the triumphs of a vigorous, self-reliant and independent people.

"We have built these splendid edifices, but we have also built the magnificent fabric of a popular Government whose grand proportions are seen throughout the world. We have made and here gathered together objects of use and beauty, the products of American skill and invention; we have also made men who rule themselves.

"It is an exalted mission in which we and our guests from other lands are engaged as we co-operate in the inauguration of an enterprise devoted to human enlightenment, and in the undertaking we here enter upon we exemplify in the noblest sense the brotherhood of nations. Let us hold fast to the meaning that underlies this ceremony, and let us not lose the impressiveness of this moment. As by a touch the machinery that gives life to this vast Exposition is now set in motion, so at the same instant let our hopes and aspirations awaken forces which in all time to come shall influence the welfare, the dignity and the freedom of mankind."

When the President had finished his speech he stepped over to a table draped with the American flag.

Mr. Cleveland struck the electric button vigorously, and the circuit to the Allis engine and the Worthington pump was at once thrown on. There came a roar of revolving wheels from Machinery Hall, the fountains in the lagoon burst forth into active life, the veil which covered the immense bronze figure of Liberty was thrown aside, and the screaming of hundreds of steam whistles filled the air.

The great orchestra took up the grand strains of the "Hallelujah Chorus" of Handel, and the World's Columbian Exposition was formally opened.

Some Applications of Electricity to Chemistry.*

Most of the applications of electricity to chemistry depend on the electrical decomposition of saline solutions, or electrolytes. A glance at the work of the chemist shows that a very large proportion of his labors consists in oxidizing or reducing the various substances with which he deals. Sometimes he is making changes or substitutions, but his chief work is oxidizing and reducing. Here, then, we have at once the reason why electricity is becoming so important. Consider for a moment the advantage of the electrical over the chemical method. Take the case of water already mentioned. To reduce it to hydrogen it would have to be, let us say, heated in contact with iron, carbon, or something which has enough affinity for oxygen to abstract it from the water. In this case, the hydrogen is set free, but the oxygen is not; it is combined with another body. Again, to oxidize the chloride some such treatment as that with manganese dioxide and sulphuric acid is necessary. By electrolysis, however, the oxygen and hydrogen, or the copper and chlorine, are produced direct without any complications and without introducing foreign substances. When it is remembered that many of the ores from which the metals are obtained are oxides, and that the smelting of these consists of reduction only, and is carried out in a manner which gives impure metals, and that the remaining ores are mostly sulphides, which are roasted into oxides, and then reduced, it will be realized that electricity has a magnificent future in metallurgy. This is not by any means all. The important alkali industry consists of splitting up common salt into caustic soda and chlorine, and the process of manufacture, as at present carried on, is a bewildering maze of oxidation, reduction and substitution. In making alkali and bleaching powder by the Leblanc-Weldon processes, beginning with salt and pyrites and ending with caustic and chlorine, there are, taking it favorably, four oxidations, one reduction, and three substitution processes. By electrolysis, salt is decomposed into caustic soda and chlorine at one operation without the aid of any other chemicals, and without any waste, loss, or by-product. Direct electrolysis of solutions of salts is by no means the only process available; fused salts can be electrolized, and aluminium is reduced extensively from its salts by this method. It is probable that sodium and potassium will soon be produced from their fused salts in the same way.

Electro-deposition is now largely practised in copper refining. Crude copper is cast into anodes and placed in vats of sulphate of copper with thin sheet copper cathodes. The copper is dissolved off and deposited on the thin cathode plates. The silver and gold fall to the bottom, with various impurities, such as antimony and arsenic. The silver and gold are thus completely separated, and the crude copper is changed for the much more valuable pure product. Lead would be treated much in the same way if it were not that it is apt to deposit in a loose spongy form, instead of in a coherent mass. Electrical processes are also coming into use by which many of the ores are merely roasted to convert them into oxide, and then dissolved in acid, the solution being electrolized to yield the metal in a state of almost perfect purity.

One of the most important applications of electricity will be in the manufacture of soda and bleaching powder direct from salt. If a solution of salt is electrolized, caustic soda is produced at the cathode and chlorine is given off at the anode. The chief difficulty is to find a good material for the anodes. Carbon is the only material available. It is attacked to some extent, not by chlorine, but by oxygen; but electrolytic soda has now reached a stage in which this last difficulty may be said to be overcome by using a form of carbon which is so cheap that its corrosion does not much matter. At Snodland there is a model caustic plant at work which has been making soda and bleaching powder by the ton for some time. If the caustic is allowed to mix with the rest of the liquid, chlorine is no longer given off, but the salt is changed to hypochlorite of soda. This may be used for bleaching. If the operation is now carried on at a higher temperature, chlorate is formed. Chlorate of potassium is now manufactured on a large scale from the chloride in this way.

One of the most complicated branches of the study of chemistry is the formation of dyestuffs. Oxidation and reduction can frequently be carried out by electrolysis without introducing special oxidizing and reducing agents. Here, then, is a wide field for scientific research. Dr. Goppelsroeder has done a great deal of work on the subject, but it is well worthy of further attention. Whether such a process is valuable commercially is a matter of doubt, but it provides the chemist with a new method of investigation, and may lead to important discoveries in this branch of organic chemistry.

Electricity also derives benefits from chemistry. Faraday discovered that the quantity of metal deposited was strictly proportional to the quantity of electricity passed through the solution. This has provided electricians with a very exact method of measuring quantities of electricity. Lord Rayleigh has made very careful determinations of the exact weight of silver deposited by a unit quantity of electricity, and this measurement now serves as the practical standard for the measurement of electricity, and hence of electric currents.

An Electric Yacht Libelled.

The yacht Electron was recently libelled in the United States District Court by the Electro-Dynamic Company to recover a balance of $2,000 due for furnishing the yacht with 250 additional storage batteries and other material in 1891. The batteries were added for the purpose of increasing the motive power and giving the yacht more speed. It was found that the additional cells did not increase the speed to the desired limit; and the owner not only refused to pay the $2,000 demanded but entered a cross-suit for the recovery of $2,000 already paid. Judge Addison Brown, before whom the case was brought, decided in favor of the electric company on the ground "that the whole subject was in the nature of an experiment which, whatever may have been the hope or expression of confidence as to the result in increased speed, no warranty or guarantee was assumed by the libellant."

The defence having alleged that the batteries were an infringement of the Brush electric patents, the Judge ordered the libellant within thirty days to procure from the Brush Electric Company a license to enable the yacht to continue the use of the batteries.

Current Items.

The ideal method of using electricity in manufacturing, in the view of Alexander Siemens, is to supply an electric motor to each machine tool. This reduces the strengthening necessary for floors, and dispenses with shafting, counter-shafting, bands and pulleys. Lord Kelvin has made calculations to show whether power can better be transmitted by shafting and belting or by electricity. His results prove that electric transmission supplied to the machines at least 70 per cent. of the indicated horse power, while with the shafting not more than 60 to 63 per cent. is made available.

Russian engineer officers have been experimenting with an electric hand-lamp of Russian invention. It seems to be well adapted to the inspection of mines and trenches at night. The lamp, or lantern, is in the form of a tube two and a half feet long, the interior being made of tin. Tiny cells, forming a battery, are placed in this tube and connected in a special manner. The light is enclosed in six plates of glass at the top of the tube, and the brilliancy is regulated by a screw at the lower end.

Nelson Perin, president of the City and Suburban Railway Company, has been presented by the residents of Towsontown Md., with a silver pitcher bearing the following explanatory inscription: "Presented to Nelson Perin, president of the City and Suburban Railway Company, by the citizens of Towsontown, Baltimore County, Maryland, as a testimonial of their appreciation of his enterprise, displayed in completing the electric railway from Baltimore to their town."

H. Sellers McKee, the electric railway magnate, says it will not be long before an electric line will be built between New York and Philadelphia, and the run between the two cities made in one hour with one stop only (at Trenton). The cars and rails will be of a special design and very heavy in construction, with the cars built so as to bring the center of gravity near the track level. The engines and motors will be of special pattern and extra power. "All these difficulties," adds Mr. McKee, "I am confident the ingenuity of George Westinghouse will surmount."

India now boasts the finest land telegraph service in the world. Recently duplex messages were transmitted without relays a distance of 2,100 miles over a line extending from Calcutta to Madras. The wire employed was of copper, and the feat was rendered possible by the employment of an apparatus introduced by a member of the Indian Telegraph Staff.

After a debate extending over three hours, the Senate of the Connecticut Legislature passed the General Electric Street Railway bill by a vote of 17 to 5. It becomes imperative that a majority of all directors of all street railways must reside in the State. This will place control of all electric roads and street railways in the hands of local authorities, subject to the restrictions made by the railway commissioners regarding carrying freight and paralleling steam railroads.

Last Monday the Boston *Journal* appeared as a 60-page sheet in commemoration of its having completed sixty years existence. Reading notices and cuts of the works of many of the leading industries of Boston and New England filled page after page, the various electrical firms and corporations securing unwonted space. The electrical industry was characterized as being the leading industry of Boston, and the various concerns must have been gratified at reading the complimentary notices published about them. It was a great piece of journalism, and the electrical features of it were among the most startling and attractive.

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* Abstract from *Industries* of lecture at the Royal Institution, delivered by Mr. James Swinburne.

Personal.

The engagement of Mr. L. E. Whicher, of Boston, to Miss M. Brausen, of Cincinnati, is announced.

Mr. Whicher is a director of the Beacon Vacuum Pump and Electrical Company, and has been its treasurer since the formation of the company. He is also a member of the firm of T. A. Whicher & Company, one of the oldest and largest shoe manufacturing concerns in the world.

Miss Brausen is a most estimable as well as charming young lady.

The engaged couple have the best wishes of a host of friends both in Boston and Cincinnati.

General News.

What is Going on in the Electrical World.

Donaldsonville, La.—The establishment of an electric light plant is being discussed here.

Seattle, Wash.—A proposition for the purchase of a $100,000 electric light plant is to be submitted to a vote of the citizens.

Rhinebeck, N. Y.—The contract for the construction of the electric road between Rhinebeck and Rhinecliff will soon be opened for bids.

Rome, Ga.—The formal transfer of the Rome Gas Light Company's electric property was made a few days ago to the Rome Electric Light Company.

Salisbury, Md.—The plant of the Electric Light and Power Company was destroyed by fire on the 22d ult. The company's loss was $15,000.

Providence, R. I.—The ordinance permitting the Union Railroad Company to operate cars by the electric trolley system has been approved by the city council.

Albany, N. Y.—The State Board of Railroad Commissioners has approved the use of electric motor power on the New Paltz and Highlands Street Surface Railroad.

Gettysburg, Pa.—The electric railway that is to form something like a belt road over the battle lines of the famous field will be ready for operation by the 1st of July.

Oshkosh, Wis.—A. F. Ferdinand has asked permission of the council to place poles, wires, and other requisite things for conducting a new telephone system in this city.

Tampa, Fla.—The Tampa Street Railway and Power Company will have electric cars on its line in a few weeks. The Consumers' Company is already running its cars by electricity.

Little Rock, Ark.—The City Electric Street Railway has been placed in the hands of a receiver on application by the St. Louis Trust Company for default of April interest on $300,000 bonds.

Middletown, Md.—Some New York parties have been looking over the route of the projected electric railway between Frederick and Middletown and were favorably impressed with the scheme.

Sheridan Post, Col.—Subscriptions for stock in the proposed electric light company are filling up satisfactorily. The company will be capitalized for $30,000, and the plant is estimated to cost $15,000.

Cincinnati, Ohio.—The new electric light building which was in course of erection here collapsed on the morning of the 24th ult., killing some of the workmen engaged on it and wounding several others.

Fargo, N. D.—The new electric light and power company have purchased lots, and will immediately put up a power house. The plan provides for 450 horse power, to run machinery and street railways.

Conshohocken, Pa.—The directors of the Montgomery Passenger Railway have decided to begin immediately the construction of the trolley line from the Bridgeport terminus to the borough line of West Conshohocken.

Duluth, Minn.—City Engineer Cooper has furnished the common council an estimate for an electric light plant to be owned by the city. It is designed to supply an arc light circuit and its cost is estimated at $100,000.

Dallas, Tex.—Ft. Worth and Dallas are to be connected by an electric railway in which New York and Philadelphia capitalists will have a leading interest. Spencer M. Janney, of Philadelphia, is president of the new company.

Elizabeth, N. J.—The Elizabeth and Plainfield Electric Light Company has made an application to the Street and Law Committee of the city council for a franchise to construct an electrical railway from Elizabeth to Plainfield.

Missoula, Mont.—The Electric Light Works Company expect to have their new dam on the Missoula River, a short distance east of this place, completed by the middle of June, and will move their entire plant to that point.

Buffalo, N. Y.—The city chemist, Dr. Herbert M. Hill, has been testing the arc lights furnished to the city by the General Electric Company, and reports that many of them give a feeble light, far below the requirements of the contract.

Syracuse, N. Y.—The People's Railway Company has secured the necessary signatures for the change from animal to electrical power in South Salina street, and the work of obtaining signatures in North Salina street is going on rapidly.

Freeport, Ill.—Congressman Haines has been granted a fifty year franchise for an electric street railway in this place and will shortly begin the work. He will also create a pleasure resort in the suburbs to which the line will be extended.

Dover, Del.—The Senate passed the House bill authorizing the town of Smyrna to borrow $25,000 for building sewers and erecting an electric light plant. It provides that an election shall be held first, to ascertain the wishes of the people.

Charleston, S. C.—The Enterprise Street Railroad has become the property of the Great Western Manufacturing Company of Chicago and Duluth, who will convert it into an electric line if a franchise can be obtained from the city council.

Gloversville, N. Y.—The railroad trouble in Gloversville has been settled. The common council has granted a franchise to the Cayadutta Company, which enables them to connect with the Johnston and Gloversville Railroad and the Belt line.

Cleveland, Ohio.—The stockholders of the Cleveland Electric Railway Company have formally ratified the consolidation of the East Cleveland, Broadway and Brooklyn companies. Henry A. Everett has been elected president of the new company.

West Chester, Pa.—The Lancaster and Philadelphia Electric Traction Company has now secured the right of way from Coatesville and Malvern, and the prospects are that Atglen, Parkesburg and Downingtown will grant rights within a short time.

Shelbyville, Ind.—The common council advertises for proposals for lighting the streets of this city for a term of five years from July 1, 1894. Proposals will be received until September 1, and particulars may be obtained by addressing C. Ahele, chairman of committee.

Vicksburg, Miss.—The consolidation of the interests of the Vicksburg Electric Street Railroad Company and the Hill City Electric Light Company is announced. The railway has some track laid, but none in operation at this time. The electric company is lighting the city.

Boston.—The House has passed an act giving the Storage Battery Company the right to run its cars over the tracks of the West End Railway.—The electric welding process of Prof. Thomson has been applied in a practical manner and successfully to street car rails in Johnstown, Pa.

Huntington, L. I., N. Y.—Among those interested in the new electric company forming here are Dr. Walter Lindsay, Rev. Samuel T. Carter, William H. Stoyle, Charles B. Scudder, Rev. Francis C. Hill, J. Abner Smith, Ansel B. Gildersleeve, Philip Pearsall and Thomas Aitkin.

Los Angeles, Cal.—The city council has adopted an ordinance providing for the sale to the highest bidder of a franchise for a street railway, and the sale will take place on May 22. The franchise runs for thirty years and provides for the construction of an electric railway along certain streets in the city.

Baltimore, Md.—The *Herald*, in an editorial, cites several instances of the success of electrical suburban railway lines carrying freight as well as passengers, and says the level Eastern Shore of Maryland would be an ideal place for such transit. Electric roads may yet solve the transportation question for that garden spot of the State.

New York.—The stockholders of the Anglo-American Electric Light Manufacturing Company, which formerly did business at Kensington, met at the Metropolitan Hotel on Broadway, New York, recently, and moved to dissolve the corporation and to discontinue business. Frederick R. Lee, secretary of the company, is to settle up affairs and divide whatever may be left among the stockholders.

Brooklyn, N. Y.—A new electric road will be built in the Twenty-sixth Ward. The proposed line will be from the Cleveland street station of the Union Elevated Railroad through to Linwood street, down to the Mill road to Jamaica Bay. Among those interested are J. Grattan McMahon, Nathan Kaplan, Alexander Foreman, Dr. George C. Jeffrey and Fred. C. Dexter.

Toronto, Can.—The Automatic Telephone and Electric Company of Canada, incorporated by special Act of the Dominion of Canada, March, 1893, and assented to the 1st of April, 1893, to transact a telephone and electrical supply and manufacturing and operating business throughout the Dominion of Canada, intend increasing their capital stock to $250,000, and offer the stock to the public.

Hartford, Conn.—The Senate has at length passed the Electric Railway bill, after agreeing to the amendment requiring a majority of all directors of street railway companies to be residents of the State. The bill places control of all electric roads and street railways in the hands of local authorities subject to the restrictions made by the railway commissioners regarding carrying freight and paralleling steam railroads.

Concord, N. H.—The Concord Land and Water Power Company has purchased from the Concord Gaslight Company the gaslight company's power house on Bridge street, with all its electrical appliances, poles, lines and supplies for electrical business in Concord. The Land and Water Power Company has also purchased the exclusive right to use the water power at Garvin's Falls for the generation of electricity to be used in any form or for any purpose in Concord and north of Concord for a term of fifty years.

Altoona, Pa.—The Logan Valley Electric Railway Company has absorbed the Altoona City Passenger Railway, having purchased a majority of the shares of stock. The following were elected officers of the reorganized company: President, John Lloyd; secretary and treasurer, C.A. Bunch; directors, John Lloyd, M. H. Canan, M. H. Mackey, J. C. Hughes, A. C. Shand and Cornelius Campbell, of the Altoona and Logan Valley Company, and James Lowther, A. J. Anderson and D. K. Ramey, of the Altoona City Passenger Railway Company.

Indianapolis, Ind.—The syndicate which, through its attorney, ex-Judge Byron K. Elliott, has made such a liberal bid upon the franchise for the street-railroad privileges, is believed to be the strongest combination financially that has ever dealt with any Indianapolis enterprise. Messrs. Dieterich and Benedict are said to be the leaders in the combination, which is composed of over twenty members. The bid will probably be accepted by the council, although the Citizens' Company maintains that its franchise is a perpetual right.

Toledo, Ohio.—The electric railway enterprise which the Put-in-Bay and Southwestern Railway Company has in view comprehends a line from Findlay to Fostoria, thence to Tiffin and to Fort Seneca, and from there to Fremont and Port Clinton. At this place it is proposed to divide the system, running a branch to Catawba Island and Ottawa City. From there a ferry will be run to Put-in-Bay. The other branch is projected to Lakeside, on Lake Erie. Still another branch of the system will run from Tiffin to Upper Sandusky. As projected, the road will be about 150 miles in length. The main line will be part of the local system in the towns touched.

St. Louis, Mo.—The Missouri Pan Electric Telephone Company have elected the following officers: President, Samuel Kennard; vice-president, Dr. K. Morgner; secretary and treasurer, F. W. Mott; board of directors, John H. Terry, Chas. H. Peck, K. Morgner, John H. Keiser, Sam Kennard, Epham Catlin, S. R. Francis, A. Moll, Dr. J. O'F. Delaney, James Black, Fred W. Mott, P. Nicholson and S. F. Ramsey. The company intend putting up private wires to commence with and then introducing an exchange system. They have been advised by the attorney of the National Company to go ahead and give no attention to intimidation by the Bell Company.

Portland, Ore.—What promises to be one of the most elaborate water-power plants in the world is now in process of erection at Portland. It will be operated by the Portland General Electric Company, which proposes to utilize the falls at Portland not only to make electric lights, but also to run a number of electric street railway lines and to supply electric power to the citizens of Portland. Ten thousand horse power is to be generated in blocks ranging from 600 horse power down. Twenty-two turbines are to be put in at once—two 48-inch, ten 42 inch and ten 60-inch vertical cylinder gate wheels set in iron flumes and feeds.—The poles for overhead wires on the Portland and Vancouver Railway have been planted as far as Woodlawn. The whole line, it is thought, will be completed and in operation in sixty days.

Boston Notes.

The Legislative Committee on Railways after considering the evidence put in by the Storage-Battery Railway Company, of Cambridge, in support of its petition for authority to run cars over the tracks of the West End Railroad, reported to the House leave for the petitioners to withdraw. The House, however, substituted the bill of the petitioners, which bill will be discussed in the House at an early date. Meantime the promoters are maturing their plans, being sanguine that their reasonable petitions will finally be granted.

The installation of lighting plants on the four Nantasket Beach steamboats has just been completed by the New England Weston Electric Light Company, and the work has been inspected by a representative of the General Electric Company, who failed to secure the contract, and he candidly expressed his opinion that it was the best piece of work he had ever seen done. An admission like that from an unsuccessful competitor should amount to something.

There is a decidedly strong public opinion growing up in Lynn in favor of all overhead wires being put underground. Professor Elihu Thomson has been consulted and he is reported as being favorable to such a change. He considers the plan both feasible and practicable, and considers that the removal of personal danger together with the increased efficiency of the fire department would justify all the labor and expense that might be involved.

So well known and respected in Lynn are Prof. Elihu Thomson and E. W. Rice, Jr., the latter being superintendent of the General Electric Company's factories, that two steamboats have been named after these gentlemen.

One of the chief attractions at the Mechanics' and Merchants' Exhibition now being held in this city is the serving of meals every course in which is cooked by electricity. Madame Lemcke is the chef and her culinary operations with the new medium engross every visitor's attention.

The aldermen of the city of Brockton have decided that in future passengers by the electric street cars shall ride to any part and all parts of the system for a uniform fare of five cents. The new rule will apply to the East Side and Whitman branches, two out-of-town sections of the road. In granting franchises for the construction of roads in Stoughton and Bridgewater the aldermen imposed a like condition.

Some very successful experiments have just been made in Lynn with the Genette patent air brake for street cars. This apparatus may supersede the old style of hand power for stopping cars. The air is compressed by the revolution of the wheels and operated in nearly the same manner as on steam cars. It was proven that a car running at seven miles an hour can be stopped within a distance of its own length. The Lynn and Boston road is to equip a number of its electric cars, and if all that is claimed for this invention is sustained, all its cars will be so equipped.

To obviate the difficulty and danger arising from the leakage of current from the return circuits on the West End Railroad much larger wires are being laid in various parts of the city. The new wire is about five-eighths inch diameter tinned copper.

A new incandescent lamp is being perfected in the John Hancock Building which the inventor, Mr. D. C. Voss, claims is something entirely different from any other lamp ever made. Its special feature is the way in which the leading-in wires are secured. Unlike the Edison lamp these wires are first imbedded in a plastic substance which is then secured in the neck of the lamp bulb. Experiments have been made at a lamp factory in Brockton which have proven highly successful, and lamps are now burning that have been in service several weeks and show no falling off in efficiency. It gives a clear white light, the heat evolved being scarcely perceptible. Parties are now negotiating for the purchase of the patents. Much interest is being taken in this candidate for public favor.

The Van Choate Electric Light and Storage Battery Company has removed its chief offices to Portland, Me. The directors report satisfactory progress being made in the closing up of certain transactions that will enable the company to begin actual business ere long. This company does not appear to have met with the recognition in Boston from capitalists that its promoters anticipated.

The first annual meeting of the Van Choate Electric Car and Light Company was held in Portland, Me., Wednesday, April 19, at which meeting a complete change was made in the board of directors. The seven new members consist almost entirely of Boston men, while the previous board was composed mainly of New Yorkers. The new management will be entirely in harmony with Mr. Van Choate.

Mr. Henry Kaliske, the genial and enterprising manager of the Beacon Vaccum Pump and Electrical Company, Boston, goes on a fishing trip next week. As he is notorious for his adeptness in handling the rod, flinging the fly and all the other minutiæ of Isaak Walton's favorite pastime, Mr. Kaliske's innumerable friends regard it as a foregone conclusion that he will return from his trip with a creel full of finny beauties either as big as a tarpon or as diminutive as the aristocratic whitebait.

Chicago Notes.

Mr. J. H. Dean, of the West Side Electric Company of St. Paul, was a visitor in the city last week.

Mr. J. G. Nolan, formerly with the Illinois Lamp Company, has been appointed electric light inspector by the recently elected Mayor.

Mr. F. S. Palmer, manager of the Electric Heat Alarm Company, of Boston, arrived in Chicago this week. Mr. Palmer will make a very interesting display of his apparatus at the World's Fair.

T. A. Pamperin, President of the Electric Manufacturing Company of Oconto, with his attorney, was an interested listener to the proceedings of the incandescent lamp case in progress before Judge Grosscup.

Riehle Bros.' Fair Exhibit.

Riehle Bros. Testing Machine Company, Philadelphia, are installing a very extensive and interesting exhibit at the World's Columbian Exposition, Machinery Building, Column 0 25. Among other articles they will exhibit: 300,000 lb. Vertical Screw Power Testing Machine with Patented Electric Automatic Screw Beam, Plate 178; 200,000 lb. Horizontal Car Coupler Testing Machine, arranged for links, pins and brake beams, Plate 22; 200,000 lb Vertical Screw Power Testing Machine, Plate 154; 100,000 lb. Vertical Screw Power Testing Machine with Electric Automatic Beam, Plate 34; 80,000 lb. Spring Testing Machine, Plate 210; 20,000 lb. Vertical Screw Power Testing Machine with Vernier Poise, Plate 153; 20,000 lb. Horizontal Hand Tester, Plate 10; 5,000 lb. Transverse Testing Machine with Indicator, Plate 13; 3,000 lb. Transverse Testing Machine with Indicator, Plate 26; 5,000 lb. Torsional Testing Machine, Plate 159; 1,000 lb. Cement Testing Machine, with worm gear and rubber grips [the style the United States Government uses], Plate 14; also, Cloth and Twine Testing Machines

In addition to this, they also show their latest improved Patented Marble Molding and Countersinking Machine, and other articles of interest too numerous to note here in detail.

They applied for more space than they obtained, and were obliged to erect a platform on which to place some of their smaller Testing Machines.

This exhibit is in charge of Mr. J. R. Matlack, Jr., who is well known to the professors of the leading universities in the United States, also the officials of the railroads and the larger iron and steel works throughout the country.

At the Government Building in the Government Exhibit, in charge of Capt. A. H. Russell, will be found a Riehle 200,000 lb. Vertical Screw Power Testing Machine; and in the Quartermaster's Department in the Government Building, a 200 lb. Cloth Testing Machine. These were loaned by the Riehle Bros. Testing Machine Company to add to the Government Exhibit.

An exhibit of the Riehle-Roble Patented Frictionless Ball-Bearing Screw Jacks will be found in the Government Exhibit, as well as in the space of the Riehle Bros. Testing Machine Company.

The Columbia Incandescent Lamp Company.

The following announcement is sent out by the winners in the recent lamp suit at St. Louis:

The bond given by us affords protection to buyers of Columbia lamps against claims for infringement or royalties by the General Electric Company, and under present conditions, by reason of the above, this is the only company other than the General Electric Company, offering absolute protection to users of incandescent lamps.

In defeating the Edison Company we have not alone been benefited, but every purchaser of electrical apparatus, lamps and supplies has participated in our success, and we therefore feel justified in expressing the hope and belief that we shall have the support of all buyers of incandescent lamps, by receiving their orders on equal terms offered by the General Electric Company.

During our past four months' fight with the Edison Company, our expenses legal and otherwise have been extremely heavy, and should the case go to a final hearing, the cost will reach a large additional sum; we have therefore felt obliged to adopt the following schedule of prices for Columbia lamps, which prices are identical with those now being made by the General Electric Company; although, as you will note, we depart from their rule by making no extra charge for lamps in other than Edison base:

16	C. P., 500 or upwards,	$.50	net.
16	" less quantity,	.55	"
32	"	.75	"
50	"	1.35	"

Yours truly,
THE COLUMBIA INCANDESCENT LAMP CO.

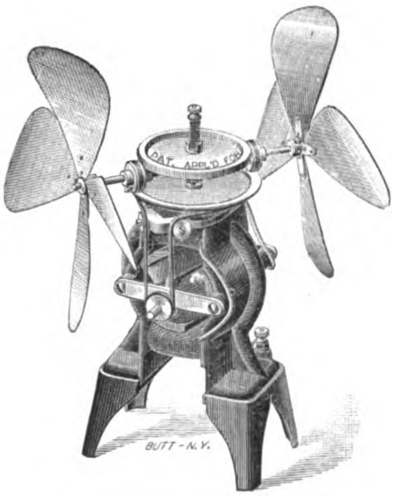
Electric Gas Lighting Company.

The tenth annual catalogue and price list of the Electric Gas Lighting Company of Boston has just been issued, and is the most complete and useful one which this company has yet published.

The list of goods embraced in this number demonstrates the growing extent of this company's business, which now includes all classes of domestic electric appliances, and which has recently necessitated a considerable extension of its manufacturing facilities.

The New De Mott Fan Motor.

The following cut illustrates a new fan motor just introduced by the De Mott Motor Company which is unique in a number of points of its construction and is designed to distribute the currents of air set up by the fans in all parts of the room in which it operates. To this effect the two fans shown in the cut are set on a horizontal shaft which has two distinct movements, one being a simple revolution about its axis and the other a horizontal revolution between the two discs shown.



THE NEW DEMOTT FAN MOTOR.

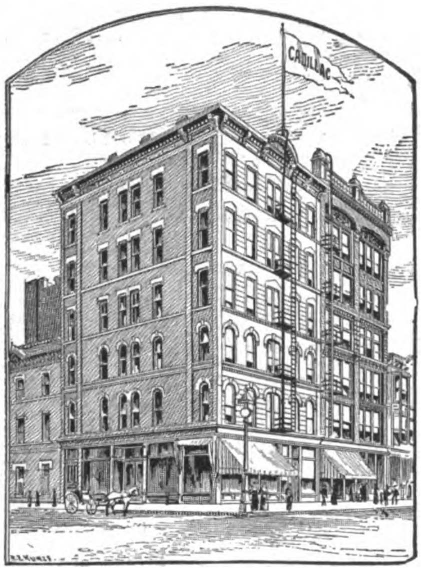
The upper disc consists of a gear which meshes with the pinions on the revolving shaft. In this way the effect of the fans is felt radiating in every direction from the motor.

In all previous attempts to produce this effect the motors themselves have been made to revolve about a vertical axis, and owing to the weight of the moving parts only a slow speed was found feasible. In the De Mott motor a much more mechanical arrangement is adopted, in which the inertia of the moving parts is reduced to a minimum, permitting a good speed to be attained, and reducing the power consumed proportionally.

World's Fair Hotel for Electrical People.

The Hotel Cadillac, shown in the illustration, has recently been leased and entirely refitted and refurnished with all the modern conveniences by Messrs. C. L. Pierce and Louis F. Allardt.

The proprietors have made special arrangements to entertain the electrical fraternity and their friends through the entire season of the Fair. All of the electrical journals are to be kept on file and daily bulletins of electrical information concerning the Fair and country in general will be posted for the benefit of its patrons. The hotel is pleasantly situated, being within two blocks of the lake. Ready access to the Fair grounds may be had by twelve direct routes, and it is also within walking distance of the business portion of the city. The hotel will be run on the European plan and will contain all the conveniences necessary to a modern building, including light, heat, baths and elevator service.



HOTEL CADILLAC, CHICAGO.

COMMERCIAL PARAGRAPHS.

The Pettingell-Andrews Company, Boston, has just issued its second annual catalogue, which is a remarkably handsome volume of 196 pages profusely illustrated with cuts of about every appliance, device and piece of apparatus used in the electrical business. The price of each article is given to facilitate business, and the book as a whole is so well arranged and complete in its details that no one in the business can afford to be without a copy. Incidentally it may be stated that the Pettingell-Andrews Company continues in the lead in New England as a supply house, and great as was the volume of business done last year the firm is doing 40 per cent. more business than a year ago.

The Shultz Belting Company, through its Boston house, has just sold 5,000 feet of leather belting of various widths to a European firm which purchases large bills of these belts almost every month. The Shultz factory in St. Louis is kept running almost night and day to keep up with its orders.

The W. S. Hill Electric Company, Boston, will have on the market in a few days a most unique fan motor equipment. By the aid of a crescent shaped brass rudder on which the current of air from the fan impinges the entire machine is kept revolving, so that every part of a room gets the benefit of the breeze in turn. It is by all odds the greatest novelty that has yet been introduced, and being high grade in every detail is bound to have a big sale.

The W.-W. Lightning Arrester, manufactured by the Ansonia Electric Company, formerly the Electrical Supply Company, is certainly built after the latest theoretical principles, and from all reports its success cannot be doubted. The Ansonia Company are also Western Agents for the Helios arc lamp, for both alternating and direct current lighting, and are in receipt of flattering reports from all directions as to the successful working of these lamps used on incandescent circuits.

The Ansonia Electric Company, formerly the Electrical Supply Company, report one of their largest weeks in the sale of the celebrated Shield Brand Moisture-Proof Line Wire.

The Ansonia Electric Company, formerly the Electrical Supply Company, will soon be in a better position than ever before to supply Wirt indicators and the standardized fuse links, as all testing, calibrating, etc., is now to be done in the new Wirt laboratory.

The Iona Manufacturing Company, Boston, the well-known makers of electrical supplies and specialties, of which Mr. N. Marshall is manager, have just removed their factory to very much larger and more commodious quarters, at 336 Congress street. By this change their capacity will be considerably more than doubled, and will enable them to take care of all orders hereafter with promptness.

The Ansonia Electric Company, formerly the Electrical Supply Company, recently received orders for some 1,800 ampere Wirt indicators.

A very handsome display of Wirt indicators will be made by the Ansonia Electric Company, formerly the Electrical Supply Company, in the Electricity Building at the Fair grounds.

INCORPORATIONS.

The Greenville, Ind., Electric Light Company has increased its capital stock from $25,000 to $50,000.

The American Electric Debenture Company, at Des Moines, Iowa. Capital stock, $500,000. Incorporators: David W. Evans, Charles E. Hunn and Eli S. Hunn, all of Des Moines. The officers are: President, L. R. Casey; vice-president, R. M. Newport secretary and treasurer, Frank F. Reed, and assistant secretary, Charles E. Hunn.

The Royal Arc Electric Company of U. S. A., to conduct a general electrical business at Plainfield, N. J. Capital stock, $1,000,000. Incorporators: Louis E. Howard and G. Harry Squires, of Plainfield; Frederick C. Marsh, of Elizabeth.

The Suffolk Gas Company of Islip, L. I., to manufacture and supply both gas and electricity. Capital, $200,000. Directors: B. I. H. Trask, I. L. Egbert, F. Everhart of New York City, Charles A. Kittle of Mount Kisco, A. D. Palmer, of East Orange, N. J.

The Christian County Coal Company, Taylorville, Ill. Capital stock, $25,000. Among other things, the company proposes to furnish electricity for heat, light and power.

The Oshkosh Telephone and Electric Service Exchange (new system), Oshkosh, Wis. Capital stock, $50,000. Incorporators: George Bauman, George W. Pratt, R. B. Evans, A. J. Barber and Bernard C. Gudden.

Indiana Electric Power Company of Goshen, Ind. Capital stock, $800,000. Directors: Gurney F. Coleman and Clinton D. Fireston, of Columbus, O.; Henry W. Kratz, of Norristown, Pa., and W. Ralph Wanner and Lew Wanner, of Goshen. The company proposes to construct and operate electric street railway lines in Goshen, New Paris and Nappanee, and between Goshen and Elkhart, and between Goshen and Nappanee.

An amended certificate of incorporation of the Municipal Gas Company of Albany, N. Y., has been filed. The amendment is that in addition to the objects for which the corporation was formed shall be included the manufacturing and using of electricity for producing light, heat and power in lighting streets, public parks and public and private buildings within the State of New York. And it is further authorized by the directors to purchase the stock of the Albany Electric Illuminating Company, and to issue in exchange its own stock. The company will increase its capital stock from $1,500,000 to $2,000,000.

Gallitzin Electric Light Company, Gallitzin, Pa. Capital stock, $20,000. Directors: J. L. Mitchell, A. A. Stevens, G. Lloyd Owens, Tyrone; Michael Fitzharris, William M. Smith, Gallitzin.

The Hewlett Voltaic Electric Company, Jersey City, N.J. Capital stock, $150,000. Incorporators: John J. Toffey and J. Herbert Potts, Jersey City; Cornell T. Griffith, New York. The purpose of the company is to manufacture, buy and sell batteries, electrical compounds and supplies, and to deal in patents.

The Madison Electric Light and Power Company, London, Ohio. Capital stock, $10,000.

Bluefield Telephone Company, of Bluefield, W. Va. Capital stock, $16,000. Incorporators: Geo. C. Hill, of Salem, Va.; A. M. Prince, Burke Prince, Geo. A. Shirkey, J. C. Darst, N. D. Maher and Jas. E. Mann, of Bluefield, and David E. Johnson, of Princeton.

The Concord Light and Power Company, Concord, N. H. Capital stock, $200 000.

The Arverne and Rockaway Beach Electric Company, for furnishing electric power for lighting and other purposes in the town of Hempstead, L. I., N. Y. Capital stock, $50,000. Directors: R. Florence and C. C. Vernan, of Arverne-by-the-Sea.

The Washington Electric Company, Chicago. Capital stock, $40,000. Incorporators: Victor W. Johnson, Oloaf R. Iverson and William J. Maddock.

The Chicago Electric Manufacturing Company increased its capital to $20,000.

The Automatic Telephone and Electric Company of Canada, Montreal, Can. The company's charter permits it to purchase, acquire and hold, sell and deal in any patents of invention covering any electrical device or apparatus, and to manufacture, lease, sell and deal generally in the articles covered by such patents of invention and embodying the principles of construction thereof, and to manufacture telephones, telephone instruments, switches and such other apparatus and appurtenances as are connected therewith, etc.

The West Michigan Electric Company, to generate electricity by water power at Lowell, Mich., and to transmit it to Grand Rapids, Mich., for distribution and use. Capital stock, $60,000. Incorporators: Edwin F. Sweet, Alfred C. Sekell, John E. More, of Grand Rapids; C. Jesse Church, of Greenville; Otto C. McDonnell and Charles A. Church, of Lowell.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED APRIL 25, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

495,996. Closed-Conduit Electric Railway. William P. Patton, New York, N. Y. Filed July 15, 1892.

496;280. Electric-Railway Trolley. Wesley W. Pritchett, Odgen, Utah. Filed Nov. 2, 1892.

496,329. Telpher System. Charles J. Van Depoele, Lynn, Mass.; C. A. Coffin and Albert Wahl, administrators of said Van Depoele, deceased, assignors to the Thomson-Houston Electric Company, Boston, Mass. Filed May 15. 1891.

496,330. Electric Locomotive. Charles J. Van Depoele, Lynn, Mass; C. A. Coffin and Albert Wahl, administrators of said Van Depoele, deceased, assignors to the Thomson-Houston Electric Company, Boston, Mass. Filed Sept. 24, 1891.

ELECTRIC LIGHTS AND APPLIANCES.

496,366. Electric-Light Display System. Daniel McF. Moore and Charles M. Jacobs, New York, N. Y. Filed Nov. 22, 1892.

496,386. Electric-Arc Lamp. William H. Akester, London, England. Filed Sept. 9, 1892.

496,387. Electric-Arc Lamp. William H. Akester, London, England. Filed Sept. 9, 1892.

DYNAMOS AND MOTORS.

496,307. Combined Dynamo-Electric Machine and Water Motor. John O. Heinze, Jr., Lynn, Mass., assignor to the Heinze Electric Company, same place. Filed Oct. 15, 1892.

BATTERIES.

496,126. Storage-Battery. Frederick A. La Roche, Philadelphia, Pa. Filed March 25, 1892.

496,228. Dry Battery. Hugo Koller, Vienna, Austria-Hungary. Filed June 21, 1892.

TELEPHONE AND TELEGRAPH APPARATUS.

496,137. Mechanical Telephone. George H. E. Ricke, Cincinnati, Ohio, assignor of one-half to John A. Ringold, same place. Filed April 15, 1891.

496,224. Diaphragm-Holder for Telephones. Silas W. Holman, Boston, Mass. Filed Nov. 5, 1892.

MEASURING INSTRUMENTS.

496,309. Volt and Ampere Meter. John O. Heinze, Jr., Lynn, Mass., assignor to the Heinze Electric Company, same place. Filed Oct. 17, 1892.

496,312. Electric Measuring-Instrument. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Nov. 16, 1892.

496,371. Electric Meter. Francis Teague, London, England, assignor, by mesne assignments, to Joseph Sinclair Fairfax and Jasper Wetter, same place. Filed Feb. 2, 1892.

MISCELLANEOUS.

496,019. Electric Soldering. Elihu Thomson, Lynn, Mass., assignor to the Thomson Electric Welding Company of Maine. Filed Jan. 22, 1889.

496,020. System of Electric Distribution. Elihu Thomson, Swampscott, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Dec. 29, 1890.

496,041. Electro-Mechanical Block-Signaling Apparatus. Murray Corrington, New York, N. Y. Filed April 26, 1892.

496,060. Electrical Stop-Motion for Knitting-Machines. George J. Manderfield, Royersford, Pa., assignor of one-half to J. M. Lewin, Samuel Lewin, U. S. G. Finkbiner and A. R. Saylor, same place. Filed Nov. 25, 1892.

496,067. Electric Alarm for Tanks. Frederic C. Skelton, Montreal, Canada. Filed Oct. 4, 1892.

496,076. Signaling Apparatus. Hermann Wetzer, Pfronten, Germany. Filed Aug. 8, 1892.

496 081. Insulator. Joseph F. Wright, Colorado Springs, Col. Filed Jan. 31, 1893.

496,103. Electric Cigar-Lighter. Lawrence T. Smith, Barrington R. I. Filed Oct. 24 1892.

496,134. Electric Synchronizer for Clocks. Henry S. Prentiss, Elizabeth, N. J. Filed May 21, 1892.

496,185. Electric Synchronizer for Clocks. Henry S. Prentiss, Elizabeth, N. J. Filed June 22, 1892.

496,176. Method of Electroplating Aluminium and its Alloys. George Wegner and Paul Guhrs, Berlin, Germany. Filed Feb. 3, 1893.

496,191. Phonograph. Thomas A. Edison, Llewellyn Park, N. J. Filed Feb. 9, 1891.

496,192. Annunciator. John H. Elfering, Milford, Conn. Filed Oct. 3, 1892.

496,207. Electric Reporter. Major D. Porter, Brooklyn, N. Y., assignor, by mesne assignments, to the National Electrical Manufacturing Company of New Jersey. Filed Nov. 27, 1886

496,212. Electric Converter. William Stanley, Jr., Great Barrington, Mass., assignor, by mesne assignments to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Original application filed Oct. 1, 1887. Divided and this application filed April 1, 1889.

496,244. Electro-Galvanic Adhesive Plaster. Frederick A. Barrett, St. Louis, Mo., assignor of one-fourth to Jacob Lippe, same place. Filed Sept. 28, 1892.

496,258. Electric Program Clock. Henry C. Hain, Booneville, Mo. Filed April 18, 1892.

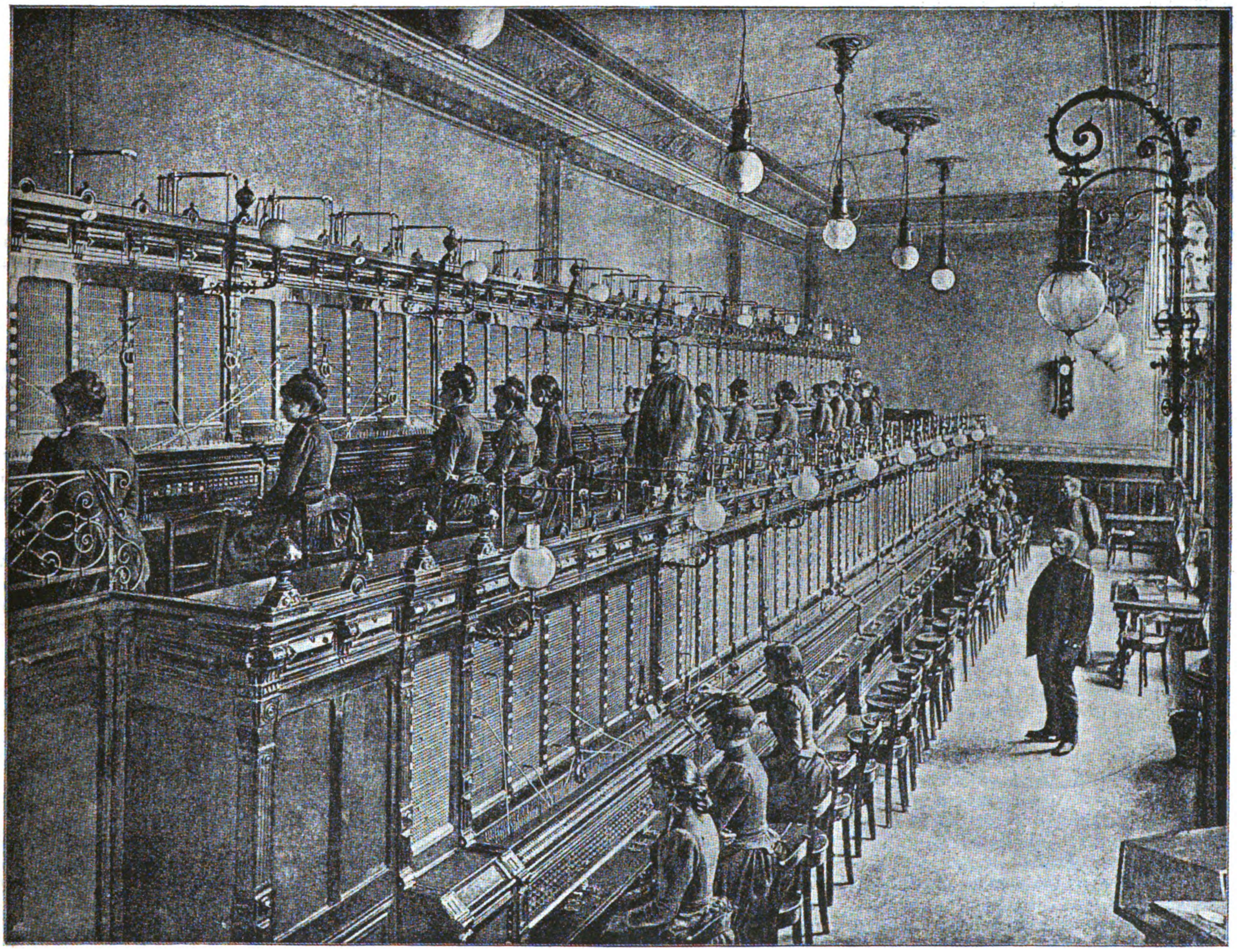
496,308. Cut-Out and Circuit-Protector. John O. Heinze, Jr., Lynn, Mass., assignor to the Heinze Electric Company, same place. Filed Oct. 15, 1892.

496,331. Electric-Magnetic Reciprocating Pump. Charles J. Van Depoele, Lynn, Mass.; C. A. Coffin and Albert Wahl, administrators of said Van Depoele, deceased, assignors to the Thomson-Houston Electric Company, Boston, Mass. Filed Dec. 12, 1891.

496,382. Controlling Device for Electric Elevators. Charles E. Moore, Boston, Mass. Filed June 21, 1892.

ELECTRICITY.

VOL. IV. NEW YORK. MAY 10, 1893. CHICAGO. No. 17



VIEW IN THE TELEPHONE EXCHANGE, BERLIN, GERMANY.

The Telectroscope.

Vision at Great Distances by Electricity.

BY LEON LE PONTOIS.[*]

I designate by this name an apparatus having for its object the transmission of pictures or views of moving or stationary objects at great distances, and as I use electricity for the purpose of obtaining this result, I call this apparatus a Telectroscope.

First let me say that by the transmission of pictures to great distances I do not mean the graphic transmission of sketches or writing as done, for instance, by the very ingenious invention of Prof. Elisha Gray, namely, the telautograph.

I intend to describe to you to-night the general outline of an apparatus that I have conceived for the purpose of seeing over as great distances as we hear by the long distance telephone.

There is, to a certain extent, an analogy in the mode of propagation of light and sound, therefore it seems rational to transmit the light rays over as great distances as we transmit the sound waves, by converting at a transmitting apparatus the rays of light into proportional electric undulations and reconverting at the receiving apparatus the electric undulations into rays of light of proportional intensity.

But the analogy between the telephone and the telectroscope is not so close as it seems to be. Sonorous vibrations affect our nerves of hearing by differences in the number of their vibrations per second, their loudness or their character. We can easily detect a certain sound amongst other separate sounds and even give a name to their harmonious groupment (what the musicians call a chord), because each sound or its harmonies vibratse one of our nerves of hearing and only this one.

Vision is the sensation produced on the nerves dispersed all around the retina by the rhythmic motion called light.

Each of the nerves can indistinctly vibrate for the different light radiations known as colors, and we have an exact idea of them because they differ one from the other by the number of vibrations per second.

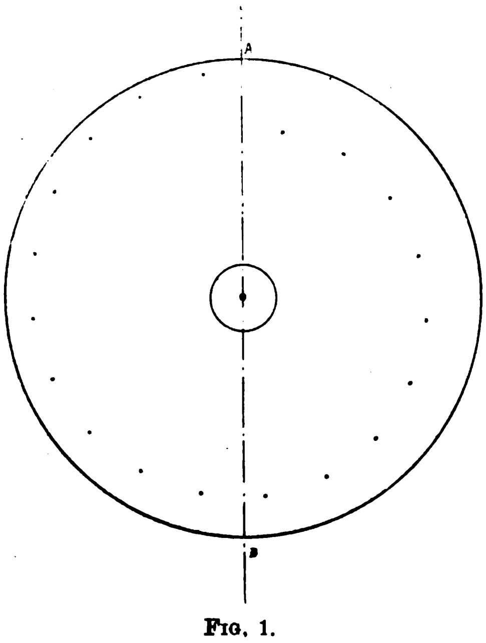


FIG. 1.

We see an object when it produces light by itself or reflects the radiations of another source of light, and we have a notion of its structure because from each point of its surface starts a ray of light affecting by its color and its relative intensity one of the nerves of the retina and only one.

Another object will affect this same nerve differently and will communicate to the cerebral matter a different impression, while on the contrary each of the nerves of hearing, similar to a resonator, always vibrates for the same sound and thus always transmits to the cerebral matter the same impression. This essential difference in the mechanism of vision and audition renders the realization of an apparatus to see at long distances more difficult than the realization in an apparatus to speak at long distance, because while we distinguish one object from another by differences in the number of vibrations and the relative position of its radiations, we differentiate one sound from another merely by the number of their vibrations per second.

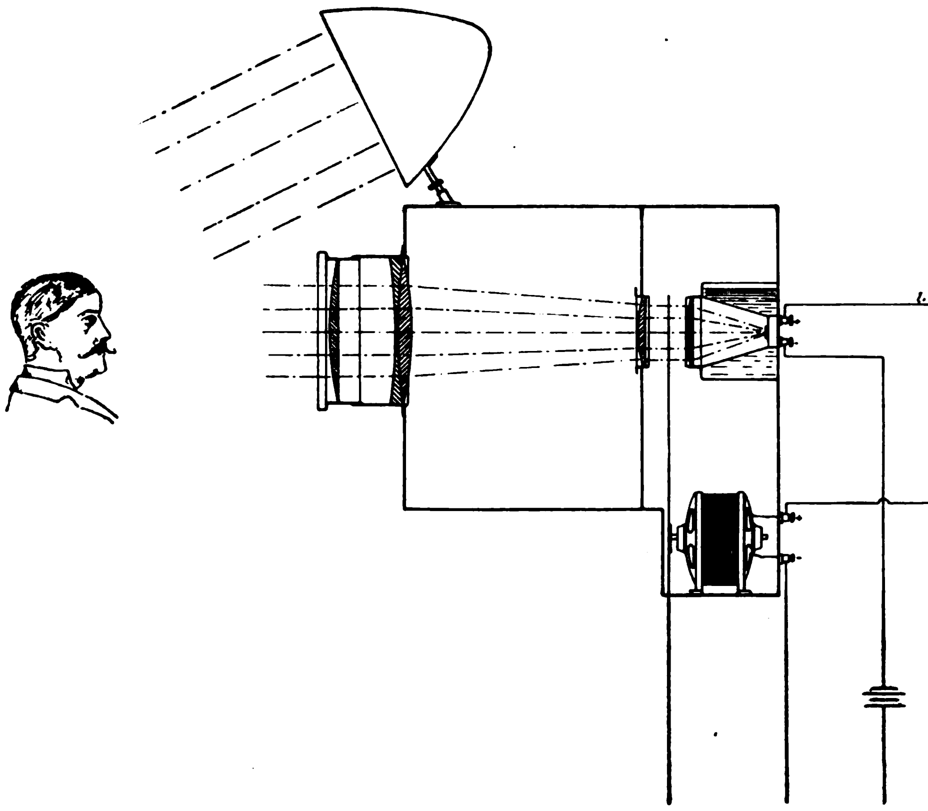


FIG. 2.

However, a few attempts have been made in this fascinating field, and among them I must recall to your minds the telephote of Prof. Bidwell. This apparatus for producing pictures or writing at a distance is an application of a property of selenium in combination with the chemical telegraph. In this telegraph a colored mark is made at a distance when current is transmitted, and fac-simile of the original may be produced by a series of dots and lines. A continuous current of greatly varied intensity would result in similar variations in intensity, and such a variable current is producible by changes in the resistance which may be produced by light acting upon selenium.

Mr. Shelford Bidwell made an apparatus for this purpose. The transmitter is a dark box, one end containing a selenium cell forming part of the line circuit, and facing a small hole at the other end; the box is mounted on an axis so as to move up and down, each upward motion corresponding to one rotation of the receiving cylinder, and so to one line on the drawing produced. The box also moves sideways at each stroke, to correspond to the distance of the lines apart. The face of the box corresponds to the screen of a magic lantern, and the picture to be transmitted is thrown upon it continuously, so that the pin hole is, so to speak, an eye by which the selenium cell looks the picture over, and receives impressions from each part successively as it traverses over the space filled by the picture. When a dark line is thrown on the hole the resistance increases, while a white portion reduces it. The transmitter is really a differential instrument, it receives the line current at one terminal and that of an opposed local battery at the other, the line being also connected to the other pole of the battery and resistance so arranged that the local battery acts and makes a mark whenever a dark line is to be produced, and thus the travelling style produces either no action at all or colored lines varying in depth of tone in correspondence with the amount of light falling upon the selenium cell from the distant transmitting illuminated picture.

It is a well-known fact that the impressions made on the retina by the rays of light emitted or reflected by a body do not disappear instantaneously if an opaque body is suddenly placed between the eyes and the luminous body. This persistence of vision can be explained by the fact that, vision being caused by vibratory movements imparted to the optic nerves by the rays of light, on account of inertia these vibrations have a tendency to persist a short time after the cause that has originated them disappears.

On account of the same principle of inertia, the impressions do not take place on the retina as soon as the light rays strike it. It takes a certain time before the optical nerves vibrate synchronously with the rays of light. That is why we cannot see a body when it passes very rapidly before our eyes, and we have in optics the retardation of vision as we have in electricity the capacity and the self-induction. That is why we can see distinctly and continuously an object placed on the rear of a fly wheel turning very fast though the spokes cover successively the different points of its surface, and it does not matter whether the object has a movement of its own or not, provided of course that the speed of this movement does not exceed a certain limit. Quite a number of optical instruments—rather toys—have been constructed on this principle: the taumatrope, the phenakistiscope, the kaleidoscope, so universally known that they do not need to be described.

The only difference existing between this last instrument and the Edison kinetograph lays in the fact that the pictures that in the phenakistiscope represent a different position of a body while moving are drawn by guess (so to speak) while in the Edison kinetograph they really represent a different phase of the movement because each of them is a photograph taken in the one-ninety-ninth part of a second, showing a different position occupied by a moving body. Forty of these pictures are taken in a second, and their rapid succession before the retina gives a perfect illusion of the motion.

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[*] Read before the Pittsburg Electric Club.

The impression is striking and one would vow that the picture is really moving. Consequently the kinetograph stores and reproduces the impression made on the retina by moving objects as the phonograph stores and reproduces the human voice.

I have spoken at some length about the persistence of vision because the telectroscope is partially based on this fact.

The transmitting apparatus is made of a dark box provided with lenses like a camera. At the focus where the sensitive plate is ordinarily exposed to the action of light is placed an open disc made of very thin and light material, mounted on a shaft. This disc is shown in part in Fig. 2. Pin holes, about $\frac{1}{100}$ of an inch in diameter, are perforated near the periphery on concentric arcs of circles, the difference between the radius of two successive arcs being $\frac{1}{100}$ inch, while the distance between two holes is equal to the width of the image painted by the rays of light on the superior part of the disc.

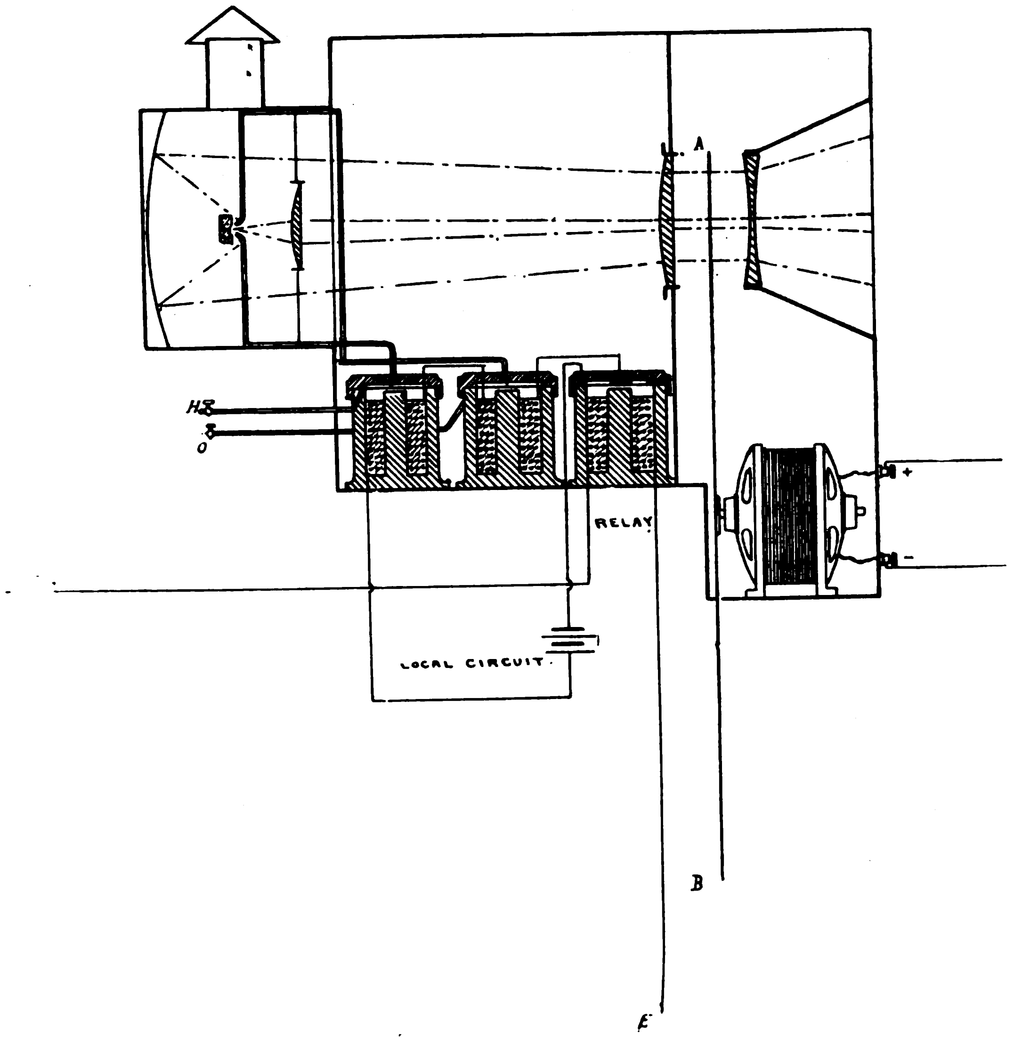

FIG. 3.

The number of the perforations is such that the total of their diameter is equal to the height of the image. The holes being thus dispersed on the surface of the disc, and the disc revolving, the perforations traverse the surface of the picture according to different concentric lines and the rays of light pass successively through the disc when the perforations are moving past them.

The conversion of the rays of light into electric currents of proportional intensity is effected by a special selenium cell of an extreme sensitiveness acting by the influence of the heated light.

There has been considerable debate as to whether the changes in the resistance of the selenium are due to the light or to the heat. In fact, I believe as the result of my own experiments that in most of the cases the increasing in the intensity of the current is due to the combined action of both

Send a beam of light through a tube containing a solution absorbing the hot rays, alum for instance, before directing it upon the selenium, and let us suppose that the beam of light falling upon the selenium has exactly the same temperature as the selenium.

The resistance decreases in a certain value or seems to decrease—but how can we admit that in the conditions of the experience the light has modified the molecular structure of the selenium? In fact, the change of resistance is apparent, and the current flowing through the circuit has a greater intensity, not on account of a diminution in the resistance of the selenium, but because the undulatory movement called light has imparted an excess of speed to the undulatory movement called electricity.

I have demonstrated that in the mechanical theory of electricity the E. M. F. expresses the speed of the undulatory movement called current.

Consequently, the excess of speed imparted by the light to the vibrating atoms of the selenium will cause an increase in the E. M. F. of the battery and therefore in the current.

I am convinced that even if a galvanometer sensitive enough could be constructed, one could possibly detect the presence of a current merely due to the action of light falling upon the selenium.

If now the hot lights act directly upon the selenium the variations in strength of the current are much greater, but the action of heat differs from the action of light.

While the light sets up, we might say, an additional E. M. F. heat causes really a diminution of resistance due to the fact that selenium being a crystalline body the contact between its surface and the electrode on which it is deposited is far from being perfect, and is rather a microphonic contact that can be modified by expansion or contraction.

It does not seem at first possible that such modifications can take place instantaneously, but we have learned by recent discoveries how great is the sensitiveness of matter to the smallest variations in the streams of radiant energy. The changes of temperature are attended with great molecular changes, modifications of structure and properties, which occur with a rapidity comparable only to the speed of light.

The reason of this lies in the fact that each molecule of matter is the centre of action of many forces, a centre modified instantaneously by any change of relation among those forces.

As a consequence of this, a beam of obscure heat of variable intensity must modify the resistance of the selenium, and in fact it does so, but the action is more complete if the falling beam of heat is luminous, because the heated light penetrates more deeply through the selenium whose molecules are probably more diathermanous for the luminous rays than for the obscure rays.

Consequently the variation that will occur in the resistance of the selenium cell, upon which falls a beam of heated light, will be greatly increased if the difference between the temperatures of the selenium and the rays of light is as great as possible.

In order to obtain this result I direct the light of a projector located on the top of the apparatus towards the object whose picture is to be transmitted to a distance, and I use preferably a source of light giving very hot rays—calcium light for instance; thus the temperature of the light rays reflected by the object and directed by the lenses on the surface of the selenium is higher, and therefore the effect is increased, but in some cases it is not possible to raise the temperature of the illuminating rays above a certain limit. To remedy this inconvenience, I cool the selenium cell by placing it inside a conical cavity forming part of a receptacle containing a cooling mixture; the cone is closed at its base by a lens facing the disc, and directed at its focus where the selenium cell is exposed, and the rays of light pass through the perforations of the disc.

By this disposition the difference in the temperature of the heated light rays and the selenium is as great as possible, and consequently the variation of the current is a maximum.

The selenium cell is made of strips of tinsel foil separated by narrow strips of dry paper—the pile is held by a clamp, and its face covered by a coating of selenium, which in turn is covered by a very thin coating of lampblack.

With the apparatus thus constructed, it can be easily understood that if the disc is caused to revolve each of the rays of light forming the picture will successively set in the line currents of varying strength. These currents act at the receiving apparatus upon a microphonic relay acting on the telephone receiver, shown in Fig. 3, modified by the addition of a narrow chamber placed between the disc and a cover hermetically closing the telephone.

One of the chambers is full of oxygen, brought in by a pipe, and the other is full of hydrogen.

On the top of the covers is tubing properly adjusted and provided with regulating valves.

The two gases are brought under pressure near the surface of a cylinder of carbonate of calcium.

The variations in the strength of the current of the microphonic relay, cause pulsation of the diaphragms.

But those pulsations, even if they are of a molecular nature, impart to the molecules of the gas an excess of speed, causing proportional variations in the intensity of the oxyhydrogen light. Lens and a reflector concentrate the light on a ground glass or screen after having previously passed by one of the perforations of a disc absolutely similar to the disc placed in the transmitting apparatus.

Then, according to the position occupied by the perforation on the surface of the disc, the beam of light passing by this point makes a more or less luminous point some place on the depolished glass.

But as the two discs are evolved synchronously by the two pulsating current motors, whose pulsations are controlled and even created by the vibrations of a tuning fork, when the light of the receiver passes through a certain perforation of the receiving disc one of the rays of light emitted by the object passes by the same perforation of the transmitting disc. If the disc turn slowly, each ray of light emitted by the different points of the object placed in the field of the transmitting apparatus is converted into an electric current of proportional intensity, which current is re-converted at the receiving apparatus into a beam of light of proportional intensity, and if a sensitive plate was substituted for the ground glass a picture would be taken of the object placed in view of the transmitter after a complete revolution of the disc. But if the discs are revolved at a rate of ten revolutions per second, each point of the depolished glass is more or less luminous or dark ten times a second, and on account of the persistence of vision the retina is not affected by the successive disappearance of the points, which taken together reproduce exactly the object placed in view of the transmitter.

It does not matter even if this object moves or not, because the image of the receiver is constantly modified by its movements.

Atomic and Molecular Motions.

BY A. E. DOLBEAR.

That all kinds of matter are resolvable into ultimate particles, which by common consent are called atoms, is now so well settled that the sciences of both chemistry and physics are founded upon that idea and ultimate explanations of all phenomena are now believed to be due to the inherent qualities of such atoms. The knowledge which has so well established this atomic theory of matter has been nearly all acquired in this century. Ask any chemist for his reasons for holding by this theory, and he will reply that he can isolate the elements, and by no known process yet discovered can they be more finely divided that he can measure their individual magnitudes, can weigh them, prove their existence in the sun and stars, and that the weight of such cumulative evidence is very great. If one goes among those who style themselves philosophers, yet who have only apriori reasons for believing in atoms, he will hear it often asserted that the atomic theory is very old, that Democritus and Lucretius, old Grecians, taught that philosophy two thousand years ago, and it is true they did, but the reasons given for holding to such tenets are not such as any modern scientific man can give any weight to, and the reasons now given for the atomic theory are of such a nature that none of the ancients could have understood them without the scientific knowledge of this nineteenth century. In all historic times there have been thoughtful men who have sought for an explanation of the universe as they saw it, and have guessed how it might be. Some have guessed one way and some another way, but none of them gave a sufficient reason. Of course, some would guess nearer right than others, but such guessing gives no claim to the discovery, or entitles one to be considered the founder of a philosophy that had to wait two thousand years for later men and different methods to substantiate it. This is true in other departments of knowledge as well. Whewell, the historian of the sciences, tells us: "No discovery of general laws, no explanation of special phenomena, rewarded the acuteness and boldness of these early students of nature." And again: "They arrived at no doctrines from which they could deduce by sound reasoning such facts as they saw." From which one may fairly infer that modern science is not in any way founded upon ancient speculations, but upon laborious painstaking experiment and verification. By far the larger part of what we have is the work of this century. The first evidence having a real scientific character bearing upon the existence of atoms was given by Dalton, an English chemist who died about fifty years ago, but since his day a great body of corroborating evidence has been collected. A number of persons have devised methods for measuring the size of atoms, and their determinations agree very well. For instance, the atoms of the element hydrogen are found to be about one-fifty-millionth of an inch in diameter; other elements, some a little larger and some smaller. How such minute things can be measured even approximately has been a puzzle to many persons, and not a few have doubted that it could be done at all. I once had such a skeptical person tell me he doubted very much whether anybody could measure to the thousandth part of an inch. I sat down with a common wire gauge, and very soon convinced him of that, though it was admitted with some reluctance. Every one has admired the beautiful play of prismatic colors seen on the surface of a soap bubble. As the material of the bubble flows down its sides, it gets thinner and thinner at the top and thicker at the bottom. When a certain degree of thinness is reached by the downward flow, the colors begin to appear and in the same order as they are in the rainbow. A second, a third ring of such rainbow tints is formed, and so on, sometimes as many as a dozen all moving down the sides of the bubble, but at last no further colors are added, but beyond the last purple tint there is a white circle, and then in a good persistent bubble may generally be seen forming next to the bowl of the pipe a very black patch with a ragged edge. In the course of two or three seconds after this is formed the bubble bursts. Now by attending to the phenomena in their order one may get a good lesson on the minuteness of the molecules of water out of which the bubble is formed. The colors are produced by the interference in the light rays that are reflected from the two surfaces of the bubble, so that when the thickness of the film is such that the distance through and back is equal to half a wave length of light the interference can take place and colors appear. The length of a wave of blue light is found by measuring in other ways to be about one sixty-thousandth of an inch, and as the thickness of the bubble where the last colors appear is but the fourth of the wave length of the light, it follows that at that place the thickness of the film is

$$\tfrac{1}{60000} \times \tfrac{1}{4} = \tfrac{1}{240000} \text{ of an inch.}$$

It is found in other ways which I cannot dwell upon here that the thickness of the black patch is only one-fortieth of the thickness of the film where the color last shows, and that will give for the thickness of the film

$$\tfrac{1}{240000} \times \tfrac{1}{40} = \tfrac{1}{9400000} \text{ of an inch,}$$

yet the film has tensile strength enough to hold the weight of the bubble for a short time. If there were but a single thickness of molecules, it does not seem in any degree probable they could support such a weight as they do. One may now speculate if he cares to as to the probable least number that could hold it together any time. If he thinks that a film of five molecule thickness might do it, he will then have for the diameter of the water molecule,

$$\tfrac{1}{9400000} \times \tfrac{1}{5} = \tfrac{1}{47000000} \text{ of an inch.}$$

If he thinks it needful he will make the molecule nearly the hundred-millionth of an inch in diameter. In any case one can see he is reckoning with millionths of an inch.

Everybody knows that water is composed of hydrogen and oxygen combined together, and a chemical combination of atoms is called a molecule. When only two or three atoms are thus combined, the molecules thus formed cannot be very much larger than the constituent atoms, but some molecules contain as many as a thousand atoms, and such molecules in all probability have a diameter as much as ten times the diameter of its constituent atoms, for the cube of ten is a thousand. So one must think of the molecules of all such matter as we can see and investigate as having definite magnitude, and as possessing properties which are the resultant properties of the atoms that compose them. But if one would perceive still clearer the extreme minuteness of these particles, let him compute the number there must lie in, say a cubic inch of water. If the diameter given is, say fifty millionths of an inch, then of course fifty millions in a row would reach but an inch, and the cube of fifty millions would be the number in a cubic inch. This written out gives the number of 125 followed by twenty-one cyphers. If one fancies that kind of work he may compute how many molecules there are in a cubic foot in the earth and in the sun. In the atmosphere at ordinary pressures there can hardly be less than a million million millions in each cubic inch, and when in the common air-pump one reduces the pressure to one millionth of the common air pressure, he then has left in the so-called exhausted vessel no less than a million millions in every cubic inch. So that one can easily see that a perfect vacuum cannot be obtained with every air pump, nor indeed with any device one can possibly make. Matter exists in all degrees of condensation, and for convenience physicists have adopted such words as solids, fluids and gases to represent the various states of aggregation and freedom among molecules. Where the molecules are free, as in the air and in gases in general, they move about and bump against each other, rebounding after collision like billiard balls, and that is the way one must think of the air in this room, the average distance each molecule must move between impacts being somewhere in the neighborhood of the one-two hundred and fifty thousandths of an inch. As one rises in the atmosphere, the density becomes less and less, and at the height of a hundred miles from the surface of the earth the molecules are so far apart that one might have to move a million miles before coming in collision with another molecule. It has been computed that at the height of three hundred miles an air particle might travel freely from one star to another, so it is thought quite probable that the earth is slowly losing its atmosphere by molecular impact forcing some away with a velocity too great for gravitation to return it, and also that the earth is picking up other free-roving molecules in the space it travels in very much as it now captures meteors. The spectroscope shows that the space through which the earth is now moving contains benzine and alcohol in small quantities.

We have obtained our knowledge of most of the properties of matter by studying the phenomena exhibited by bodies of visible magnitude. That a body will continue in its state of rest or of motion until some other body acts upon it, that compounding forces does not alter the value of either, and that action and reaction are equal: these laws are as applicable to a small body as to a large one, to molecules as well as a mass as big as the earth or the sun, and it is through the recognition of this that the growth of physical science has lately been so rapid. Indeed, it may be said that what is called molecular physics is simply the application of mechanical laws to molecules, and the explanation of any phenomenon is given when the mechanical antecedents of that phenomenon are pointed out. Although large and small bodies obey in their motions the same fundamental mechanical laws, it is found convenient to make some distinctions. Thus, when a body large enough to be easily seen has a visible motion from one position to another such motion is called *mechanical* or *translatory*; whereas a molecule, too minute to be seen but moving in a similar way, is said to have *free path* motion, and such free path motion is the kind going on all the time among the particles of air or of any gas. Another kind of motion both large or small bodies may have is *vibratory*, this is distinct from the kind called oscillatory, which is the kind of motion a body like a swinging pendulum has. The true vibratory motion of a body is that due to a change in form as when the prongs of a tuning fork vibrate, or a bell while sounding; the whole does not necessarily swing to and fro, it is the motions of a part of a body with reference to some other part of the same body. A good idea can be formed of this by imagining a flexible ring of wire or of rope. Crowd its sides together and it will elongate in the opposite direction, and when the same sides are drawn out the parts that were furthest apart will be drawn together. If the body were an elastic body and it should be struck, it would go through a series of such motions, that is, it would vibrate. A third kind of motion is called *rotary*. This does not imply any change of position in space of the center of mass of the body, nor of change of form. One can easily see that a given body might have all three of these motions at the same time without interference. For instance, suppose a common hand-bell be struck, if it gives out a sound we know it vibrates though it be held steadily in the hand. If one suspends it by a long string to the ceiling, he can give it a spinning motion while it sounds, and in addition he can swing it through a long arch, giving it a translatory motion, each of which kinds of motion it will retain independent of either of the others. A bullet shot from a rifle has a translatory and a rotary motion, and all free moving bodies if elastic have more or less of these three kinds of motion. All the various movements of even the most complex machinery may be reduced to these three kinds of motion, either simple or compounded. And what is true of masses of matter large enough to be plainly seen and studied must be assumed to hold true of bodies too minute to be seen. Is it not so obvious as not to need argument that mere size can make no difference in the quality of motion in a body?

Apply this then to the molecules of the air in this room; they are in a gaseous state, that is, are not in contact with each other; they are elastic, for all gases are elastic. And the fact that the air exerts a pressure of nearly fifteen pounds to the square inch shows that they are bumping against each other and the walls of the containing vessel, for the pressure varies as the amount of air acting. The molecules have a free path, that is, their translatory motion, and as they are also elastic, when they collide they *must* vibrate in the way stated. I emphasize the word must because I want each one of you to see the necessity for it if the laws of mechanics, found to hold true for bodies of visible magnitude, hold true for smaller bodies. If, however, anybody is not satisfied with such a reason and thinks it possible that small elastic bodies on impact may not thus vibrate, I will give him other evidence presently that cannot be gainsaid.

(To be continued.)

American Electro-Therapeutic Association.

At a meeting of the Executive Council of the American Electro-Therapeutic Association, held at the office of the Secretary March 2d, 1898, the following resolution was adopted:

"*Resolved*, That the Secretary be instructed to prepare a circular to send to Fellows of the Association, to members of the medical profession, to electrical experts and to manufacturers of electrical appliances for medical work, containing titles of all the committees, the members serving on them, with their addresses, and the matter prepared for discussion and investigation by each committee.

"And that manufacturers be asked to communicate with the members of the different committees, if they desire to have their instruments examined and tested, stating their claims and merits.

"And that physicians, electrical experts and manufacturers be asked to co-operate in making suggestions and in relating their experience and preference for instruments, with reasons and data.

"And to mail this circular to all members of the Association, manufacturers, medical journals and to others who are known to use electricity extensively, asking for a speedy reply either to the Secretary or to the members of the respective committees whom it concerns."

In accordance with the above resolution the following committees have been appointed:

COMMITTEE ON STANDARD COILS.

Dr. W. J. Morton, 19 East 28th street, New York.

Dr. A. H. Goelet, 351 West 57th street, New York.

Dr. Wm. F. Hutchinson, Providence, R. I.

Dr. G. Betton Massey, 212 South 15th street, Philadelphia.

Mr. A. E. Kennelly, Chief Electrician, Edison Laboratory, Orange, New Jersey.

COMMITTEE ON STANDARD METERS.

Dr. Margaret A. Cleaves, 68 Madison avenue, New York.

Dr. H. E. Hayd, 78 Niagara street, Buffalo, N.Y.

Dr. Wellington Adams, 2741 Olive street, St. Louis, Mo.

Dr. W. F. Robinson, 214 State street, Albany, N. Y.

COMMITTEE ON STANDARD ELECTROSTATIC OR INFLUENCE MACHINES.

Dr. W. J. Morton, 19 East 28th street, New York.

Dr. J. H. Kellogg, Battle Creek, Mich.

Dr. G. Betton Massey, 212 South 15th street, Philadelphia.

Dr. Margaret A. Cleaves, 68 Madison avenue, New York.

COMMITTEE ON CONSTANT-CURRENT GENERATORS AND CONTROLLERS.

Dr. W. J. Herdman, 48 East Huron street, Ann Arbor, Mich. Rheostats and Dynamo Current Controllers.

Dr. Robert Newman, 68 West 36th street, New York. Primary Stationary Batteries.

Dr. Frederick Peterson, 201 West 54th street, New York. Secondary Batteries and Primary Portable Batteries.

COMMITTEE ON STANDARD ELECTRODES.

Dr. A. Lapthorn Smith, 248 Bishop street, Montreal, Canada.

Dr. R. J. Nunn, 119 York street, Savannah, Ga.

Dr. Charles R. Dickson, 263 Victoria street, Toronto, Ontario.

Personal.

A dispatch from Naples states that the Italian Minister of Public Instruction has nominated Lord Kelvin, better known as Sir William Thomson, to be a member of the Naples Academy.

Mr. L. H. Rogers, of Boston, has been appointed assistant general manager of the Brush Electric Company and general manager of the Sperry Electric Railway Company at Cleveland, Ohio, and has removed his family to Cleveland. He had been for several years connected with Eastern offices of the General Electric Company, and is well and favorably known in New England.

Practical Talk on Meters.

Mr. White, the Superintendent of the Meter Department of the Brooklyn Edison Company, delivered a practical lecture on electric meters before the Electrical Section of the Brooklyn Institute of Arts and Sciences on Friday evening last. He showed the workings of various types of both American and European meters, and made it plain how the electrical current can be accurately measured.

Mr. White was introduced by Mr. W. S. Barstow, the General Manager of the Brooklyn Edison Company, who has lately returned from a tour of inspection of foreign stations. Mr. Barstow described briefly the various meters in use abroad, those in Venice having particularly attracted his attention. They use there a small meter for every fixture. It is in reality only a small clock with solenoid switch. A number of lamps of a given candle power, say 16 C. P., are attached to the fixture. When the current is turned on the clock starts and registers the length of time the lamps burn. A little figuring tells how much current the consumer has used—provided he has not substituted 50 C. P. lamps for his regular allotment of 16 C. P.

Mr. White explained in detail a number of designs of meters which he exhibited, among which were one of his own invention, soon to be adopted by the Brooklyn Company, and one of the latest of Lord Kelvin's inventions, said to be the first and only one imported to this country so far.

BOOK NOTICE.

HOW TO THINK IN FRENCH. BY CHARLES F. KROEH, A. M., PROFESSOR OF LANGUAGES IN THE STEVENS INSTITUTE OF TECHNOLOGY. PUBLISHED BY THE AUTHOR. Lordon and Hoboken, N. J. 140 pages. Price, $1.00.

The fundamental idea contained in this work is aptly called by Prof. Kroeh the "living method," in which the student associates his actions with the French phrase describing them and avoids thinking of them in English or making a literal translation. The author considers it impossible to speak in French and at the same time think in English, and that the only way to accomplish this is "to live in French." This method is intended as supplementary to the Natural Method in which all references to English are entirely dispensed with, and the idea of thinking in French is by no means confined to class exercises but may be carried on at any time.

The preparation of phonograph cylinders is in progress which will contain the exact pronunciation of all the fundamental sentences contained in this book. The "living method" commends itself as the most natural and feasible method of acquiring a speaking knowledge of a foreign language, and is highly endorsed by teachers who have adopted it in class work.

The Wonders of Electricity.

J. H. Mason, inventor of Mason's new battery system of electric lighting and power, will lecture in Rochester Avenue Church, Brooklyn, Wednesday evening, May 10.

Mr. Mason is thoroughly posted on the practical applications of electricity and his audience is sure of an evening of instructive entertainment.

The Central Railroad Company of New Jersey has had one of its cars equipped with the Young-Muskowitz railway electric lighting system, and it has been run over three thousand miles of track as a test with satisfactory results. The light is generated by a one-horse power dynamo, which is run by a system of shafting, sprocket wheels and chain belts, which connect with the axle of the car. A storage battery takes up surplus electricity and supplies current when the car is not running. This battery will feed the car four hours.

ELECTRICITY.

The Popular Electrical Journal.

GEORGE R. METCALFE, - - - Editor.
R. H. WILLOUGHBY, - - Associate Editor.

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Our columns are open for the discussion of any question in which the interests of the Electrical Industry are at stake. News notes, descriptions of new devices with drawings or photographs, are at all times desired.

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Constant Current Transformers. The lecture by Prof. Crocker on Dynamotors, an abstract of which is given elsewhere, suggests some useful applications of these machines, which have so far been very little used outside of experimental purposes. There is one application for which these machines seem to be admirably adapted, and that is for methods of regulation or where small differences of potential are required. This is easily accomplished by connecting the secondary winding of the machine in series with the main line, and thus raising or lowering the pressure on the main according to the ratio of the transformer circuits. In order to secure a variable range of pressures several machines would be necessary, but this extra cost should be more than offset by the loss involved in the use of large resistances or feeder equalizers. Another application of this principle which has lately been patented is a combination of several auxiliary machines to avoid the use of resistances in charging storage batteries. The usual method employed for this purpose is to run the generator at the maximum pressure required for the batteries at the end of the charge, and start in with a large resistance in series which is gradually cut out as the batteries become charged.

In the other case several auxiliary machines, say four, are run directly connected on one shaft, two as motors and two as generators, and their potentials vary by a few volts. The main generator can then be run at the average pressure of charging, and by using the small machines in series with the main line a range of pressure of five steps, two below and two above the average, is secured. This method we believe has been found very successful in practice, and where a large number of batteries are to be charged, effects considerable saving over the use of a rheostat.

There appears to be a considerable field for these machines, and numerous new applications will undoubtedly arise as soon as their efficiency is improved, as it is pretty sure to be by careful designing and good workmanship.

* * *

A New Electrical Instrument. An instrument by means of which we may obtain views of distant objects or places by transmitting pictures of the same by an electric current is the subject of a lecture by Mr. Le Pontois before the Pittsburg Electric Club, and will be found elsewhere in this issue. The operation of seeing over as great distances as we now hear by the telephone seems almost too difficult to be classed among the possibilities, yet sufficient advance has been made upon an instrument of this character to give color to the belief that its perfection is only a matter of a short time.

The operation of the instrument described is based upon the property of selenium by virtue of which its resistance is affected by light, and by submitting a selenium cell successively to the various degrees of light reflected from the object to be pictured a current of a pulsating nature is produced, whose pulsations correspond to the various light waves reflected, and are transmitted over the line and reproduced at the receiving instrument.

It should be understood that this instrument differs fundamentally in principle from the kinetograph, in which a permanent record is obtained of the object by means of photography, and which is not an electrical instrument. In the telectroscope the image is reflected as in a looking-glass, and transmitted over a wire without the use of photography or any permanent recording of the picture.

* * *

Atomic and Molecular Motions. We commence in this number an interesting paper on the accepted theory of atomic and molecular motions, contributed by Prof. Dolbear. As modern science is based upon the atomic theory, it stands at the foundation of all our scientific knowledge at the present. The relations which this theory bears to the phenomena of heat, light, electricity, etc., are treated in a solid though simple manner, and the paper contains in concrete form information which would require considerable research to obtain.

* * *

Conspiracy and Theft. The charges of conspiracy and theft made by the Westinghouse Company against the General Electric Company and its agents are summarized elsewhere.

It is as yet too early to discuss the merits of this case, but there are a few facts which stand out clearly.

Mr. W. J. Clark, one of the accused officials, charges that the entire move is one for stock-jobbing purposes. This is monumental nonsense; and considering that Mr. Clark is known to be possessed of at least an average intellect, the only conclusion is that he was very badly rattled.

In the first place the interests of the Westinghouse Company would not be bettered in any degree by a collapse in General Electric stock, such as was recently threatened. The officials of the former company would not aid in any attack which had for its object the placing of the stock of any electric company before the public as unsafe investments. The reasons for this ought to be plain to any of Mr. Clark's office boys.

In the next place, the charges made are of a very grave character, and no company would dare to make them for stock-jobbing purposes. A failure to produce satisfactory proof would render the Westinghouse Company liable for more damages than its gross earnings from this year's business. Moreover, the District-Attorney of Allegheny County, Pa., is presumably a man of average legal attainments, and has weighed carefully the information laid before him.

* * *

Mr. Morris W. Mead has made an emphatic denial of all the charges brought against him by the Westinghouse Company. Those who know Mr. Mead best will accept his statements as true, and it will be a pleasure for Electricity to state, when the matter is finally cleared up, that Morris Wideawake Mead was not in it.

THE slump in General Electric to **58** must have been a surprise to the guileless New Englanders who have placed their faith in Mr. Coffin's assertions that the stock was going to 150. ELECTRICITY's charges have been borne out to the letter, and we are not surprised. The intrinsic value of the stock has not yet been established, but we place it far below 58.

* * *

ELECTRICITY is not prepared to assert that Mr. Coffin and his agents are guilty of the charges preferred against them. We are prepared to assert that the history of the Thomson-Houston Company has been such that no one will be surprised if the charges are fully substantiated. The stealing of other people's ideas has been a common occurrence with this company, and its employees have been taught that roguery was a virtue which would be rewarded.

* * *

"WITH the prospective advent of new lamps, consumers and supply dealers should not forget their duty. The General Electric Company will soon be on its knees begging for trade, and for the services of the middle-man in securing it. But non-infringing lamps should be the only ones used or sold."—ELECTRICITY, *March* 22.

The begging will soon begin, and every enemy of monopoly should do his duty.

This is the slogan: Let no man purchase one dollar's worth of supplies of the Trust or of the Trust's agents which can be purchased elsewhere.

The Prophecy Fulfilled.

General Electric's Rottenness is Proven.

General Electric was depressed on the circulation of a number of disquieting rumors. There is little reason to doubt that since the recent flurry in money the accommodation usually obtained by the company with the banks in this city and in the East has been curtailed. It is also understood that the company will have to compete with a new patent about to be introduced, which may involve a complete change in the system of supplying incandescent lights.—*Brooklyn Eagle.*

All sorts of unfavorable rumors are in circulation respecting General Electric. There appears to be no doubt that the company is in need of funds, which it is unable to obtain in the present condition of the money market.—*N. Y. Advertiser.*

There is a general impression in Wall Street that the Edison General Electric Company is in need of funds. Serious competition is having its effect, and the steady decline of the stock creates no feeling of surprise.—*N. Y. Journal.*

The General Electric thieves have grown rich by their loaded dice manipulation, at the expense of Wall Street and the outside public, and now their fleeceless victims strew the highways and byways, and the besom of destruction is sweeping away the rubbish that the thieves had so long cracked up so high to delude people into buying.—*Daily Investigator.*

The question having beeu raised in Pottsville, Pa., whether the city council had power to abrogate the contract now in force with the Edison Illuminating Company, and to award a new contract for lighting the borough, Borough Solicitor Matten has submitted to the council his opinion that the contract authorized by council with the Edison Electric Illuminating Company is within the scope of its legislative powers, and binds the corporation of the Borough of Pottsville for five years from February 10, 1892, if said company faithfully comply with the covenants contained in said contract.

CONSPIRACY AND THEFT.

ORDERS OF ARREST FOR PRESIDENT COFFIN AND SOME OF HIS SUBORDINATES.

THE WESTINGHOUSE COMPANY'S GRAVE CHARGES.

Our readers have already been made familiar through the daily press with the charges made by the Westinghouse Company at Pittsburg, against the General Electric Company and its paid accomplices, of the theft of various blue prints and drawings from the Westinghouse factory, and their subsequent use by the General Electric Company.

It is evident that a grave crime has been committed, and that the actual facts in the case cannot be long concealed.

Civil suits have already been begun in Pittsburg and in Salem, Mass., for the recovery of the stolen drawings, and District-Attorney Burleigh, of Allegheny County, Pa., has issued orders of arrest for President Charles A. Coffin, W. J. Clark, E. W. Rice, Jr., W. H. Knight, and M. H. Hamilton, of the General Electric Company, on the charge of conspiracy. Morris W. Mead, Frank Carey (a draughtsman), John Butler and C. C. Christian, of Pittsburg, have already been arrested and released on bail.

It seems that in July last Frank Carey was employed as a draughtsman by the Westinghouse Company. He had previously been employed in the Lynn factory of the T. & H. Company.

The Westinghouse Company became aware some time ago that drawings and plans were being systematically stolen from their office, and detectives were called in.

It is claimed now that Carey was all the time in receipt of a handsome salary from the General Electric Company, and had in addition a large corruption fund at his disposal; that his arrangements were made directly with President Coffin and W. J. Clark; that the drawings were traced to the desk of E. W. Rice in the Lynn factory, and that W. H. Knight, when called upon by a deputy sheriff, admitted that certain Westinghouse drawings were at that time in use in their draughting room.

The officials of the Westinghouse Company have made the following statement in regard to their charges of conspiracy, the arrests they have made and the arrests they are still to cause to be made:

> We have been informed that as far back as July last an arrangement was made under the direction of Mr. Coffin, president of the General Electric Company, with the assistance of his right hand man, William J. Clark, by which a certain young man entered the employ of the Westinghouse Company as a draughtsman at the works in Pittsburg for the very purpose of getting into the secrets of the company for the benefit of the General Electric Company.
>
> Besides receiving a salary from the Westinghouse Company we are informed that he received a much larger salary from the General Electric Company, and a liberal fund by which he was placed in a position to be regularly furnished with blue prints and other information received from the offices and works of the Westinghouse Company.
>
> At this point a large number of the missing blue prints were located at the Lynn factory of the General Electric Company, and the Westinghouse Company served upon the General Electric Company, the Thomson-Houston Company, and several of their officials, a notice to the effect that all the blue prints were stolen property, and replevin writs for their recovery were obtained. We also gave the officials notice that if the prints were not returned to us further proceedings would be taken.
>
> Notwithstanding the great secrecy with which all these alleged deals of the General Electric Company were carried on, the Westinghouse Company believes it has complete evidence of all these facts alleged. Its evidence is supported by a large mass of original correspondence passing between the officials of the General Electric Company and parties who will be connected with the alleged conspiracy.

As a result, Morris W. Mead, Chief of the Bureau of Electricity of Pittsburg, and Frank Carey and Joseph Butler were arrested in Pittsburg, Friday afternoon, on the charge of conspiracy.

The complaint was drawn by A. S. Carpenter, counsel for the Westinghouse Company. At the same time he filed a complaint on the same grounds against Charles Coffin, president; William J. Clarke, general agent, and Milton H. Hamilton, E. N. Rice and Walter H. Knight, electricians of the General Electric Company.

A bill in equity against the General Electric Company in its corporate capacity, and also against several of the officers of the company individually, was filed on May 6 by Warren & Brandeis, of Boston, counsel for the Westinghouse Company.

The bill alleges that the defendants "have in their possession certain plans relating to electrical devices which have been wrongfully obtained from the plaintiff company, and asks that the defendants be ordered to produce them and deliver them to the plaintiff."

Mr. Coffin and Mr. Clark, for the General Electric Company, have denied these charges in toto. The latter practically admits that Westinghouse drawings have been in the possession of his company, and claims that drawings and plans are never regarded as private property.

Lieutenant S. Dana Greene, if he is correctly reported, has made the following brilliant remark on the subject: "The only point of similarity between our plans and those of the Westinghouse people is that they both provide for the use of a generator with a vertical armature. This is called for in the specifications and is, of course, common to all the plans."

The Allegheny County Grand Jury meets early in June. The case of the Westinghouse Company and the proof of conspiracy and theft will then be made public.

The American Bell Telephone Company has filed a bill in the United States Circuit Court at Pittsburg against the McKeesport Telephone Company for an alleged infringement of patent. The McKeesport company was organized a short time ago, and began business on the understanding that the Bell patents had expired. The case is a test one and will be watched with great interest by all who manipulate or patronize the telephone.

SOCIETY NEWS.

The 152d Meeting of the New York Electrical Society.

Lecture by Prof. Crocker on Dynamotors, or Direct Current Transformers.

The 152d meeting of the New York Electrical Society was held at Columbia College, Friday evening last, at which Prof. Crocker delivered an address on "Dynamotors, or Direct Current Transformers," treating successively the historical development, construction, characteristics and applications of these machines.

In his allusions to the historical development of this class of machines, the lecturer compared them with the many good inventions which fall flat upon the market in distinction to the more numerous and comparatively useless inventions which find a ready sale. He considered the dynamotor identical in principle to a dynamo and a motor acting together on any system of distribution, and thought that anyone capable of designing either a dynamo or a motor separately would be able to construct an operative dynamotor, which in its action performs the same function for a continuous current system that the transformer does in an alternating system. In this sense, such a machine was to be considered as an ordinary combination of a dynamo and a motor.

The next step in the development of the dynamotor was the combination of these two parts in a single machine having two armatures and separate fields for each. Following this an important advance, which was suggested by Gramme in 1874, although not adopted in practice until many years after, was the placing of both armature windings upon one core and the use of a single field magnet, which at once simplified the construction and added materially to the compactness of dynamotors. This disposition is characteristic of all the designs now upon the market.

One of the most important advantages offered by this arrangement is that the armature reactions found in either dynamos or motors acting separately are practically neutralized, at least to a negligible extent in this combination, and the brushes, for this reason, need no adjustment under varying loads, but act without sparking under all conditions when adjusted to their normal position, which corresponds exactly to the neutral line of the commutator. In the case of a motor the brushes, in order to work without sparking, require a backward lead, and in a generator, the demagnetizing effect of the armature coils being in the opposite direction, the brushes require a forward lead. Both of these leads in separate machines vary with the load, but in a dynamotor the two are counterbalanced, and the brushes remain normally on the neutral line under all conditions.

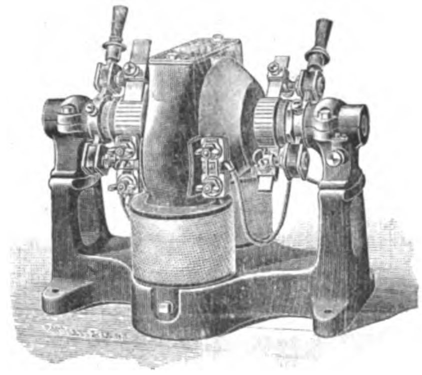
In practice it has been Prof. Crocker's experience that these machines work very successfully, and, as "the proof of the pudding is in the eating," this fact is probably the strongest indorsement of their utility. It was formerly considered impossible to use such machines for purposes corresponding to that of alternating current transformers, owing to the care which was supposed to be involved on account of the moving parts, but experience has proved that dynamotors are well adapted to take care of themselves, even when located in cellars or on inaccessible shelves, largely for the reasons that the normal position of the brushes is not shifted with changes of load, and the consequent absence of sparking, which conduces to slight wear.

The lecturer stated that there was one point in which transformers still held the lead, viz., efficiency. It is no easy task to design a dynamotor of high efficiency, especially machines of small capacity. This he considered the principal difficulty in the way of their general introduction, as their use implied two transformations of energy, each of which involves a loss. In illustration of this fact there was cited the case of two small machines of, say, one or two horse power. An efficiency of 90 per cent. in either a dynamo or a motor of this size would be considered good, and in a dynamotor, which comprises a combination of both of the former, the efficiency would be (90x90=) 81 per cent.

In the design of these machines a number of conditions arise which can only be determined by experience, such as the proportion of space to allow on the armature for both the dynamo and motor winding, the relative position of each, the most desirable density of the magnetic field, etc.

For a laboratory outfit these machines are of the greatest utility, as a number of them in connection with an ordinary electric light circuit offer almost any desired range of voltage and current, and the use of large currents, as for metallurgical work, is not accompanied by the waste due to the use of resistances where a low voltage is required.

Several machines having various ratios of transformation were exhibited in operation running on the lighting circuit of about 110 volts. In one the ratio of transformation was about 20 to 1, reducing the pressure to about six volts with a corresponding increase of current. In another the voltage was raised in the ratio of about 1 to 5, lighting five 100 volt incandescent lamps in series. An interesting machine was also exhibited which transformed the 110 volt current into an alternating current of 33 P. P. S., and in which the secondary winding was connected to two collecting rings instead of a commutator.



CROCKER-WHEELER DYNAMOTOR.

It is apparent that with direct current transformers the ratio of E. M. F. must be constant for any machine, but the ratio can be chosen at any figure. It is, of course, possible to vary the pressure by the use of resistances in either the dynamo or motor circuit, but this does not alter the actual ratio of transformation.

A dynamotor of a ratio of 1 to 1, which appears at first sight to constitute an apparently useless transformation, was alluded to by the lecturer, who pointed out the object of such a machine, especially in telegraph work. In cities of medium size there are required several voltages of various amounts for telegraph lines, many of which lines may be run from an electric lighting circuit and use about the same pressure. As the latter is supposed not to be grounded it would be impossible to connect a telegraph circuit to it without altering this condition, but by the use of a dynamotor with a 1 to 1 ratio it is perfectly feasible to run a grounded circuit from the lighting circuit without introducing grounds on the latter.

There are many applications of these machines which were alluded to besides the above, such as taking incandescent lights from a railway circuit of 500 volts or from power circuits of the same voltage which are used extensively out West. A special application of the direct-alternating transformer is in ringing bells as for telephones. In this use all that would be necessary would be to press a button and dispense with the crank altogether. While this would be a useless expense for a single instrument, in office buildings one machine could be installed which would supply current for all the telephones in the building and thus dispense with a large number of magnetos. An incidental advantage would result from being able to keep up a continuous ringing without much effort until answered.

For a system of general distribution these machines were proposed by Lane-Fox in 1883 and they include some advantages as well as disadvantages in comparison with the alternating current.

In the latter the only gain over a direct current is the ability to run at high voltages, which implies a saving of copper wire, and transform down in any desired ratio. The efficiency of the alternating current transformer is much higher than the direct current transformer, but to counterbalance this the effect of induction in the latter is avoided and its efficiency does not decrease with a reduction of load to the extent that it does with the former.

In the future development of the continuous current transformer its efficiency, according to the views of Prof. Crocker, is capable of the same improvement that has marked the development of the alternating current transformer.

The increase of three or four per cent. in the latter is a matter of the greatest care in its design and workmanship, and the same amount of refinement in the detail of the dynamotor would undoubtedly result in a proportional increase in its efficiency. In a machine exhibited which had an output of 500 watts the efficiency was about 60 per cent., which means an efficiency of approximately 78 per cent. for each part—a figure which may be considered good in either a dynamo or motor of this capacity.

A brief discussion followed the lecture in which the question of the practicability of running such transformers from constant current or arc light circuits arose. In answer Prof. Crocker stated that he had devoted considerable study to this problem, but a satisfactory solution was very difficult owing to the fact that arc light currents were only nominally constant and in practice varied from the rated ten amperes by two or three amperes in either direction. The use of dynamotors as "boosters" by running the secondary circuit in series with the primary was also discussed.

At the conclusion of the meeting a vote of thanks was unanimously tendered to Prof. Crocker, after which the annual election of officers for the society was held the following ticket being elected:

President, J. Wetzler; Vice-Presidents, Prof. F. B. Crocker, Nikola Tesla, M. M. Davis, C. E. Emery, Dr. W. E. Geyer, W. J. Jenks, C. O. Mailloux; Treasurer, H. A. Sinclair; Secretary, George H. Guy.

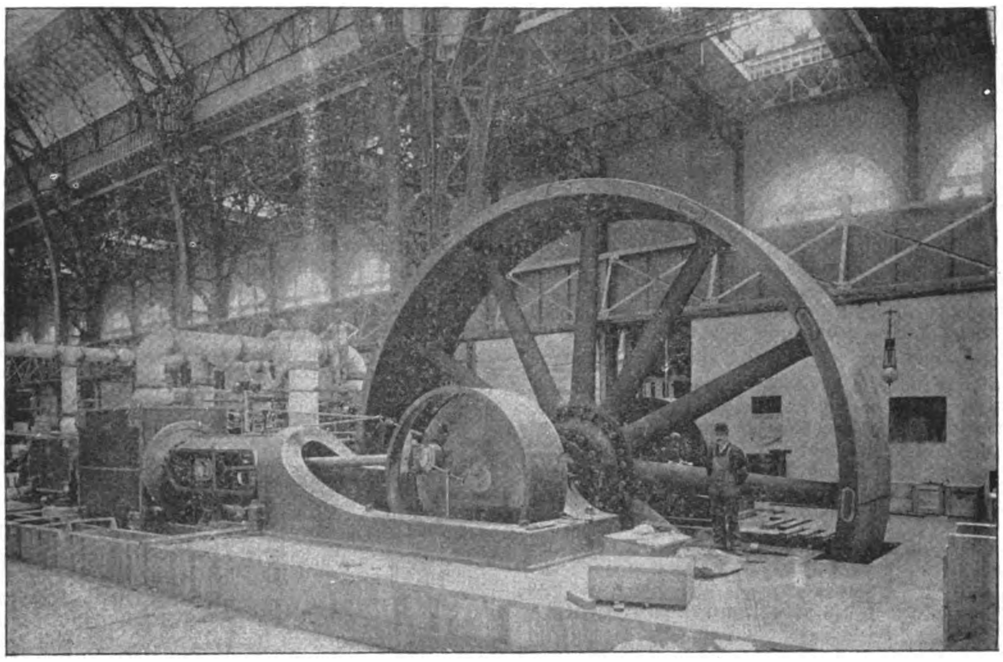
Legal Notes.

A report of the assignee of the W. D. Graves Electrical Company, filed recently in the Probate Court at Cleveland, O., shows the indebtedness of the company to be $19,446.75, distributed among 105 creditors. A majority of the stockholders were in favor of having Attorney F. B. Skeels continue in charge as assignee. Judge White reappointed him.

The attorneys of the Short Electric Railway at Atlanta, Ga., have filed an application for a receiver for the Collins Park and Belt Railroad Company. The petition shows that the defendants owe the petitioner $41,000.

World's Fair Department of Electricity.

Visitors to the Columbian Exposition in the next six months will during their tour of the buildings be attracted more by the exhibit shown in Machinery Hall than that in any of the other buildings. The size of the machines will be not the least attractive part of the display, especially those machines used in connection with the power plant. This plant occupies a space of 100 feet wide by 1,000 feet long, and is situated on the south side of the building. Most of the engines are held direct to one or more dynamos. Of all the engines which run to furnish the 5,000 horse power the one exhibited by the E. P. Allis Company is the most interesting, not only on account of its size, but also its construction. It is of the quadruple expansion type, having the four cylinders of the following diameters: 26, 40, 60 and 70 inches with a 72-inch stroke. The fly-wheel is built exceptionally heavy to make up for the diameter, it being only 32 feet across with a 62-inch face. The valve gear is of the Corliss type with a break wheel and handle attachment for starting. This engine, which is illustrated in Fig. 1, was the one which formally opened the Exposition when President Cleveland pressed the button and sent a current through the electric valve.



CORLISS ENGINE—WORLD'S FAIR. (FIG. 1.)

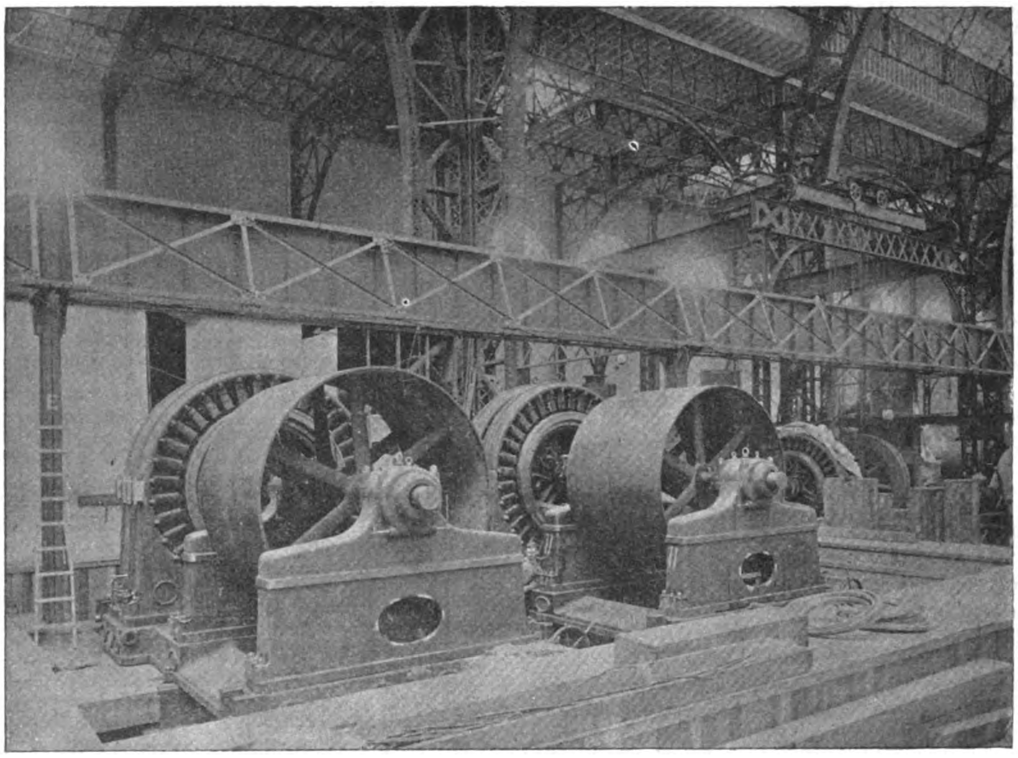
The two Westinghouse dynamos, shown in Fig. 2, and which have been fully described before, are to be belted in tandem direct to the large engine just described. The combined plant will undoubtedly represent the largest of its kind in the world.

Boston Notes.

Brookline, the most wealthy and aristocratic suburb of Boston, has not yet been pervaded by the electric street-railway system, being content to regard horse cars as more than a set off against the introduction of the overhead trolley system which the plutocrats generally don't admire. The West End Railroad Company, however, is contemplating the electrical equipment of that section of its road, and this fact has stirred up some of the daily papers to suggest to the Brookline selectmen to insist on the West End Company making elaborate tests and trials of the storage battery system before it erects the overhead system; and in view of a most important victory gained last Thursday in the State Legislature by a storage battery railway company such suggestion may have to be acted upon.

The bill to authorize the Natick Street Railway Company to extend its tracks, increase its capital stock and purchase other corporations has been passed to be engrossed by the Massachusetts State Legislature.

The two electrical topics engaging most attention in and around Boston this week have been the tremendous fall in General Electric stocks, which coming immediately after the publication of the Trust's first annual report showing a phenomenally profitable eight months' business —on paper—is a revelation of the suspicion with which these stocks are now regarded on all hands; the other topic has been the plucky fight in the Legislature over the bill submitted by the Storage Battery Electric Railway Company, of Cambridge. The bill was debated practically the entire week until Thursday afternoon, when it passed the House by such a clinching majority that its opponents did not even ask that the votes might be counted. This is a big victory and is believed to carry with it possibilities of great and radical changes in the sphere of electric railways.



WESTINGHOUSE GENERATORS—WORLD'S FAIR. (FIG. 2.)

The Lynn and Boston Street Railway, which has quite recently been equipped with electricity, will do a freight as well as a passenger business.

Ere long the West End Railroad Company is to make some important experiments with an apparatus designed and built for welding track rails together as they are laid in the roadbed, in place of them being secured as now with fish-plates, bolts, etc., etc. The apparatus will be operated by current taken from the overhead trolley wire. It has been successfully tried at Johnstown, Pa. Continuous rails, having no joints, will offer many advantages, including increased life of the rails, a saving in wear and tear of motors under the cars, greater comfort for passengers, less running noise caused by cars, while last but most important will be that these continuous rails will carry back the current to the dynamo, so that the leakage now so general will be obviated.

The "Novak" lamp, which was placed on the market less than a week ago, is proving a genuine bonanza for Claflin & Kimball, selling agents. As the result of their unique advertising, they are receiving orders by every mail from every part of the country. Their factory, extensive as it is, is already running full blast, and it looks as if increased facilities would have soon to be provided, so ready appears the entire country to be once more free from the Trust and its minions.

"The Law of the Conservation of Energy in its Practical Limitations" was the subject of an intensely interesting and instructive paper read by Mr. Charles P. Steinmetz before the Thomson Scientific Club in Lynn on Thursday evening.

A new arc lamp is under construction in Boston which is said to be, after many exhaustive tests, no less than 77 per cent. more efficient with the same current than any other lamp now on the market.

Mr. Walter Badger, who has just completed the expert course at the General Electric Company's factory, Lynn, has accepted the appointment of Assistant Superintendent of the Electric Street Railway in Rio Janeiro, Brazil, and sailed for that city last Saturday from New York. Mr. Badger enjoyed a wide circle of acquaintance in Lynn and Boston, and takes with him abundance of good wishes for his future success.

Mr. J. K. Brydes, who for several years has been superintendent of the central station at East Weymouth, Mass., has resigned that position to accept the appointment of Inspector of Central Stations for the General Electric Company.

Chicago Notes.

Harry Bishop, Western representative of the Massachusetts Chemical Company, has gone East on a visit for a week.

I. A. Gorman, Superintendent of the Richmond City Railway, Richmond, Ind., was in the city last week.

Mr. James H. Dean, of St. Paul, has joined the force of Taylor, Goodhue & Ames as traveling salesman.

Mr. E. H. Heinrich, of the Westinghouse Electric Company, made Chicago his headquarters for the past week.

Mr. H. A. Foster, formerly with the electrical division of the Census Bureau, has joined the staff of *Electrical Industries* as associate editor.

A fly-wheel on an engine in the Chicago Illuminating Company's works on Indiana ave. burst while running, and almost destroyed the station. Parts of the wheel flew into the armature of a T. & H. dynamo, and ruined the machine.

Mr. H. Cochrane, late of Denver, is in the city in the interest of the Perret Motor Company. Mr. Cochrane will have charge of the exhibit at the Fair for his company.

General News.

What is Going on in the Electrical World.

Alexandria, Va.—A new electric railway line is being laid out between this city and Washington.

McKeesport, Pa.—The electric light plant put in to replace that destroyed by fire a few weeks ago is now ready for business.

New Britain, Conn.—The Electric Light Company are having two new factories built, the combined cost of which will be $30,000.

Great Neck, L. I., N. Y.—An electric railway from this place to the steamboat landing on the Sound is a local project that is meeting with favor.

New Orleans.—The work of converting the old lines of the New Orleans City and Lake Railroad into electric roads will be begun without delay.

Muskegon, Mich.—Surveys have been made and the right of way secured for an electric railway from this city to Hackley Park Assembly grounds.

Hannibal, Mo.—A fund has been raised for a preliminary survey of a route for an electric road between Hannibal and Palmyra, a distance of twenty miles.

Norwalk, Ohio.—The Sandusky, Milan and Huron Electric Railway has given a mortgage for $100,000, covering all its property, to the Marine Bank of Cleveland.

St. Catharines, Can.—The St. Catharines and Merritton Street Railway, said to be the first electric road operated on this continent, is being extended to Thorold.

Columbia, S. C.—The electric railway is completed and cars are running to the delight of the citizens, who have been anxiously waiting to see the trolley in operation.

Terre Haute, Ind.—A sale of the property of the Electric Street Railway Company to Eastern capitalists is being negotiated. The purchase price is said to be $500,000.

Maumee, Ohio.—T. P. Brown has been granted a franchise by the town council for the construction, maintenance and operation of an electric street railway in this town.

Harrison, Ohio.—A Boston syndicate are said to be formulating plans for an electric road between this city and Cincinnati to compete with the Harrison branch of the Big Four.

Millvale, Pa.—An ordinance for the issue of $80,000 bonds to construct electric light and water plants has been introduced in the councils. It is claimed the private companies charge too much.

Fayetteville, N. Y.—A line of electric railway from Syracuse to this town is projected, and the road may be extended to Manlius. E. W. Emmons, representing the New York Electrical Works, is promoting the scheme.

Indianapolis, Ind.—The Citizens' Street Railway Company seems determined to throw every obstacle in the way of the new company and is laying track on every highway that is likely to be desirable ground for the new company.

Reading, Pa.—The directors of the East Reading Electric Railway have leased the road to the Reading Traction Company for ninety-nine years, and the cars and other property of the company have been transferred to the Traction Company.

Staten Island, N. Y.—Owing to the embarrassment of Erastus Wyman, work on the electric power plant at Livingston has been suspended and the workmen discharged. The plant will probably be completed under new management.

Cincinnati, O.—L. W. Davis, the superintendent of the Cincinnati Edison Electric Company, was found guilty by Judge Gregg of attempting to coerce employees into severing their connection with labor unions, and was fined $100 and costs.

Halifax, N. S.—The Automatic Telephone and Electric Company of Canada, incorporated by the Dominion Parliament, proposes to run a copper metallic trunk line from Halifax to Vancouver, over 3,500 miles long. Local plants will be established in towns en route.

Jersey City, N. J.—All the old cable machinery of the North Hudson County Railroad has been removed, and preparations are making for the erection of a power house on the old site to be equipped with electrical machinery of large dimensions and most approved type.

Charleston, S. C.—The city council has granted a franchise to the Enterprise Street Railway Company to construct an electric railway system throughout the city. The Enterprise Railway property was recently purchased by the Great Western Manufacturing Company of Chicago.

Shelbyville, Ind.—Representatives of a New York syndicate have contracted with the Shelbyville Electric Street Railway Company to put in a complete line and have the same in operation by August 1. The company has reorganized with Judge Hord as president, Ed Major secretary and Scott Ray treasurer.

Spokane, Wash.—A new enterprise is receiving the careful attention of several Spokane capitalists. It is the fitting up of a great health resort and summer pleasure grounds within a short distance of the city, and the building of an electric line from Spokane to the Four Lakes, ten miles southwest of the city.

Ilion, N. Y.—A corps of engineers have lately been engaged in surveying a route in this village, and from here to Mohawk and thence to Herkimer for the proposed electric road. It is understood that the Herkimer and Mohawk Company is at the bottom of the scheme, and that it is proposed to run the cars through certain streets of the village of Herkimer, forming a belt.

West Orange, N. J.—The township committee has granted an electric franchise to the Suburban Traction Company, the only stipulation being that the company should pay the township $50 a mile each year for all tracks operated in the township for the first five years, and thereafter at the rate of $100 a mile each year.

Middletown, Conn.—A meeting of the directors of the New York and Boston Inland Railroad Company is to be held here to-day (10th) to discuss the construction of a proposed electric line between New York and Boston on the Boynton system, in which a single rail only is used. Engineer Franklin Mead, of Boston, is the promoter of the plan.

Gas City, Ind.—A contract has been closed by which the American Electrical Supply Company of Indianapolis will remove its manufactory to this place. The concern will erect brick buildings covering two acres of ground and will employ over one hundred men. By the terms of the agreement the new works must be in operation by August 1.

Brooklyn, N. Y.—The linemen employed by the Citizens' Electric Light Company of Brooklyn have struck for an increase of wages from $2.50 to $3.00 a day. The New York and New Jersey Telephone Company's men are also on strike.—The strike on the DeKalb Avenue Railroad line has ended, the demands of the men for $3 a day having been granted by the company.

Geneva. Ill.—At a late meeting of the Board of Supervisors, a franchise was granted the Aurora Street Railway Company to extend its line along the highway from Aurora to Batavia, the ultimate object being to reach the county seat. A petition for a franchise for another line, to be known as the Elgin, St. Charles and Geneva Electric Railway, to extend from Elgin to the county seat, is also before the board, and will undoubtedly be passed.

Hartford, Conn.—The House passed the electric railway bill on Wednesday after making important changes in it. It now goes back to the Senate. Sections 7 and 8, which prohibit the carrying of freight and put a practical prohibition on the building of a line parallel to a steam road, were struck out by a large majority. Other important amendments were adopted which make the bill a very different measure from that passed by the Senate. It is doubtful whether the Senate will agree to the House amendments.

Salem, Ohio.—The Salem-Canton Electric Company have been discussing an electric railway project of large proportions. The scheme is to unite Massillon, Canton, Alliance, Salem and Youngstown, and the plan proposed is to obtain franchises on the right of way along the route, get all the railway companies operating electric plants in towns mentioned above to combine and extend their lines until they are finally absorbed into one gigantic system. The other towns which the road will touch are Louisville, Damascus and Canfield. Negotiations are pending to purchase the Davis electric light plant in Youngstown, and the deal will probably be consummated. This will give the syndicate control of the Salem electric road.

Chicago.—The wiremen in the employ of a number of electrical companies have quit work, having been called out by the men of the Chicago Edison Company's Works, who have been on strike for some time. Several firms, having signed the agreement not to employ non-union men, are not affected by the strike, and their men remain at work. Among these firms are the "C. & C." Motor Company, the McFell Company, the West Side Electrical Construction Company, the McEntee Company, the Cornish Electrical Company, the Heine & Fuller Company, the West Side Construction Company and the Illinois Construction Company.

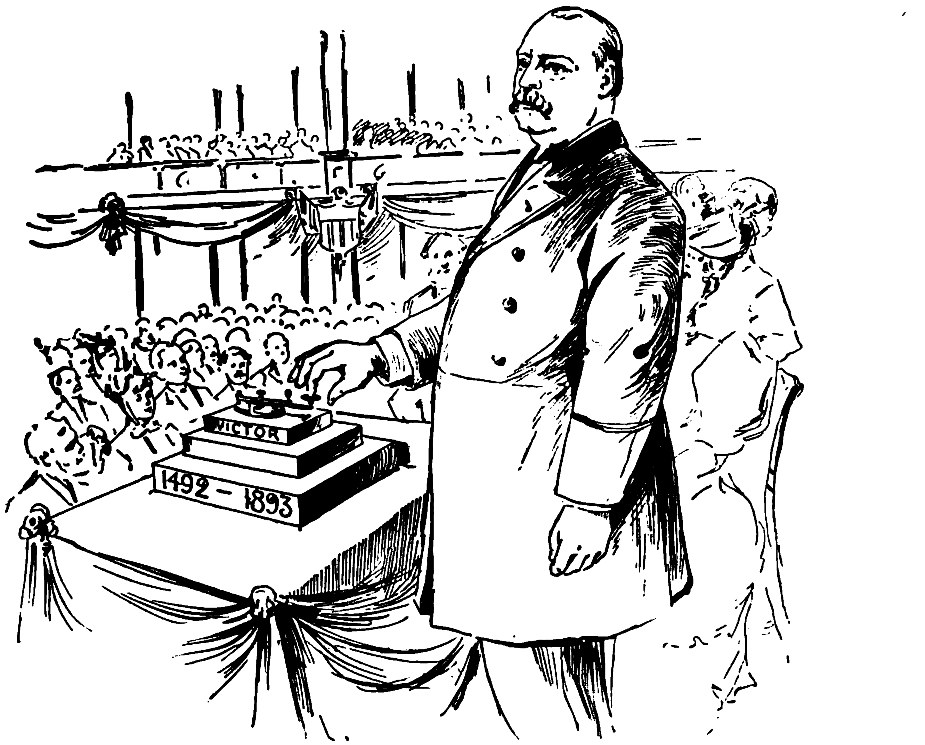
Syracuse, N. Y.—It is rumored that a company is about to be organized here for the operation of telephone plants by a new system, the invention of Syracuse men. The capital stock of the company will be $2,500,000 or $5,000,000. The object of the invention is to present an automatic telephone system whereby each subscriber can call and talk with any other subscriber without the intervention of the central office to make the necessary connection. It is simply necessary to move the indicator of the call to the desired subscriber's number, depress the call lever, when the bell at the desired station immediately responds, thus signaling the subscriber to his telephone. The men said to be interested in the enterprise are Charles M. Warner, Hendrick S. Holden, Edward A. Powell, William Nottingham, George M. Barnes, Anthony Lamb, George W. Hey and Arthur E. Parsons.

Opening the Great Fair.

A highly interesting, not to say important, incident in the ceremonies at the opening of the Columbian Exposition at Chicago was the touching of the key which closed the electrical circuit and set all the enginery of the great Fair in motion. As the supreme moment approached the eyes of the countless multitude were fixed on the little instrument that, as it were, held the machinery in leash, and as President Cleveland, pausing in his speech, raised his hand and placed his finger on the key there was a momentary hush of expectancy which was broken by tumultuous cheers as the pressure of the finger was applied and the vast and complex aggregation of mechanical apparatus became imbued with life. The scene as the President stepped forward is graphically portrayed in the illustration given herewith.

The instrument used on the occasion, clearly outlined in the picture, was the Victor Telegraph Key—in this instance made of gold although ordinarily composed of steel. It is needless to say that it performed its function in the proceedings as perfectly as science and art conduce to

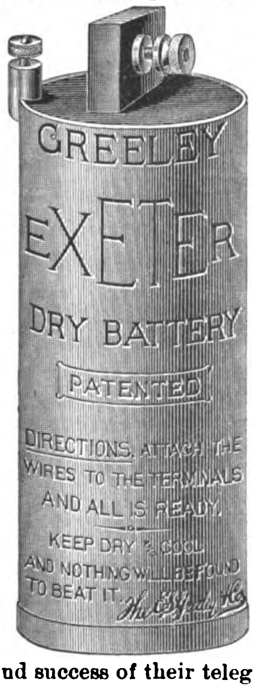
perfection, and awakened admiration for the splendid electrical engineering by which such a vast and promiscuous array of machinery could be put into spontaneous action through its operation.



PRESIDENT CLEVELAND OPENING THE WORLD'S FAIR.

The " Victor" telegraph key, which gained historical significance by its employment on so memorable an occasion, will be on exhibition in Chicago at the headquarters of its makers. The E. S. Greeley & Company, Floor 1, Section F, Space 8, Electricity Building, where the company have also a large and elaborate electric and railway exhibit.

Pleased as this company must have been at the selection and success of their telegraph key they had an additional reason for feeling gratified in the effective work of another of their productions on the same occasion. Conjointly with the key which executed its task so successfully, the Greeley Exeter Dry Battery is entitled to due credit for its share in the " opening " performances. From four cells of this battery was derived the initial electric current that was employed upon the circuit which was closed by President Cleveland touching the key. The electromotive force of this cell was 1.5 volts and the amperage 8; size (cylinder) 6 × $2\frac{1}{2}$ inches. A cut of the battery is given above.


GREELEY
EXETER
DRY BATTERY
PATENTED
DIRECTIONS. ATTACH THE WIRES TO THE TERMINALS AND ALL IS READY.
KEEP DRY & COOL AND NOTHING WILL BE FOUND TO BEAT IT.
The E.S. Greeley & Co.

Queen & Company at the World's Fair.

An Elaborate Exhibit.

We have received from Philadelphia an attractive pamphlet, " Some Features of the World's Columbian Exposition," issued by Queen & Company, Incorporated, from a perusal of which it is evident that the exhibits of this concern cannot fail to prove of interest to all who appreciate high grade apparatus. electrical and otherwise.

To the readers of ELECTRICITY the name of " Queen ' at once suggests electrical testing instruments, and it may surprise some to learn that while a large department is devoted to such apparatus, it is only one of several others which embrace scientific appliances of almost every description.

Five separate exhibits are made necessary to properly exploit these various branches—one in the Electricity Building and four in the Liberal Arts Building.

Queen & Company will be glad to mail a copy of the above pamphlet to intending visitors, who will find it of much assistance, containing as it does general information regarding Chicago and the Fair and exact particulars as to the location and character of each of their exhibits. Application should be made at once as the supply is limited.

The Commercial Electric Company.

This company has appointed the following well-known supply houses agents for their goods:

The E. G. Bernard Company, Hall Building, Troy, N. Y.; F. A. Swan, 194 Summer street, Boston, Mass.; the W. D. Graves Manufacturing Company, 8 Case Place, Cleveland, Ohio; Jones Bros. Electric Company, 30 Court street, Cincinnati, Ohio; Bissell & Dodge, 518 Summit street, Toledo, Ohio; Commercial Electric Company, 55 Gratiot avenue, Detroit, Mich.; Southern Engineering Company, 238 Fifth street, Louisville, Ky.; F. L. Wolfrum, 455 Rookery, Chicago, Ill.; E. G. Bruckman, Equitable Building, St. Louis, Mo.

The products of the company, although on the market for a few months only, have met with a wide sale, and have already established for themselves a solid reputation.

The "Premier Products."

The electrical specialties offered to the public by Mr. M. R. Rodrigues, No. 17-19 Whipple street, Brooklyn, are worthy the attention of all who are using, or contemplate using, electricity in the operation of apparatus needing small power. For fans, sewing machines, and the like, the Premier Motors, Dynamos and Batteries are especially to be commended as embodying all the latest improvements and constructed with a view to the best practical results. The No. 1 Premier Motor. made on improved model and of neat design, starts immediately when current is applied and will run on one cell of the Premier Grenet Battery. It can be used for driving small machinery, and is well adapted for the use of students and amateur electricians. A four inch fan is provided for this motor. The new brush holder designed for use with the Premier motors enables the user to govern the pressure without the use of screwdrivers or pincers and can be raised and cleaned and the commutator cleansed without the slightest trouble.

The Premier Outfits are so well known that to mention them is simply to evoke the good estimation in which they are held by all who have made use of them, and those who need any of the apparatus or material supplied by this house need have no misgivings about the quality of the articles purchased. The stock comprises dynamos, motors, batteries, cells, fans, wire, castings (rough or finished), zinc, bluestone, lamps of various kinds, telegraph instruments and everything kept on hand in a specialty supply house.

Imported Carbons.

The General Incandescent Arc Light Company (S Bergmann president) has taken the agency for the United States and Canada for the arc light carbons and carbon brushes manufactured by Fabrik Elektrischer Beleuchtungskohlen in Nurnberg, Actiensgesellschaft vormals Ch. Schmelzer. The electric lighting public will hence have an opportunity to purchase the very best grade of imported carbons at prices which compare favorably even with domestic carbons. It is well known that the Europeans have beaten us on the quality of carbons, but their high price has heretofore kept them out of the market here. Sold in competition with American goods they are sure to be well received.

Washburn & Moen.

Washburn & Moen Manufacturing Company, Worcester, Mass., report an enormous business in their Insulated Wire Department. They have recently secured some of the largest railroad contracts.

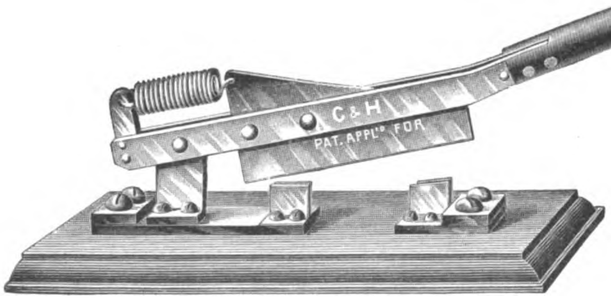
The company announce that they will soon locate in a large and commodious factory at their South Works. This factory will be equipped with most modern machinery.

It is their intention to produce nothing but exceptionally high grade wire. The large number of orders which they are daily in receipt of plainly shows the trade appreciate their high grade goods.

The rapid progress of this department clearly demonstrates the push and energy of the corporation.

The C. & H. Snap Knife Switch.

The C. & H. switch, which is herewith illustrated, is designed to meet the demand for a good knife snap switch, that will have a positive quick break action without too much complication and consequent expense. The length of the break is greater than any other switch on the market, making it especially desirable for high tension circuits. The design is extremely simple, taking and new. They are made dipped and polished, single, double or triple pole, mounted on wood or slate bases, in a great variety of styles and capacities from 15 to 1,000 amperes. The switch is designed and patented by Mr. H. H. Cutler, and is manufactured by the firm of Cutler & Hammer, 313 Canal street, Chicago.



THE C. & H. SNAP KNIFE SWITCH.

"C. & C." Co.'s Philadelphia Branch.

The following announcement is made by Mr. G. H. S. Young, of Philadelphia:

> I beg to advise you that I have severed my connection with the Pennsylvania General Electric Company, 509 Arch Street, this city, taking effect May 1st, and am now located at the address of the " C. & C." Electric Motor Company, No. 43 N. Seventh street, where I shall be glad to hear from you whenever you are in the market for electrical apparatus, or have information concerning prospective buyers. We are in a position to furnish motors and dynamos in any size from $\frac{1}{8}$ H. P. to and including 100 H. P., also to contract for isolated lighting and transmission power plants in part or whole. Thanking you for past favors and asking a continuance thereof, assuring you that any information will be fully appreciated, I am,
>
> Respectfully yours,
>
> G. H. S. YOUNG.

Micanite.

The Mica Insulator Company, 218 Water street, New York City, report increased sales for their perfect micanite insulators.

Besides the leading electrical manufacturers here and abroad who have adopted this improved method of handling mica, it is being used by the largest electrical street railway companies for repairing their motors and generators. Mica as an insulator is acknowledged by leading electricians to be equal, if not superior, to any insulating material now on the market. The advantage is seen at a glance, when one can purchase micanite insulators in any form ready to be placed in the machine without loss of time or material. Taking into consideration the great saving in cost over using mica in the regular sheet form, it will certainly pay any one wishing the best insulator to investigate micanite.

Howson & Howson.

The above firm announce that Mr. Robert T. Frazier has been appointed Manager of their Washington office, which has now been moved to the National Union Building, 918 F Street. Mr. Frazier is a graduate of the Naval Academy at Annapolis, and has had an experience of five years as Examiner in the Patent Office, having at the time he resigned from the Bureau to take charge of the Washington office of Howson & Howson, earned his promotion to the position of a Principal Examiner.

The New Sunbeam Lamp.

The trade have begun to show their appreciation of the enterprise exhibited by the Star Electric Lamp Company of Chicago in getting their new lamp ready for market so promptly. Orders are already beginning to come in in a way that is encouraging to them, and the outlook for the new lamp is very satisfactory. Those that have been sent out are proving all that has been claimed for them, and the company feel that they have made a great hit.

The Columbia Lamp Company.

The Columbia Lamp Company of St. Louis are now in full blast, with factory running full time.

The popularity of the Columbia lamps has been proven again by the influx of orders. The company deserves full success and has really laid the trade at large under obligations to it by its winning fight against the Trust.

New York Insulated Wire Company.

The above company, best known to fame through its justly celebrated Grimshaw wires, has just issued a neat little handbook containing full information as to the company's various products and a number of valuable tables of a practical nature, such as wiremen and engineers need to refer to almost constantly. Copies will be sent free to the trade by addressing the company, 15 Cortlandt street, New York.

On Deck Again.

The Buckeye Electric Company, of Cleveland, Ohio, makers of the Buckeye lamps, are again open for business, and are ready to fill orders promptly. Buckeye lamps need no endorsement, and the announcement that they are again on the market will give pleasure to many consumers.

COMMERCIAL PARAGRAPHS.

Another week of large sales of Shield Brand Moisture-Proof is reported by the Ansonia Electric Company, formerly the Electrical Supply Company.

George Cutter is supplying the Morris Poletops for the new electric railway at Syracuse, the first order being for over four hundred.

The Redding Electric Company, 41 Federal street, Boston, have issued their April catalogue, giving full information in regard to the well-known Iona specialties.

The International Trading and Electric Company have removed from the offices formerly occupied in the *Times* Building to larger quarters at 40 Cortlandt street, where they will have greater facilities for handling an increasing export electrical business.

We would call attention to the change of advertisement of the Star Electric Lamp Company in this issue. This company is now prepared to fill all orders in any quantity promptly.

The full page advertisement which appears in another part of this issue, showing eleven different types of electric gas lighting devices which are manufactured exclusively by the Electric Gas Lighting Company, Boston, forms the complete set of these devices in existence. This company owns all the patents on these devices and for years has been making and selling them by tens of thousands. To-day a practical monopoly of this branch of the electrical business is enjoyed by the same corporation and the amount of business being done is enormous.

INCORPORATIONS.

The Southwestern Telephone Company has filed articles of incorporation to operate in La Plata County, Col., with a capital stock of $25 000. Directors: J. E. Schutt, G. W. Larimer, A. R. Lewis, H. C. Fancher and J. M. Morgan.

Articles of incorporation of the Pecos Company, with a capital stock of $5,000.000, have been filed in the office of the Secretary of State of New Jersey. The purpose of the company is to aid and promote enterprises for the development and exploration of the agricultural, mineral, landed, or other resources, natural or artificial, in the valley of the Pecos River in New Mexico and Texas. The company will equip railways, telegraph, telephone, electric, gas and water lines. The principal office in New Jersey will be in Jersey City, while the main office will be in Colorado Springs. The incorporators are James A. Hagaman, Thomas H. Edsall, of Colorado Springs, and Charles A. Otis and Richard J. Boths, of New York.

The Pittsburg, Greenburg and Latrobe Electric Railroad Company, of Pittsburg, Pa. Capital stock, $1,000.000. The officers are: J. L. Mitchell, president; James H. Thomson, G. L. Owens, A. A. Stevens, John N. Givin, all of Tyrone, Pa.

The South Jersey Traction Company, Bridgeton, N. J. Capital stock, $400,000. Incorporators: George Wood and Richard W. Clay, of Philadelphia; and Walter H. Bacon, of Bridgeton. Mr. Wood has been elected president. Mr. Clay vice-president, Mr. Bacon secretary and treasurer. The company has contracted for the purchase of the property and franchise of the Bridgeton Rapid Transit Company and the Bridgeton and Millville Turnpike Company, and will succeed them in establishing trolley railways in Bridgeton and along the turnpike to Millville.

The Northwestern Water and Light Company, Lemars, Iowa. Capital stock, $200,000. President, J. H. Winchel; vice-president, Dr. M. W. Richey; secretary and treasurer, J. K. Alline. The new company will acquire the title to the water and light plant now owned and operated by J. H. Winchel, which has been constructed at a cost of $150,000, and will extend its facilities to meet the requirements of Lemars. The new company will also build, equip and operate similar plants in other towns and cities.

The Independence and Salem Railroad Company, Independence, Ore. Capital stock, $100,000. Incorporators: J. A. Veness, J. M. Vanduyn, George A. Smith, J. M. Starke and R. D. Cooper. The purpose of the company is building of a railroad from Independence to a point on the west bank of the Willamette River opposite Salem.

The Crouch Electric Supply Company, of Portland, Ore., for the purpose of manufacturing electrical supplies Capital stock, $100.000. Incorporators: Samuel L. Lovell, Edmond C. Giltner and Harry J. Singleton.

A charter has been granted for a new electric railway which will connect Chester, Pa., with Media, and the busy manufacturing towns of the Chester Creek valley. The officers of the new company are John B. Robinson, president; Edmund Jones, secretary; Edward A. Price, treasurer, and Wm. Ward, solicitor.

The Electric Railroad Company, Auburn, N. Y. Capital stock, $50,000. Directors: Charles E. Eddy, Frederic E. Storke, Frank B. Bemis, Arthur L. Sweetzer, Arthur F. Eastabrook, George Underwood, Edward B. Martin, Edward F. Allen, Alexander Beal.

The Winchester Electric Light Company, Winchester, Ill. Capital stock, $14,000. Incorporators: William Hinsfurther, Solomon Hinsfurther, William Milhous, Charles H. Condit, William Neat.

The Franklin, Bridesburg and East Fairmount Park Railway Company, Philadelphia. Capital stock, $78,000. President, George W. Ruck. It will be an electric railway.

The Huntington Electric Light Company, of Huntington, Suffolk County, N. Y. Capital stock, $20.000. Directors: Walter Lindsay, A. B. Gildersleeve, F. C. Hill and others, of Huntington.

The Chicago Electric Transit Company, Chicago. Capital stock, $500,000. Incorporators: John Casselman, Henry Wulff and Alonzo H. Hill.

The Ossining Electric Railway Company, at Albany, N. Y. Capital stock, $50,000. Directors; John V. Cockcroft, Hiram McGonegal, S. R. Stone, J. P. Truesdall and others, of Sing Sing, N. Y. The company will construct a street railroad from Sing Sing to Sparta, Westchester County, N. Y.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED MAY 2, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

496,533. Electric-Distribution System for Railways. Nelson W. Perry, Cincinnati, Ohio, assignor of one-fourth to Thomas T. Gaff, same place. Filed May 27, 1891.

496,550. Electric Locomotive. Eben M. Boynton, West Newbury, Mass. Filed Dec. 7, 1891.

496,631. Double-Pole Trolley. Thomas E. Adams, Cleveland, Ohio, assignor to the Brush Electric Company. Filed June 11, 1889.

ELECTRIC LIGHTS AND APPLIANCES.

496,409. Electric-Arc Lamp. Fritz Hansen, Leipsic-Reudnitz, Germany. Filed Dec. 13, 1892.

496,455. Electric-Lighting System. Elihu Thomson and Edwin W. Rice, Jr., Lynn, Mass., assignors to the Thomson-Houston Electric Company of Connecticut. Filed April 14, 1884.

496,474. Electric Bunch-Light. Joseph Dillon, Larchmont, N. Y. Filed June 22, 1892.

496,701. Electrode for Arc Lamps. John F. Sanders and Sarah J. Sanders, Portland, Oreg. Filed June 15, 1892.

496,702. Electric-Arc Lamp. John F. Sanders and Sarah J. Sanders, Portland, Oreg. Filed June 15, 1892.

496,792. Attaching Device for Electric-Light Fixtures. George Peeples, Philadelphia, Pa., assignor to the Thackara Manufacturing Company of Pennsylvania. Filed Nov. 19, 1892.

DYNAMOS AND MOTORS.

496,449. Perforated Pole-Piece for Dynamo-Electric Machines. Charles E. Scribner and Ernest P. Warner, Chicago, Ill., assignors to the Western Electric Company, same place. Filed Feb. 7, 1890

496,456. Commutator for Dynamo-Electric Machines. Elihu Thomson, Swampscott, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Dec. 2, 1891.

496,514. Armature for Dynamo-Electric Machines. Waldemar Fritsche, Berlin, Germany. Filed Dec. 2, 1892.

496,522. Controlling and Equalizing Electric Motors. David Mason, Schenectady, N. Y., assignor to the General Electric Company of New York. Filed April 22, 1892.

496,567. Utilizing Electric Motors for Operating Machinery. Carl Hoffmann and Ernst Richter, Berlin, Germany, assignors to Siemens & Halske, same place. Filed Nov. 7, 1892.

496,710. Friction-Coupling for Dynamos or Motors. Elihu Thomson, Swampscott, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Dec. 10, 1891.

496,791. Armature Attachment. William D. Packard, Warren, Ohio. Filed March 25, 1892.

496,648. Magnet-Armature. Fred L. Gregory, Chicago Ill. Filed Nov. 16, 1892.

BATTERIES.

496,517. Manufacture of Electrodes for Primary or Secondary Batteries. Rudolph T. E. Hensel, Dresden, Germany. Filed June 17, 1892.

496,658. Galvanic Battery. Frank K. Irving, Brooklyn, assignor to the Franklin Electric Company, New York, N. Y. Filed Jan 27, 1892.

496,743. Element for Galvanic Batteries. Auguste L. De Meriteus, Paris, France. Filed Sept. 30, 1891.

TELEPHONE AND TELEGRAPH APPARATUS.

496,513. Vibratory Telegraphy. Stephen D. Field, Yonkers, N. Y. Filed July 30, 1892.

496,549. Printing-Telegraph Instrument. Alexander H. Wirsching, Brooklyn, N. Y. Filed June 8, 1892.

MEASURING INSTRUMENTS.

496,500. Electrical Measuring-Instrument. Edward Weston, Newark, N. J. Filed Feb. 17, 1892.

496,501. Shunt for Electrical Measuring-Instruments. Edward Weston, Newark, N. J. Filed Nov. 28, 1892.

496,678. Voltmeter. Arakelyan H. Armen, Lynn, assignor to Duncan Gillis and Thomas W. Gleason, Boston, Mass. Filed Sept. 8, 1892.

496,728. Electric Meter. Joseph Edmondson and Joseph Oulton, Bradford, England. Filed Sept. 29, 1892.

496,746. Correcting Electricity Meters. Joseph Oulton and and Joseph Edmondson, Bradford, England. Filed Sept. 28, 1892.

496,801. Electrical Testing Outfit for Cables, etc. Edward W. Stevenson, New York, N. Y., assignor to Samuel L. Fox and Edward B. Fox, Philadelphia, Pa. Filed Sept. 1, 1892.

MISCELLANEOUS.

496,427. Electrically-Operated Overhead Traveling Crane. William H. Morgan, Alliance, Ohio, assignor of three-fourths to Thomas R. Morgan Sr., Thomas R. Morgan, Jr., and John R. Morgan, same place. Filed July 22, 1891.

496,432. Magnetic Crane. William H. Morgan, Alliance, Ohio. Filed June 9, 1892.

496,433. Pillar-Crane. William H. Morgan, Alliance, Ohio. Filed June 13, 1892.

496,591. Apparatus for Making Blanks by Electricity. George D. Burton, Boston, and Edwin E. Angell, Somerville, Mass., assignors to the Electrical Forging Company of Maine. Filed Feb. 20, 1891.

496,592. Working Brass by Electricity. George D. Burton, Boston, Mass., assignor to the Electrical Forging Company of Maine. Filed Sept. 28, 1891.

496,593. Electric Forge. George D. Burton, Boston, Mass., assignor to the Electrical Forging Company of Maine. Filed April 15, 1892.

496,597. Electroplating Apparatus. Seth C. Catlin, Bloomfield, N. J., assignor to Emma F. Catlin, same place. Filed June 6, 1892.

496,594. Electric Forge. George D. Burton, Boston, and Edwin E. Angell, Somerville, Mass., assignors to the Electrical Forging Company of Maine. Filed May 3, 1892.

496,602. Electric Signaling Apparatus. Stephen D. Field, Yonkers, N. Y. Filed Jan. 23, 1893.

496,611. Automatic Safety-Switch. Adelbert E. Hutchins, Detroit, Mich. Filed Dec. 22, 1892.

496,618. Electric Gas-Lighter. David J. Quinn, Brookline, and Paul W. Hoffman, Boston, Mass., assignors to the Iona Manufacturing Company, Portland, Me. Filed June 20, 1892.

496,652. Insulator for Telegraph-Wires. Ralph G. Heminway, Covington, Ky., and James C. Gill, Muncie, Ind. Filed Jan. 3, 1893.

496,690. Electric Alarm. Henry F. Kolbe, Detroit, Mich. Filed Nov. 14, 1892.

496,724. Burglar and Fire Alarm. William C. Dillman, Brooklyn, and George A. Seib, New York, N. Y. Filed July 11, 1892.

496,775. Electric Forge. George D. Burton, Boston, and Edwin E. Angell, Somerville, Mass., assignors to the Electrical Forging Company of Maine. Original application filed Oct. 6, 1891. Divided and this application filed Nov. 18, 1892.

496,786. Electric Signaling Apparatus and System. Jacob W. Lattig, Easton, Pa. Filed Dec. 27, 1892.

496,787. Electric Signal Apparatus. Jacob W. Lattig, Easton, Pa. Filed Jan. 25, 1893.

496,807. Electric Cut-Out. Augustus Wright, Providence, R.I., assignor to the Hope Electric Appliance Company, same place. Filed Nov. 9, 1892.

496,808. Electric Switch. Augustus Wright, Providence, R. I., assignor to the Hope Electric Appliance Company, same place. Filed Nov. 9, 1892.

ELECTRICITY.

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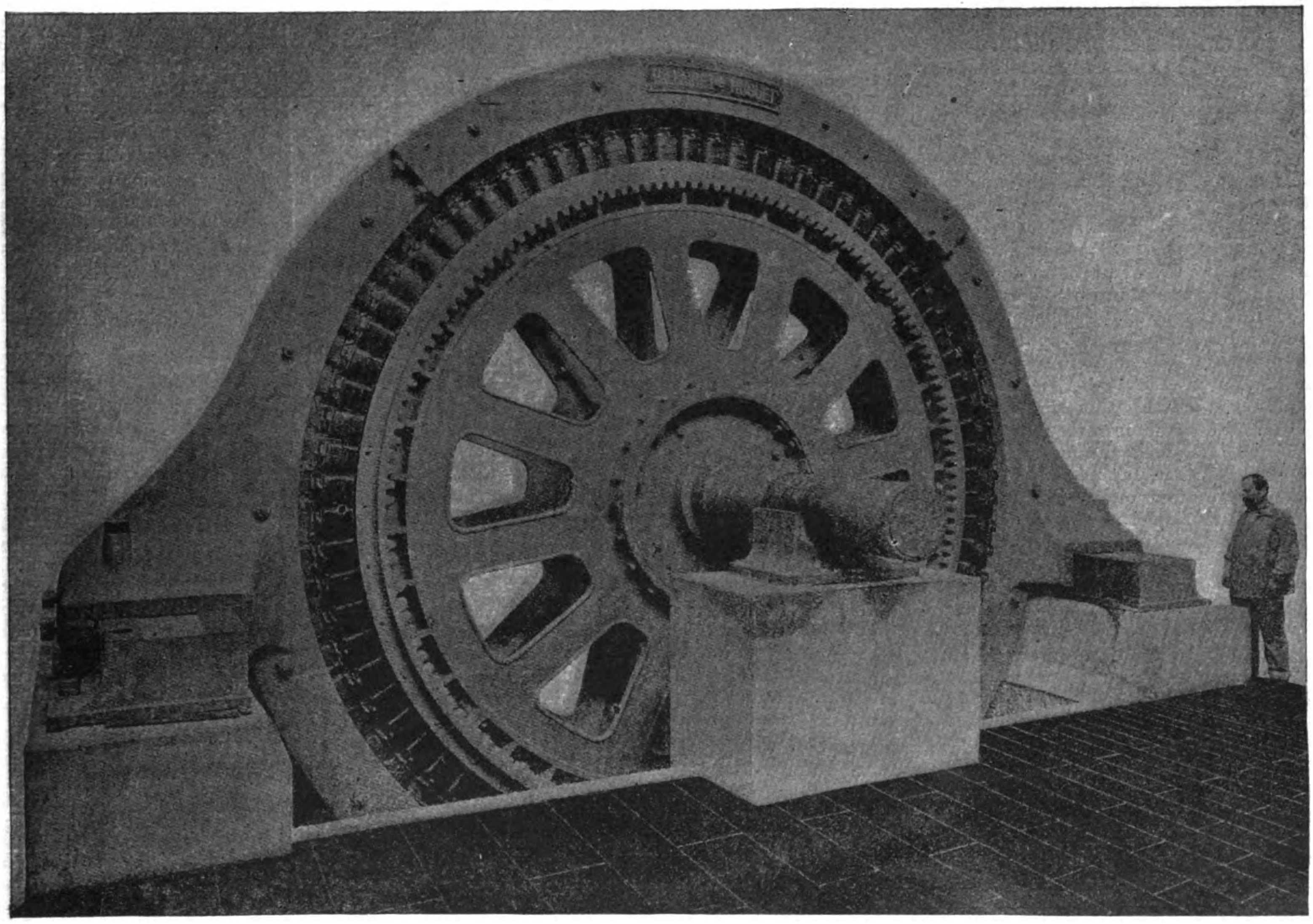

A 400 K. W. ALTERNATOR. (SEE PAGE 289.)

Atomic and Molecular Motions.

II.

BY A. E. DOLBEAR.

When there are bodies of any degree of magnitude moving among each other as air molecules must do, there will necessarily be more or less rotary movements caused for the same reason that vibratory movements are, for very few of the impacts would be exactly in the line of translation, so all of these movements I have described are present in all gases at all times, and a clear perception of their character and mechanical necessity will be very helpful in seeing what further phenomena will follow from such conditions. Thus, suppose one of you were to hold up a shield against which baseballs should be thrown. Each one as it struck would produce some pressure upon it, and if a great number should be thrown so that some were striking upon it all the time the one holding it would be subject to a constant pressure tending to force him backwards. The strength of this pressure would depend upon how many balls struck the shield per second, and also on their velocity; their momentum would produce a constant pressure, and this is precisely the condition in a vessel filled with a gas. If the pressure of the air be fifteen pounds per square inch, it is due to the impact of the free flying molecules that strike with sufficient force to produce that pressure. In like manner the pressure of steam upon the piston head of a steam engine is caused by the impact of great numbers of water molecules in gaseous form, and as we very well know may be as great as 200 pounds per square inch or more.

It is commonly said that the expansibility of gases is due to this repulsive force. If one applies the above mechanical considerations he will see that the term repulsion has no business there. When one throws a ball against the side of the house, and it rebounds to him, he does not think it needful to suppose a repulsion between the ball and the wall, he sees that the return is due to the elasticity and the energy of the ball. So if the air in this room could be all pumped out, and a single cubic inch of air re-admitted, every particle of it would move in the same mechanical way, striking upon each other, bounding away to others and to the walls, in every direction, so that one would in a very short time find as many molecules in a cubic foot of one part of the room as another, but there would have been nothing like repulsion that had anything to do with it. The laws of motion are quite sufficient to account for all that happens without having recourse to befogging ideas.

Suppose now that the vibratory rate of the molecules be increased—that is, suppose the amplitude of vibration to be increased, no matter how, so that each molecule needed more room for itself,—a series of such molecules, each one having a greater amplitude of motion, would have a corresponding increase in the length of the series proportional to the number of molecules and to the increase in the amplitude. We say of a body that has its length increased in such a way that it has expanded. We also know that such increase in dimensions is due to what we call heat, and on this mechanical theory one sees how it comes about if heat be the vibratory motion of the molecules; indeed it follows as a necessary consequence from such motion, and it gives one too a very definite idea of the nature of heat itself. Observe that what we are now talking about is not translatory motion or oscillatory motion, but the motion of molecules in contact with each other; so that only vibratory motions proper, due to change in form, are possible, it is not needful to consider that the centres of the molecules change their positions in any case further than to allow for the increase in the amplitude of the series of molecules. I have said molecules in contact with each other. One may occasionally run across the statement that molecules are not in contact with each other at all, and sometimes one reads that molecules are relatively as far apart as the members of the solar system are from each other, but numerous measurements lately made show plainly that the distances apart of molecules in many solids and some liquids is at most not greater than a fraction of the diameters of the molecules. In gases at common pressures and temperature, the statement is approximately true. For instance, the air molecules in this room may move two hundred times their own diameter before coming in collision with others. A distance two hundred times the diameter of the earth is 8,000 × 200 = 1,600,000 miles, nearly seven times the distance to the moon.

Expansion then, whether in gases or solids, is due simply to molecular impact, each molecule requiring more room for movement when its amplitude of vibration is increased. Moreover, it is found in practice that the energy of the molecules in a gas is proportional to their temperature when measured from what is called absolute zero, and this shows to us that temperature is to be measured by the amplitude of such vibratory movement, and that the energy of a molecule is proportional to the square of that amplitude. From this it follows that at absolute zero, where there is no vibratory motion, there is no such condition as what we call gaseous. The molecules would quietly fall to the bottom of the containing vessel like so many shot and lie still.

The chemists have found too that at very low temperatures chemical action does not take place, and they have come to the conclusion that at absolute zero, the condition where there is no temperature, that is, no vibratory motion, what is called chemical affinity does not exist, molecules have no ability to combine with each other as they do when each molecule has some vibratory rate. Now, all the various kinds of matter which we are acquainted with have to be examined and experimented with at common temperatures, that is, temperatures generally above freezing, which is four hundred and sixty degrees above the absolute zero I have mentioned, and consequently all molecules are chemically combined in one way or another. Even the gases, like oxygen, consist of molecules of two atoms chemically combined. It seems therefore highly probable that at the point of absolute zero even molecules would fall to pieces. It is hardly probable that any one will be able in any way to reduce the temperature very near to absolute zero, but means have been found to reduce it as much as four hundred degrees below the freezing point of water, so that it is possible to liquefy all gases, even the air, and bring all chemical action nearly to a stand still. Such considerations give us an unexpected and extraordinary view of the relations of some phenomena to molecular motion, for it makes plain that such conditions of matter as are called gases, liquids and solids, as well as those minuter cohesions due to what has been called chemical affinity, are in the last analysis dependent upon the vibratory motions of the atoms. In the absence of temperature all solidity, cohesion and many of the so-called properties of matter would disappear. It gives one also the hint that not unlikely the rest of the properties may be reducible to motions of some sort.

I have already pointed out that other kinds of motion are possible, but I wish here to invite you to attend to some other results of vibratory motion which are of the highest degree of importance both in philosophy and in science. Every one knows of the existence of what is called the ether, a substance that seems to fill the whole of space. The reasons for believing in its existence are compulsory, and physicists are studying its properties, which are different from the properties of matter in many important respects. Matter as we know it exists in the form of atoms which combine in all sorts of ways. The ether appears to be not molecular or atomic in any sense but to completely fill all space. Matter possesses gravitative ability so that all matter attracts all other matter. The ether has no such property so far as we can learn. A mass of matter, big or little, cannot move among other masses of matter without hinderance—we call it friction—but a mass of matter of any size can move through the ether without apparently meeting with any resistance, at any rate with such velocities as we have been able to observe. The earth turns on its axis and a point on the equator moves a thousand miles an hour. It swings in space about the sun at the rate of about nineteen miles a second and has been going at such a rate for no one knows how long.

Astronomers tell us that the length of the year has not varied so much as a second in two thousand years. If the ether through which it is moving offered any appreciable friction to the earth, it would decrease its velocity and the length of the year would change.

Comets have been known to move in the neighborhood of the sun at the rate of four hundred miles in a second, and some in their long journeyings in their orbits are gone scores of years, but they return on time as if they had encountered no resistance. Such phenomena show how different the properties of the ether are from those of matter, so it cannot be proper to speak of the ether as matter. The term substance is perhaps more appropriate.

Nevertheless, the ether and matter are so intimately related to each other that some kinds of disturbances or motions of matter set the whole body of ether in a tumble. Although translatory motions do not appear to be able to affect it, yet the vibratory motion we call heat sets up a series of waves that travel to an indefinite distance in it. What we call light consists of waves which have their origin always in such vibratory motions of atoms and molecules, chiefly the former. The ether transmits such wave motions with the velocity of 186,000 miles per second, so that it takes about eight minutes for the light of the sun to reach the earth, but the light of some stars reaches us that are probably so distant as to require thousands of years to come to us, so what we see to-day left the star before America was discovered, Rome was founded or the Pyramids of Egypt were built. If the ether absorbed or stopped any of the wave motions thus imparted to it, it would seem as if we would not be able to see such distant stars as we can for their energy would all be fretted away in their long journey, for the amount to begin with is not very great if it originates in a vibrating atom but the one-fifty millionth of an inch in diameter. Yet the whole of this vast space must be filled with this medium, the ether, or the light could not get to us at all. This gives one something of an idea of the immensity of space.

In all probability light has been going in a similar way and at similar rate in the opposite direction, and one may follow this process as long as he pleases. He can come to no boundary to space, and no boundary to the ether, for as the ether is required to transmit light, if the latter should come to such a boundary in any direction it would be reflected back from it, in which case the whole canopy of the sky would be luminous—there would be no dark spaces.

The ether then gives us information of the existence of matter and its vibratory motion at immense distances from us. That the motion is of the kind I have described is plain for the following reasons: When one analyzes the light that comes from heated gases, it is seen that each different kind of matter gives out light of different wave lengths and colors. Hydrogen gives some red and some blue light. Sodium gives out yellow light, and so on. The waves are of definite and measurable lengths and are found to be very short, somewhere from the thirty-seven-thousandths of an inch to the sixty-thousandths of an inch. As light moves at the rate of 186,000 miles per second, an atom must vibrate as many times in a second as there are such waves in a hundred and eighty-six thousand miles. You can cipher it out at your leisure, but you will find it such a prodigious number as four hundred millions of millions for the longest we can see and much more than that for shorter waves. This is the rate of atomic vibration per second.

(To be continued.)

The Telephone in Sweden.

BY G. EMIL HESSE.

It is a peculiar fact that new discoveries are quickly adopted in some countries while the very same thing is more or less neglected in others. There is nevertheless always some reason for such a result if considered closely.

The rapid increase of the telephone in Sweden may be attributed to the great distance between the cities and the comparatively high rates charged for telegrams. When to this is added that very powerful companies were formed for the purpose of manufacturing and introducing them, and the cost to the subscriber was reduced to a minimum, the whole thing becomes very natural.

The instruments manufactured by Eriksson & Company, Stockholm, are of a superior quality both in regard to their working and outer appearance. This firm not only supplies the demand of the country, but also exports large numbers to foreign countries where they are unprotected by patent, and which Dr. Bell thought fifteen years ago were not worth while to bother with.

Bell telephones were at first imported, but they had very soon to give way to their more aggressive local competitor. In this and every other country where patent was applied for and obtained, no such competition is possible, but there is no doubt that a livelier interest and a greater appreciation would have been manifested if such competition had been allowed. The great mass of people do not as a rule take kindly to monopolies, even if the thing itself is good. The inventor, on the other hand, is entitled to the fruits of his work, but the facts are generally that the inventor gets very little and the company that controls the patent the most.

The popularity of the telephone in Sweden can be surmised from the fact that there is hardly a store or an office in Stockholm that does not have one, and this is the case almost to the same degree in the smaller towns. One may go to any of those stores and by paying 5 öre (1.5 cents) speak to almost any one and to any part of the country. A little more must be paid if the distance is very great.

There are also a good many stations and stores where telephone messages are received and sent thence in writing to those that have no instruments, in the same way as telegrams but at a much lower rate.

At first private companies built and operated the whole system, but the Government began in 1889 to take an interest in the business, which it is gradually acquiring.

Statistical data issued by the Kongl. Telegraph Styrelsen for 1891 show that the State at the end of the year owned 22,763.7 kilometers, with 235 central stations and 10,249 instruments. At the end of 1890 the total length of the State lines was 12,779.4 kilometers with 126 stations and 4,947 instruments. This shows a very substantial increase for one year, but we must not forget that it does not represent altogether new work, because the State bought in a good many private lines.

The length of the lines owned by private companies was at the end of 1891 38,000 kilometers with 400 central stations and 15,000 instruments. The length at the end of 1890 was 39,800 kilometers with 432 central stations and 15,500 instruments. This shows a falling off for the private companies for the reason already mentioned.

The total length of the lines at the end of 1891 was therefore 60,763.7 kilometers, and at the end of 1890 52,579.4 kilometers; increase, 8,184.3 kilometers. Central stations, 1891, 635, and 1890, 558; increase, 77. Instruments, 1891, 25,249, and 1890, 20,447; increase, 4,802.

The cost of the State lines was 3,703,713.31 kroner, and of that sum 1,403,110.39 kroner was expended during 1891, which goes to show that the Government only recently took the question in earnest.

The gross receipts for 1891 were 744,983 kroner, or 72.69 kroner per instrument, which is a little less than $20. The net income was 258,299 kroner, which on the capital invested means a profit of about 7 per cent.

To show the great importance of the telephone in Sweden, it is interesting to note that the total length of the telegraph lines, including about 8,000 kilometers cable, was at the end of 1891 32,264.5 kilometers. The gross receipts were 1,464,491.31 kroner and the net income 123,096.89 kroner, which compared with the profit on the telephone is very little. Few if any inventions can show such results, but it proves that it is not always wise to neglect patenting good inventions in Sweden, a thing generally done by American inventors.

Some Applications of Electricity to Chemistry.—II.*

The electrolysis of fused salts has not been studied nearly so thoroughly, either from a theoretical or practical point of view, as the aqueous solutions of the same compounds. This is partly because it is not easy to work with substances which are red or white hot. Again, many of the salts volatilize at temperatures close to their fusing points, and on the small scale necessary for laboratory work it is troublesome to regulate such temperatures with any accuracy. The electrolysis of fused salt is a tempting process. Chlorine is given off at one pole, and there is no trouble from the formation of hypochlorites. At the other pole sodium comes off in vapor. Sodium, it need hardly be mentioned, is very much more valuable than caustic soda. It is largely employed for reducing aluminium from its chloride by substitution. In addition to that, however, it would provide a means of obtaining pure caustic, as all that has to be done is to allow water to act upon it. This would mean saving in packing and carriage. Many attempts have been made to produce sodium from fused common salt on a large scale, but so far the process does not seem to have been satisfactory. Sodium is produced, but it is difficult to collect it free from salt. Then there is trouble with the anodes. The various metallic chlorides are mostly easily fusible, and so are many fluorides and cyanides. By employing their fused chlorides, strontium, magnesium, calcium, aluminium, and barium may be reduced electrically.

The chief industrial application of the electrolysis of fused salts is in the production of aluminium. One of the forms in which aluminium occurs in nature is a double fluoride of aluminium and sodium cryolite. This ore is fairly plentiful, and was for a long time employed in Germany as a source of sodium in soda manufacture. The cryolite is fused and electrolyzed in an iron vessel. This is kept hot, and the cryolite is kept in a molten state by the heat produced by the passage of an enormous current against the resistance of the electrolyte. The oxide of aluminium or alumina is in many cases dissolved in the cryolite also. Salt is frequently added to reduce the melting point, so that a lower temperature will serve.

When an electrolyte is subjected to an electric current a transference of the radicle takes place, or as it is generally put, there is a migration of the ions. If a solution of chloride of copper were electrolyzed, and if there were no movement of the chlorine and copper during electrolysis, all the chlorine in the immediate neighborhood of the anode would be used up, and the water would be called upon to give up oxygen. At the cathodes on the other hand a little copper would be produced, but as soon as the salt in contact with the electrode was exhausted hydrogen would be evolved. The result would be that with, say, a 20 per cent. solution of the salt, only a fifth of the chlorine and copper corresponding to the quantity of electricity passed would be produced, the rest being spent on decomposing the water. The solution would in fact be decomposed in the exact proportion in which it came in contact with the electrodes. This transference is made available in electrical tanning. It takes a long time to tan a thick hide, because the tanning solution penetrates the skin very slowly, on account of the cells of which it is composed being impervious. Mechanical agitation will force the liquid into the interstices of the hide, but no farther; it cannot force the liquid through the walls of the cells. The passage of electricity, however, causes the tannin to pass through the walls of the cells also. It thus comes about that mechanical agitation alone does not accelerate tanning much, and electricity alone is also of little use, for the movement of the radicles is exceedingly slow. The combination is most effective, however, as the agitation brings the liquor into contact with the cells, and the electrical action drives it through the walls. The action of electrical tanning has been investigated by Dr. Rideal and Mr. Trotter, and Mr. Falkenstein is doing further work on the same very obscure but interesting and important subject.

The osmotic theory stated above was given by the lecturer in a discussion on a paper by Messrs. Rideal and Trotter. Electric tanning on the Groth system is in commercial work in this country, and produces first-rate leather in a few hours.

A 400 K. W. ALTERNATOR.

The machine shown in our Frontispiece represents the type of alternators built by Hillairet & Huguet, of Paris, three of which have been installed in the large station in the Champs Elysées, described in *L'Industrie Electrique*. These alternators have a fixed armature, and the fields, which are mounted directly upon the engine shaft, revolve within the armature, each of which carry 80 poles. The diameter of the fields is nearly 18 feet, and a current is generated of 133 amperes at 3,000 volts, and has a frequency of about 40 periods per second.

The nominal capacity of the machine illustrated is therefore about 400 K. W., but will run up to 455 K. W. on emergency. The net efficiency guaranteed by the makers is 85 per cent. The insulation resistance of the armature is guaranteed also 50 megohms and that of the fields 100,000 ohms.

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* Abstract from *Industries* of a lecture at the Royal Institution, delivered by Mr. James Swinburne.

The Distribution of Power by Alternate-Current Motors—II.

BY ALBION T. SNELL.*

4. MULTIPHASE ALTERNATE MOTORS.

Prof. Ferraris in 1885 experimented with multiphase currents, and published his results in March, 1888, at Turin; and in May of the same year Tesla showed a rotary motor running with four wires; and Bradley, Haselwander, Wenstrom, Elihu Thomson, Dobrowolski, Brown and others have introduced various modifications and improvements. The first practical demonstration was made by Dobrowolski and Brown with the Frankfort-Lauffen plant.

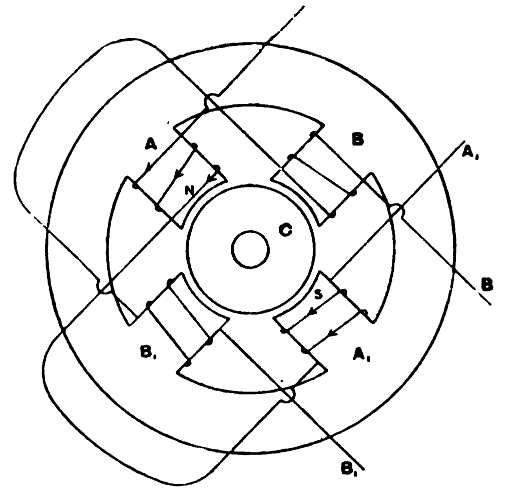

FIG. 1.

It should be noticed that in all rotary field motors and dynamos it is not the current, but the resulting magnetism, that rotates; thus, if there are two circuits and four poles, the magnetism will be displaced 90 deg. with each wave of current. In order to see this more fully, a simple case may be instanced. Fig. 1 is a four-pole diphase motor of elementary type, with a closed-circuit armature, having neither brushes nor commutator. There are two alternating exciting circuits, $A\ A_1$ and $B\ B_1$, in quadrature.

Suppose that A and A_1 be magnetized so as to cause lines of force to pass from A to A_1 through the armature C. Then B and B_1 will be neutral, for there will be no current in them at this moment.

Next, the current in $A\ A_1$ will gradually die away, and that in $B\ B_1$ will steadily rise in an equal and opposite ratio until the magnetic flux from B to B_1 and A and A_1 are neutral.

This cycle will be repeated, but with one alteration—the current in $A\ A_1$ will rise to a negative maximum (assuming it to have been positive before), and the flux will be in the direction of A_1 to A; and in the next wave from B_1 to B. Carefully noting these changes, it is seen that the magnetic field has rotated once for a complete ∿ in each of the circuits, and, therefore, the speed of the field rotation is $\frac{N}{n}$, where N is the number of ∿ per second, and n is the number of pairs of poles in one circuit. In the case referred to, since $n = 1$, the revolutions of the magnetic field will be the same as the number of ∿. To make a diphase dynamo it is necessary to replace the closed-circuit armature by a suitable electromagnet having as many free poles as there are poles in one of the alternate current circuits, to excite this magnet with a continuous current, and to cause it to revolve.*

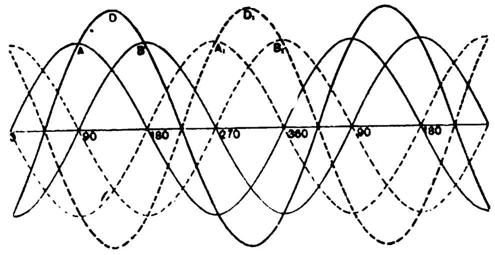

FIG. 2.

Then diphase periodic currents will be induced in the two circuits $A\ A_1$ and $B\ B_1$, the phase difference between them being 90 deg.

Mathematically the currents may be expressed thus:

That in $A\ A_1 = K \sin a$

" " $B\ B_1 = K \cos a = K \sin \left(a - \frac{\pi}{2}\right)$

which shows the phase difference between the two currents. Now, K is a constant for the particular machine and a is a measure of the angular motion of the field. It will be seen that current in $A\ A_1$ is a maximum when a is equal to $\frac{\pi}{2}$ and $\frac{3}{2}\pi$, and is zero when a is equal to O and π; the converse of this is the case with the current in $B\ B_1$.

Diphase systems require either four wires—i. e., two for each circuit—or else the common return must be of double section for the same loss. This is inconvenient on account of both cost and complexity; but a far greater objection for large plants seems to be the apparently excessive variation in the field excitation, yet this view is strongly combated by many competent engineers. Let Fig. 2 be carefully examined.

Curves A and B show the current-fluctuations in the two circuits, and D that in the common return. The magnetic field will be caused by A and B alone, and, therefore, will be proportional to their sum at any instant. When A is a maximum, B is zero, and the induction at this moment is proportional to the current in A alone, and is equal to, say, $C \sin \frac{\pi}{2} = C$. When A and B are equal, as at 135 deg. of field rotation, the induction is proportional to $2\ C \sin 135\ \text{deg.} = C\ 1.4$. Thus the excitation varies between 1 and 1.4, the difference being nearly 30 per cent. of the highest value. The mean variation will be only about 15 per cent., it is true, but hysteresis and self-induction are proportional to the limiting values of the excitation, and eddy currents approximately to the squares of these differences.

Self-induction decreases the output for a given weight of material, and also by increasing the lag may largely augment the idle current for small loads.

To illustrate the fluctuation of the field excitation and consequent induction the sign of the negative curves in Fig. 2 may be changed, and they may be plotted above the time line as if they were positive in value; or two fresh complete curves may be drawn, as shown in dotted lines and marked A_1 and B_1 in Fig. 2, referring to the next two impulses of current immediately succeeding waves A and B.

Both these diagrams are justified by the consideration that each circuit in the motor contains at least two coils wound in opposite directions, and thus produces poles of different signs; and therefore the magnetism rotates continuously.

In Fig. 3 the sign of the negative curves has been changed, and the excitation fluctuation is shown by the top curves, which may be regarded as having reference to one of the poles of the rotary field, say the north pole; while with the double arrangement shown in Fig. 2, since there are two sets of curves—one positive and the other negative—the variations of both poles are indicated. But as the fluctuations are sufficiently defined by the first method, the duplication involved in the latter seems to be unnecessary.

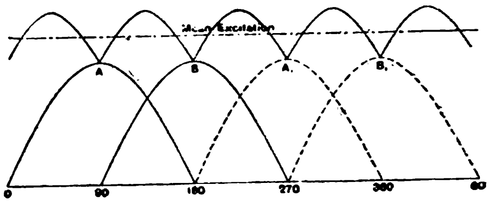

FIG. 3.

In the preceding considerations the armature reactions have been neglected. These are not easily estimated without some experimental acquaintance with the machine in question. But their effect will be a maximum at starting, and will decrease as the armature speed increases, and would be nil if the speed of armature and field coincided—i. e., if the motor worked synchronously. The last condition is unattainable even with no load, for the friction of the bearings and air requires a certain amount of current in the armature to overcome it. Generally speaking, the armature reactions tend to weaken the resultant magnetic field and also to lessen the torque for a given current.

5. TRIPHASE OR DREHSTROM CIRCUITS.

An inspection of Fig. 3 will show that in order to reduce the variation of the field magnetism it is presumably necessary to increase the number of circuits. Take four with phase differences of 45 deg. The field excitation will be nearly constant, but eight wires will probably be required; for it is doubtful whether common returns similar to the direct-current five-wire system would be practicable.

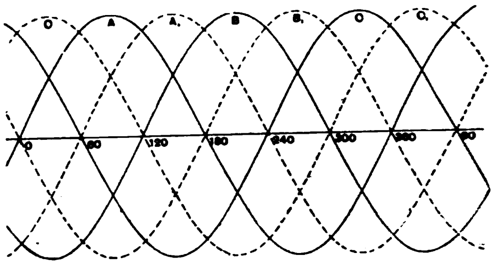

FIG. 4.—Three Periodic Currents Separated by a Phase Difference of 120 Deg.

Yet the next advance in multiphase working was made by using three circuits with currents differing by 120 deg. in phase. Since the phase difference is increased this does not seem a self-evident improvement; but on closer study it is seen that the excitation is more constant, and that the algebraic sum of the three currents is equal to zero.

In Fig. 4 let A, B and C represent three periodic currents separated by a phase difference of 120 deg.; and let the instantaneous values of the currents be severally represented by C_1, C_2, C_3. Thus:

$$C_1 = K \sin \alpha \quad . \quad . \quad . \quad . \quad . \quad (1)$$

$$C_2 = K \sin \left(\alpha - \frac{2}{3}\pi\right) \quad . \quad . \quad (2)$$

$$C_3 = K \sin \left(\alpha - \frac{4}{3}\pi\right) \quad . \quad . \quad . \quad (3)$$

And $C_1 + C_2 + C_3 = 0$ by hypothesis. For $K \left\{ \sin \alpha + \sin \left(\alpha - \frac{2}{3}\pi\right) + \sin \left(\alpha - \frac{4}{3}\pi\right) \right\} = 0$, which is easily proved to be the case.

Drehstrom working is accomplished by parallel or series coupling of the circuits, the two methods being severally known as the star and triangle systems. The author regards as the field magnet that part of the machine in which the rotary fielp

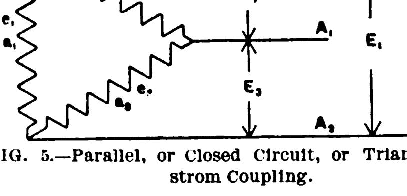

FIG. 5.—Parallel, or Closed Circuit, or Triangle Drehstrom Coupling.

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*Paper read before the Institution of Electrical Engineers, London.

*Rotary magnetic-field machines under certain conditions are reversible. See *Electrical Review*, February 10, 1893, in which an experiment is given showing the reversibility of a "three-phaser."

is produced. In a triphase motor, then, the field magnet will be that part which receives the Drehstrom from the mains, regardless of whether it rotates or not. In the dynamo there can be no confusion, for the field magnets, in present designs at any rate, always rotate and are excited by a separate direct current. In this paper large capitals are used to distinguish the main carrying the Drehstrom, and italics to denote the three windings on the field magnets of the motor, or the armature of the dynamo. Suffixes are used to mark the phase order of the circuits. It is also assumed that the effective values of the current are read by dynamometers, and that of pressure by voltmeters of the hot-wire or electrostatic type.

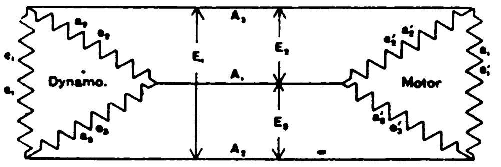

FIG. 6.—Drehstrom Dynamo Coupled to a Motor.

The parallel or closed circuit, or triangle coupling, is shown in Fig. 5. Let A_1, A_2, A_3 be the effective values of the several currents flowing in the mains, and a_1, a_2, a_3 the corresponding effective currents in the coils. Also, let E_1, E_2, E_3 be the effective pressure at the terminals of a_1, a_2, a_3. And assume $A_1 = A_2 = A_3$; then $a_1 = a_2 = a_3$, and $E_1 = E_2 = E_3$. And let there be no self-induction or capacity.

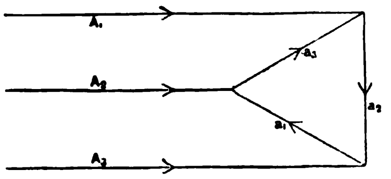

FIG. 6A.

With these assumptions, since a is in phase with e, and A lies 30 deg. removed from a, it follows, if the mains be fed with a combined three-phase current (as in Fig. 6) that the current in one main will differ in phase by 30 deg. from the pressure between it and the two other mains. This is seen to be the case from the geometrical relationship of the coils and the mains. And it can also be proved that the effective value of the current in each of the mains is equal to 1.732 times the effective current in each of the coils, when the circuits are equally loaded. In Fig. 6A let the currents in the mains and in the coils be considered positive when flowing in the direction indicated by the arrows, and let the phase and magnitude relations of these currents be represented by Fig. 6B. Then, if the diagram 6B be supposed to revolve uniformly around its center, the length of the projections of the sides of the diagram on any straight line will represent the instantaneous values of the corresponding currents; for it is plain that these projections satisfy all the necessary conditions—viz. :

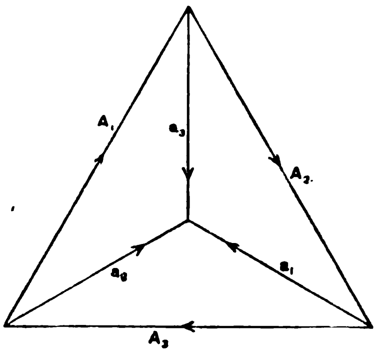

FIG. 6B.

$$\left.\begin{array}{r} A_1 = a_2 - a_3 \\ A_2 = a_3 - a_1 \\ A_3 = a_1 - a_2 \\ A_1 + A_2 + A_3 = 0 \\ a_1 + a_2 + a_3 = 0 \end{array}\right\}$$ All instantaneous values —i. e., the lengths of the projections of the corresponding sides of Fig. 6B.

Again, the sides of the diagram 6B are proportional to the effective values of the corresponding currents; and if the load be equally distributed between the three mains, then for effective values,

$A_1 + A_2 + A_3 = 0$; and $a_1 + a_2 + a_3 = 0$; and $A_1 = 2\ a_2 \sin 60$ deg.; or, generally, $A = 1.732\ a$.

The above demonstration was suggested by Dr. Sumpner.

By a similar diagram the relation between the effective pressures on the coils and mains in the open or star arrangement can be shown to be $E = 1.732\ e$. See (*b*) of this section. The relative position of the phases of currents and pressure in the mains and coils of a combined Drehstrom circuit of the closed type with no self-induction are shown in Fig. 7 (E and e have the same value and coincide in phase). It will be seen that the maxima of the currents in the mains, A, are always midway between those of the coils, a, and that the phase difference between them is 30 deg.

(*b*) The series, open circuit, or star coupling is shown in Fig. 8. As before, let there be no self-induction or capacity, and let $A_1 = A_2 = A_3$; $a_1 = a_2 = a_3$; and $E_1 = E_2 = E_3$. Now, since the mains, A, are in series with the coils, a, and there is by hypothesis no self-induction or capacity, $A_1 = a_1$, $A_2 = a_2$, and $A_3 = a_3$. But the pressures between the mains are not the same as those at the coil terminals. And e will lag 30 deg. behind E and will be numerically equal to $\frac{E}{1.732}$ or, $e = \frac{E}{2 \sin 60 \text{ deg.}}$, and therefore $E = 1.732\ e$.

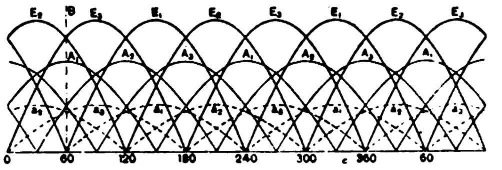

FIG. 7.—Diagram of Relative Position of Curves of Currents in Mains and Coils of a Closed-Type Combined Drehstrom Circuit with no Self-Induction or Capacity.

The phases of current and pressure in a combined Drehstrom circuit of the open type are shown in Fig. 9 (A and a have the same value and coincide in phase).

The conclusions thus arrived at are true only on the assumptions (*a*) that the coils themselves have no self-induction, and (*b*) that both the coils and the mains are equally loaded. The first condition is never found in practice, and the second is only likely to obtain with small motors, and then only in an approximate degree. The effect of self-induction is to cause the current in the coils to lag behind the pressure at the terminals. To measure exactly the power of a Drehstrom system, then, is a complicated task; but it can always be done by measuring the work performed in each of the separate circuits and adding the quantities.

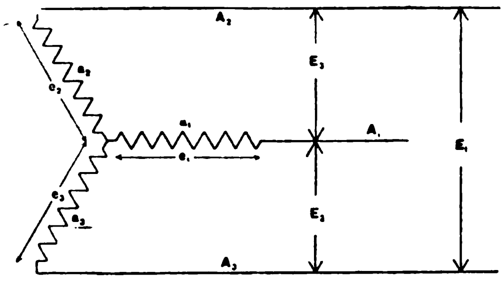

FIG. 8.—Series, or Open Circuit, or Star Drehstrom Coupling.

In Fig. 5, the energy $= 3\ a\ e = 3\ E \frac{A}{1.732} = E\ A\ 1.732$ if the three circuits be equally loaded, and there be no self-induction or capacity.

In Fig. 8, also, the energy $= 3\ a\ e = 3\ A \frac{E}{1.732} = E\ A\ 1.732$ on the same assumptions.

So it appears if there be no self-induction and an equal load in each circuit that the number of amperes in one of the mains multiplied into the pressure between two mains into 1.732 gives the power in watts. If there be self-induction, the above quantity must be multiplied by the cosine of the angle of lag between the current and the pressure. The energy absorbed by a motor, therefore, will be expressed by $E\ A\ 1.732 \cos \varphi$, where φ is the angle of lag.

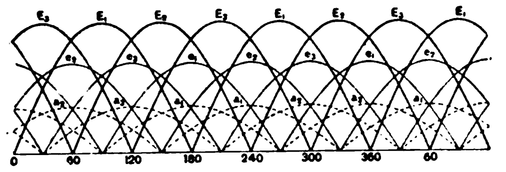

FIG. 9.—Diagram of Relative Position of Curves of Pressure and Currents in the Coils and Mains of the Open-Type Combined Drehstrom Circuit with no Self-Induction or Capacity.

If the three circuits be equally loaded, the power can be measured by one wattmeter (see Fig. 9A). Put the current coil in one of the mains, say A_2, and take two readings, one with the pressure coil coupled between A_1 and A_2, and one with it coupled between A_2 and A_3. The power will be equal to the sum of the two readings.

And if the load be unequally distributed, two wattmeters are required (see Fig. 9B). Place the current coils in two of the mains, say A_1 and A_3, and couple one pressure coil between A_1 and A_2, and the other between A_2 and A_3. The power is then the sum of the two wattmeter readings.

The author is indebted to Dr. Sumpner for the above methods of measuring the power in multiphase circuits by wattmeters. They are also applicable for reading power with direct currents.

In part (*a*) of this section it was shown that with combined three-phase currents, even when neglecting the self-induction of the coils, there is a constant phase difference between the current and the line pressure. This, although not in itself a direct loss, is the cause of great difficulty in measuring, regulating and controlling the currents, and also reduces the output for a given weight of material. Hence it has been found expedient to work the dynamo circuits unconnected, and to use six or more separate coils. The currents from these are combined by a suitable transformer so as to convert the secondary currents into a combined high tension rotary current with phase differences of 120 deg. This high pressure current is reduced at the motor end of the line by another suitable transformer, and sub-divided as required. In the transformers, says Mr. Dobrowolski, there is not the same constant difference of phase of 30 deg. (between the current and the pressure), but owing to the connections of the secondary coils the transformation ratio is not equal to that between the primary and the secondary turns, so the latter must be increased to the extent of this difference. The ratio is 2 : 1.732, or a difference of 14 per cent., neglecting all losses from other causes than the connections. The efficiency of Drehstrom transformers is probably not quite so high as that of single-phase ones, but it is not much less, and when the advantages of low pressure dynamos and motors with high pressure transformers is fully appreciated, the slight difference in efficiency appears insignificant.

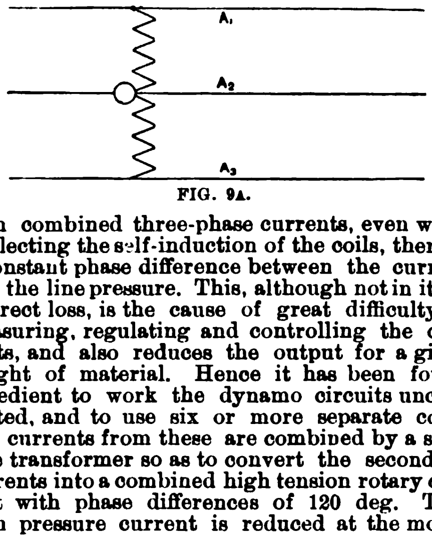

FIG. 9A.

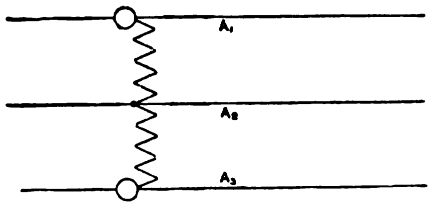

FIG. 9B.

(*To be continued.*)

Electricity In Agriculture.

The Influence of Electric Light Upon Vegetation.*

This particular phase of the question under discussion has been but comparatively little investigated. This is due to several causes. First of all, as long as electric light could only be obtained by aid of strong batteries the entailed costs were too high to render experimenting practicable. With the discovery and perfection of the dynamo-electric machines, supplying light at a relatively trifling cost, came the first satisfactory tests. Of the experiments made in recent years, those of C. W. Siemens in 1880 deserve special mention.

He first selected two electric lamps of 4,000 candle power fed by a dynamo machine, which was in turn driven by a high-pressure steam engine of 6-horse power. One of the lamps was placed in a glass house whose cubic contents were 2,318 feet; the other was placed at a height of from 12 to 14 feet over a hothouse of like size. The inside lamp was fitted with a reflector which threw the rays directly upon the plants, while the outside lamp, on the other hand, was provided with a transparent shade. The experiment began on October 23, 1880, and was continued until May 7, 1881. Sundays excepted, the light was turned on at 6 o'clock in the evening (5 o'clock during the shortest days) and kept up until daybreak. The temperature of the two houses was about 15° Celsius. A large number of vegetables and flowers were planted and observations taken. It was soon discovered that the influence of the outside light was beneficial, while the plants under the rays of the naked light showed a wilted appearance.

Suspecting that the combustible products of the light might exercise a dwarfing influence, the experimenter sought to remove this difficulty. By the help of an engine, which also pumped in currents of fresh air, clouds of steam were introduced into the hothouse between the plants and light. This device proved to be a step in the right direction, though it became eventually necessary to provide the lamp with a shade. This last served at once a double purpose, viz., it diverted the combustible products and supplied a shade between the plants and light.

In this connection it was most instructive to watch the workings of the last mentioned contrivance. If the shade was so placed as to protect only a part of the plants, the line of demarcation showed itself very plainly on the leaves—even after a single night. Those plants at a distance of from 9 to 10 feet from the naked light were distinctly wilted, while those under the shade of a thin glass presented a healthy appearance. This line of difference could even be detected on single leaves. Young stalks showed the injurious effect of naked light at a distance of 20 feet.

Here was clearly a question of the absorption of certain kinds of rays through glass. As electric light is rich in invisible, frangible rays which are capable of being mostly absorbed through shaded glass, Siemens concluded that these rays were especially destructive to the cells. To ascertain this more accurately, an experiment was undertaken. The soil of a hothouse was sown with plants of quick growth and in parcels at equal distance from the light. The first parcel was exposed to the naked light, the second was covered with thin glass, the third with yellow glass, the fourth and fifth with red and blue respectively. The growth was carefully observed daily and the following facts reported:

The plants under the thin glass showed a strong and healthy appearance. Next came the plants under the yellow glass, although the color and thickness of the stalks suffered considerably by contrast. The plants under the red glass had a feeble growth and yellow leaves, and those under the blue glass were still more sickly. Finally, the plants of the exposed parcel showed a stunted growth, with leaves very dark and partly wilted. Throughout the entire experiment care was taken to provide during the day a suffused daylight and a sufficient air circulation.

By a natural process of elimination, Siemens next turned his attention to experimenting with a lamp with a thin glass shade. He noted that peas sown at the end of October, under the influence of the electric light (discontinued, as before, on Sundays alone,) bore ripe fruit on February 16. Raspberries transplanted into the hothouse on December 16 ripened March 1; and strawberries set out at the same time bore fruit of a superior taste and color on February 14. Grapes of vines budding on December 26 ripened on March 26, but were unusually sour in taste. Wheat, barley and oats shot up with surprising rapidity, but did not ripen. After reaching the length of about 12 inches, they began to wither and die. More favorable were the results of the attempt with the same grains and the light in the open air. The sowing took place on January 6, but the germination was slow by reason of the snow and frost. With the advent of milder weather, however, a rapid growth took place, and the fruit ripened at the end of June. That plants grown under the influence of electric light bring forth fruit which can be successfully used for seed purposes was demonstrated by an experiment with peas. Peas gathered on February 16 were planted on February 18. They germinated a few days later and were healthy in appearance.

Still another interesting series of experiments was conducted by P. P. Dehérain at the time of the Electrical Exposition in Paris in 1881. The plants were grouped into five distinct sections. In the first there was electric light day and night; in the second a diffused and weak daylight, with electric light at night. The plants in the third section were in the open air, exposed to a strong natural light during the day, with electric light at night. In the fourth section there was the weak light of the Exhibition building during the day and entire darkness at night. The plants of the fifth group were in the open air and left to their normal growth.

The damaging effects of the light of about 2,000 candle power began to be clearly evident in the majority of cases at the end of seven days. This was especially true in the division having the electric light day and night. Some plants lost their leaves entirely and others had a wilted appearance. Most curious was the influence of the light upon the *Syringa vulgaris*. The leaves directly exposed turned black, while those underneath, protected by others above them, kept their fresh green color. The same phenomena were noticeable in a less marked degree with the azalias and chrysanthemums. An experiment with the blackened leaves showed that the epidermis alone had been injured. The detrimental influence of the light was more marked with the old leaves than with the young ones. In some cases new leaves immediately replaced the old ones which had fallen off, and these showed greater powers of resistance. All the plants which received the electric light during the night were in some like respect damaged, though not in so marked a manner. It was clearly shown, however, by the results in groups two and four that those plants receiving weak daylight and electric light at night were in much healthier condition than those receiving the same light during the day but left to the darkness at night.

Further, Dehérain undertook to discover to what extent the electric light decomposed carbonic acid. It was demonstrated that the light possessed this power, but in a degree much inferior to the sun. On a favorable summer day the quantity of oxygen collected in one hour equalled that gathered by the aid of the electric light in several days.

Satisfied that the direct rays exercised a harmful influence, Dehérain next experimented with shade lamps. Here, too, the plants developed unnaturally. Of a large number of varieties, barley alone ripened. The causes of this unfavorable influence were ascribed to the fact that the light was too weak to assimilate the carbon generated by the carbonic acid and too feeble to have the required effect upon transpiration.

These tests satisfied the experimenter that electric light, even under the best conditions, could be used with but relatively small returns, and this, too, only in those regions where the water power or fuel could be furnished at a very low rate. For those plants receiving a strong sunlight during the day the light might be successfully employed at night during the period of most vigorous growth, i. e., from germination to blossoming.

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* From the United States Consular Reports.

American Institute of Electrical Engineers.

Annual and General Meetings at New York, May 16 and 17, 1893.

The annual meeting of the Institute for the reception of the yearly reports, the election of officers, and other business proceedings will be held at the headquarters of the Institute, No. 12 West 31st street, at 4 P. M. Tuesday, May 16th. It is expected that this session will occupy about two and one-half hours.

After adjournment, those who so desire will assemble at "The Arena," 41 West 31st street, where a dinner will be served. This will be a purely social gathering, and it is hoped that all who find it convenient will endeavor to attend. Friends may be invited.

GENERAL MEETING.

MORNING SESSION.

The morning session of the general meeting for the reading and discussion of papers and reports will be called to order at 10 o'clock, Wednesday, May 17th.

The following papers will be read:

1. "On the Behavior of Fuse Metals in Direct and Alternate Current Circuits," by Mr. Charles P. Matthews, of Cornell University, Ithaca, N.Y.
2. "A Modified Deprez D'Arsonval Galvanometer," by Lieut. Charles D. Parkhurst, of Watervliet Arsenal, West Troy, N. Y.
3. "The Variation in Economy of the Steam Engine due to Variation in Load," by Prof. R.C. Carpenter, of Cornell University, Ithaca, N. Y.
4. "An Automatic Printing Speed Counter for Dynamo Shafting," by Prof. George S. Moler, of Cornell University, Ithaca, N. Y.

At 1 P. M. a recess of one hour will be taken.

AFTERNOON SESSION.

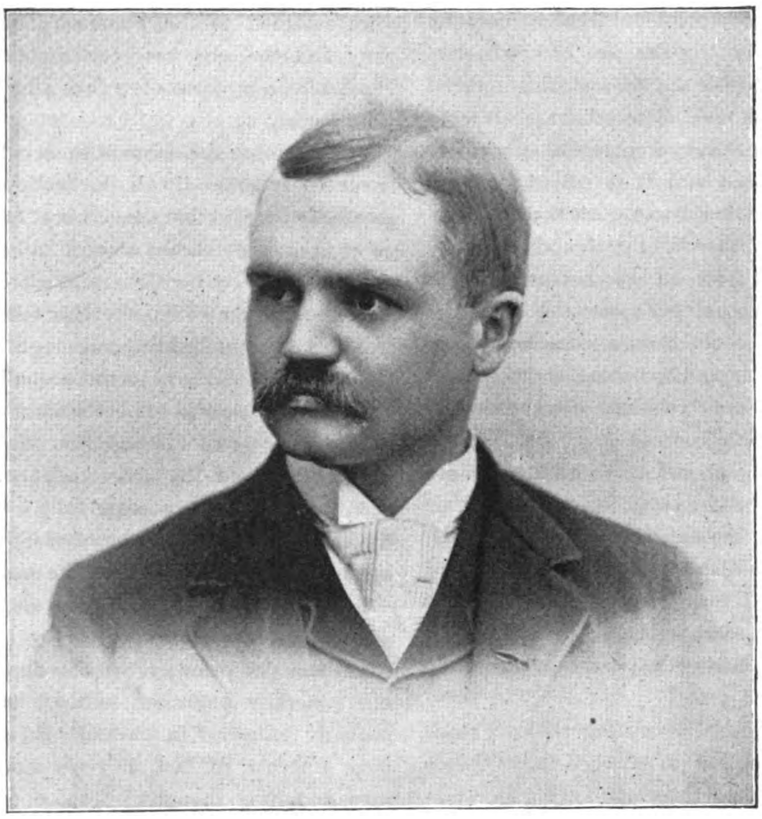
5. "Practical Aspects of Electrical Resonance," by Dr. M. I. Pupin, of Columbia College, New York City.
6. "The World's Electrical Congress of 1893," discussion of the Provisional Programme prepared by the Institute Committee. This report with its appendices has been printed in the January and February issues of the Transactions, and absent members are earnestly invited to contribute in writing any comments they desire to make.
7. "A New Method and Apparatus for Measuring Conductivity," by Mr. E. G. Willyoung, of Philadelphia.
8. "The Heating of Armatures," by A. H. and C. E. Timmerman, of Cornell University, Ithaca, N. Y.

The Novak Lamp.

Brief Sketch of the Inventor.

Among the numerous lamps which have come forward since the attempted monopoly of the styles heretofore in use, the "Novak" probably constitutes the most radical departure from the old practice, and involves a principle which has often been declared by high authorities to be impossible of application in a practical incandescent lamp.

In using a gas in the globes of these lamps the inventor, Mr. Waring, argued that to prevent "air washing" and loss of energy by heat the gas employed should possess high atomic weight, and this theory is the basis of the "Novak" lamp. From the result of the tests which have been in progress since December last on these lamps, it appears that their efficiency is fully equal to any of the vacuum lamps made, and in one respect at least they seem to be superior, as the bulbs of the lamp tested showed no signs of blackening.



JOHN WARING.

The patent for this lamp, which has recently been granted, specifies the combination of a carbon to be raised to incandescence by electrical excitement, an enveloping gas composed wholly or largely of an element or elements of high atomic weight, to wit, as high as that of bromine, a sealed chamber inclosing both the carbon and surrounding gas, and electrical conductors passing through the walls of said chamber and connecting with the carbon.

As the blackening of incandescent bulbs is due to the depositing of carbon which is taken from the filament, there follows a loss of candle power proportional to the disintegration of the latter, but if this destruction is avoided by the use of a heavy gas the "Novak" lamp should maintain practically its normal candle power during its life—a claim which the manufacturers advance for it.

In view of the timely production of a non-infringing lamp, a sketch of its inventor will be of interest.

John Waring.

Mr. Waring was born in Darlington, Wisconsin, in 1862. He received a technical education, including a course in Cornell University, from which he received the degree of Mechanical Engineer in 1884. His inclinations in the direction of electrical work led him to give special attention to this branch of study, and in his senior year he substituted a special course of physical laboratory work, under the direction of Prof. Anthony, for the regular machine shop work laid down in the course.

After graduating he began active work in the electrical field, entering the service of the Mather Electric Company, of Hartford, in 1886.

He remained with that company for four years, doing general work in the dynamo department, at the same time paying special attention to the manufacture of instruments, such as laboratory resistance boxes, voltmeters, ammeters and galvanometers. During this time he received several patents on such instruments and redesigned and improved many of the existing types, among which may be mentioned the magnetic vane ammeters and voltmeters.

In 1890 he accepted the position of electrician to the Perkins Electric Lamp Company, with whom he remained up to last February, after which, upon the production of the Novak lamp, the Waring Electric Company was organized.

Incandescent Lamp Matters.

The Sawyer-Man Case Carried to the Supreme Court.

At the session of the Supreme Court of the United States last week a petition was presented asking the court to bring up for review and determination the case of the Edison Electric Light Company et al. vs. Sawyer-Man Electric Company now pending in the Circuit Court for the Southern District of New York.

In support of the petition a brief was filed by B. H. Bristow which presents the arguments for the granting of the petition.

Counsel for the Sawyer-Man Company contend that the injunction sought ought not to be issued for two reasons:

1. That the Edison Company has been guilty of laches, and although the patent was issued in January, 1880, no action was taken to prevent its infringement until May, 1885. During all that time competitors of the Edison Company were engaged in the business of furnishing electric light plants without objections, and stockholders of these and other companies were thereby induced to invest the money in similar enterprises. All this investment, estimated at $25,000.000, counsel say, is at stake, and they argue that the court ought not to permit the Edison Company, after sleeping on its rights these five years, to reap the benefit of the pioneer work done by its competitors, the result of which has been to make the business remunerative.

2. That the Edison Company is a part of a combination the very existence of which is unlawful. Its purpose is to create and maintain a monopoly of the electric lighting business, and it cannot, therefore, have the aid of the court in carrying out the illegal purposes of its organization.

Storage Battery Litigation.

The case of the Brush Electric Company and the Consolidated Storage Company against the Milford and Hopedale Street Railway Company and the Hopedale Electric Company was heard in the United States Circuit Court, Boston, last week, before Judge Colt.

The plaintiffs were represented by Messrs. Witter, Kenyon, Bentley, Blodgett and Charles E. Mitchell, while the defendants had Messrs. W. B. H. Dawse, Edmund Wetmore, Louis D. Brandeis and W. S. Hall as their counsel.

The plaintiffs alleged infringement and asked the court for an injunction.

The patent in dispute was granted in 1886 to Charles F. Brush. Afterward the Brush Company, to whom the patent had been assigned, amalgamated with the Consolidated Storage Company or conveyed to the latter company the exclusive right to make and sell the Brush Battery.

The defendants denied the charge of infringement.

In opening the case on Tuesday morning Mr. Kenyon, of New York, gave a very full description of the Brush storage battery, pointing out its salient features, describing the process by which it is manufactured and the results attained by it when put into service.

Mr. Kenyon's opening argument also included a historical outline of the work done in this department of electrical science by Plantè, Faure and others, maintaining that what Mr. Charles F. Brush accomplished was the invention of a storage battery of unique design, high efficiency and great commercial value.

He then proceeded to show wherein the battery now being made and used by the defendants resembled the Brush device, the points of resemblance extending to the material used and the form in which they were used, the head plates being closely alike in structure, the effects of the chemical action taking place when the battery was being used being the same.

Mr. Edmund Wetmore, in behalf of his clients, by a minute description of their battery, showed that in form, method of manufacture and resultant efficiency there was the widest possible difference and therefore the plea for an injunction was unsupported by facts.

After Mr. Mitchell had addressed the court in favor of an injunction, Judge Colt took the matter under consideration and will deliver his decision at an early date.

Should the plaintiffs lose their case, a decided impetus will be given to the movement in the direction of storage battery traction.

Photographic Development by Electricity.

Combining two experiments made by Schützerberger in 1869 and Eder in 1886, Herr Liesegang, of Dusseldorf, has succeeded in developing photographic negatives by electricity. He passes the current from six Gassner dry cells through an almost concentrated solution of bisulphate of soda, containing two electrodes of platinum, separated by a porous vessel. If a photographic plate is immersed in the liquid surrounding the negative electrode, the image is developed in a few minutes with a reddish-brown tint. The liquid remains quite clear. No inconvenience is experienced from the decomposition of the liquid, as the separated elements recombine under the influence of the current. In the fixing bath it loses in intensity, but preserves its reddish tint.—*Electrical Engineer* (London).

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Suburban Electric Railways. Considerable has been written lately relative to an absurd suggestion contemplating the extension of electric railways over suburban farming districts which, notwithstanding its utter impracticability, has evidently been taken seriously in some quarters judging from the published comments upon this subject which have appeared from time to time. The almost uniform success that has characterized the introduction of electric railways in cities and towns in all parts of the country lends a certain plausibility to such a scheme which appeals to the layman, who is frequently asked to believe that any and every result, however impossible otherwise, may be readily accomplished by the use of electricity. But in many cases, like the present, the financial possibilities, which must determine the ultimate success or failure of every commercial enterprise, are apt to be ignored, and it is patent to every-one versed in electric railway work that this suggestion emanates either from profound ignorance of the subject or from an over-zealous effort to dispose of electrical railway apparatus.

In view of this conclusion, a consideration of the cost of installing and operating such a system will be found of some value in determining its practicability, which from an engineering standpoint is unquestioned, and although no absolute estimate can be made to fit every case, a fair average, based on the statistics of existing roads, is sufficient to establish the futility of an attempt to connect isolated farms, or other than cities of considerable size and in close proximity, by electric railways, having in view a profit on the investment.

The great majority of existing electric roads have been introduced to succeed horse roads operating on the same lines and having an established urban traffic. Under these circumstances the substitution of electric for animal power has proved uniformly advantageous, and this fact has been assiduously urged in favor of its further application to interurban and rural transportation.

A large number of pen pictures have appeared describing a railway station centrally located in some town from which radiate a number of roads so as to cover all the surrounding districts, and which would largely derive their incomes from carrying farm produce to market. It is obvious that such support would only amount to a small fraction of the income derived from a fair passenger traffic, and it is only by careful management that roads running even in moderate size towns prove profitable. The present enthusiasm over electric roads should be tempered with the same discretion that is used in ordinary business affairs.

* * *

A BOSTON paper, not too friendly with the Electric Trust, went out of its way recently to state that the officials of this Trust were better men than the officials of the Whiskey Trust. It is doubtful if this statement can hold water much longer; certain exceptions will need to be made. Conspiracy and larceny are not as serious offences in the eyes of the law as arson, but in the eyes of decent business men little distinction could be made.

More Patent Litigation. The General Electric Company, whose prestige appears to depend largely upon the decisions rendered in its patent litigations, is now preparing an attempt to emerge from the cloud under which it fell in St. Louis, and has apparently abandoned the incandescent lamp in favor of the trolley.

The infringement suit, noted elsewhere, which has been brought against a local electric railroad in New Haven by the Thomson-Houston Company, which names the Westinghouse Company as a party defendant, is based on two patents issued to C. J. VanDepoele on April 11, 1893, which were assigned to the Thomson-Houston Company, and the suit has been brought with commendable promptness a few days after the patents were issued.

By examining the claims of these patents, which cover pretty generally all the trolleys in use to-day, it is apparent that the suit is at foundation an effort to monopolize the electric railway business of the country by the General Electric Company, after the fashion of its abortive attempt to control incandescent lighting, although in the present case there seems to be but a small fraction of the chance of success which the lamp case offered.

Of the two patents in litigation one was filed in March, 1887, and the other in June, 1888, and granting that the same cover fully every form of under-running trolley now made, the suit still seems ridiculous in view of the many cases in which the use of such devices have antedated the applications for these patents by many years. These cases of prior use are also neither obscure nor generally unknown, as they have been repeatedly described in the daily papers and technical journals; in fact, they are matters of history, and it is thought by those competent to judge that no fundamental trolley patent could legally exist at this date.

The first use of an under-running trolley of this description was in 1854, when it was used on a railroad train for telegraphing while in motion. That occurred thirty-three years before Van Depoele's application for a patent was filed. Again in 1879 the first Siemens & Halske electric railway used this same device, and it was also used on the Lichtenburg (Germany) road in 1880. A number of under-running, spring-contact trolleys were afterwards exhibited at the Paris Exposition in 1881, which, with numerous other well-authenticated cases of the use of this device, should be sufficient to negative its novelty in 1887 without any extensive argument. The same patents claim the invention of overhead switches in which the traveling conductor is depressed, or in which it is led to either wire by upward sloping paths. The claims are hardly specific enough to constitute an invention, and would be of no special value if upheld.

In view of the weakness of its case, the question as to the General Electric's motive in pressing it at this time naturally arises, and is not difficult to explain. Since the organization of this Trust, less than a year ago, its avowed intention has been to create a gigantic monopoly which would control the whole electrical business of the country, but it has needed but a few months to learn the futility of such an attempt. Like similar conspiracies to control any branch of trade, the Electric Trust has assumed an attitude of insolent arrogance toward its competitors, and has sought to crush them by every means except that of honest competition. Such a course was impossible for a concern which must needs hide its condition of bankruptcy under cover of eight per cent. annual dividends upon a capitalization of which eighty per cent. represents the proportion of watered stock. By means of every device known to financial manipulators this corporation's stock was inflated to 119 per cent. on its par value, and to further the stock jobbing schemes of its promoters, its strongest patent, the incandescent lamp, was chosen as a legal weapon to destroy all opposition to its progress. But in spite of the temporary advantage which this patent procured, the company's position began to be generally understood and its stock was looked upon with some suspicion. This marked the commencement of a steady decline which the greatest efforts of the Trust have been powerless to check, and to which the recent defeat in the incandescent lamp litigation which it sustained has lent an extra impetus, so that to-day the market value of its stock is with difficulty held at 60 per cent. of its former price.

In the present extremity something must be done to keep up appearances and boost up the stock, and the trolley suit is a final effort to stop the impending crash which must ultimately occur. It is a simple bluff which is tried upon the public, and will doubtless be worked for all it is worth until the bubble bursts and a limit shall be reached when the sale of enough watered stock to pay eight per cent. dividends becomes impossible.

* * *

The Westinghouse Report.

The first annual report of the Westinghouse Electric and Manufacturing Company since reorganization makes a very favorable showing, and the results should be gratifying to the stockholders. At least one paragraph in the report is of interest to every one:

"The results of the past year's business have shown that apparatus can be sold for cash to responsible parties, and that the prevailing belief that long credits must be given, or that stocks and bonds must necessarily be taken in order to secure business, is not correct. Your officers and agents have found that low cash prices and good apparatus are sufficient inducements to secure all the trade the company can care for."

The evils attendant on the plan of providing the money for the customer to make his purchases with do not need to be dwelt on here. It is a plan which ought never to have been introduced into this business, and which has proved a failure from the start, working injury alike to the buyer and the seller. It was a serious handicap for the old United States Company and for the Edison Company. The Thomson-Houston Company did better, as they introduced a marvellous scheme of financiering to aid them. But with this company the inevitable end has been only postponed by ingenious manipulation, and the poison is still in the system.

It is encouraging to know that the Westinghouse Company has set its foot down firmly, and that it has been successful in getting business on a business-like basis.

The cash basis also has a strong exponent in the Siemens & Halske Company, and we believe that every large manufacturing concern in the country must sooner or later stand on the same platform.

There is no reason why the manufacturer of railway or lighting apparatus should usurp the functions of the banker, the broker and the pawnbroker.

* * *

Financiering or Swindling?

The most unfortunate feature of the present condition of General Electric stock is that the guilty have escaped loss and that the innocent have suffered. It is good opinion in Wall Street that all the large holders got out some time ago, leaving the smaller investors to bear the loss. This is nothing new, it is the rule in all combinations of this nature.

It is the unquestioned privilege of a business man to sell his goods for the highest price he can get. But we would like to know by what rule of business morality the conduct of Mr. C. A. Coffin and S. V. White can be justified. One was the organizer of the General Electric Company, and has been its President from the beginning; the other was recognized until last week as the official representative of the company in the Street. Both of these gentlemen have been looked up to in their respective communities as men of honor, whose word was not to be questioned.

Both have been claiming for ten months that the stock of the company was a sound and stable investment bound to advance in price to somewhere near 150.

Both knew in the beginning, as the world knows now, that the stock is not worth par.

The shrinkage of 30 to 40 per cent. in the market price of a stock is a serious thing even for speculators; it is a much more serious thing for the small investors, the laboring classes, whose investment of $1,000 represented perhaps the savings from ten years of hard work.

Did these gentlemen do right when they used every effort in their power to force the price of this stock up to twice its actual value, and then to unload on the ignorant public of small investors?

Would they have dared to invest trust funds of which they were trustees in such securities? We think not.

Not even the elaborate Century Dictionary gives us the proper distinction between financiering and swindling. Where, then, does legitimate financiering end and swindling begin?

We will give space to both Mr. Coffin and Mr. White if they will answer this question.

* * *

A RECORD of a mile in thirty-two seconds was made by engine No. 999 on the New York Central Railroad last week. Engineers who are working at the problem of safe high-speed electric traction are thus warned that they have a long way yet to go before they can even compete with steam.

DESPITE the columns of rosy statements poured out by the Boston and New York officials of the Trust, aided by Mr. John Surething Wise, and sent broadcast over the country, Trust stock has failed to advance materially. Yet there were sceptics sixty days ago, when ELECTRICITY predicted that this stock ought to be selling at about 75.

* * *

WE ARE advised by our Pittsburg correspondent that Ashton, the go-between sent to Pittsburg by the General Electric Company, has made a full confession, and has turned over to the authorities letters, etc., bearing the signatures of the accused officials of the Trust. Confessions have also been made by one or more of the Pittsburg men.

* * *

THE *Electrical Engineer* has made a long continued and agile effort to be on the side of the winner, and we hope it is at last off the fence to stay. What a pitiable spectacle it would be to see our contemporary make another flop should General Electric go up again to par or better.

* * *

WE HAVE had occasion at different times to compare the abilities of Mr. C. A. Coffin with those of Mr. R. T. McDonald. We have said, we believe, that McDonald is a "slicker" man than Mr. Coffin, and that he ought to be Mr. Coffin's immediate successor in the Presidency of the General Electric Company. The events of the past two weeks have given force to our opinion, and we have no doubt it will be the subject for discussion at an early meeting of the Board of Directors. When was Mac. known to get rattled? Would he ever have left Wall Street in the midst of a panic, and gone off to Fort Wayne, or to Lynn, to meddle with such a small matter as a few stolen blue-prints? Has he ever been known to allow his subordinates to discuss charges of bribery or conspiracy against themselves in the daily press? Not much. Richard is superior to all these little weaknesses. Moreover, we would like to ask, in the many games which he and Mr. Coffin have played in the last few years, has Mr. Coffin ever been known to take a trick? If so, the fact has escaped public notice.

* * *

AND now comes Rialto of the Boston *Herald*, telling the Wall Street brokers that they have made a mistake; that General Electric is not a Trust; that there was no reason why it should have been affected by the slump in Industrials; that it is not a common Industrial, like Cordage and Sugar, but a gilt-edged 8 per cent. manufacturing stock, and a good buy. Rialto's Boston audience may take him seriously, but not so Wall Street. The New York nose is not so large, perhaps, as the Boston nose, but it is more finely cultivated. And several weeks ago it detected the odor of rottenness in Electric Trust stock.

* * *

IT IS a fact that $400,000 of the bonds of the Syracuse Electric Light and Power Company have been turned over to the United Securities Company, and are now held as collateral by that company against one or more of its issues of series bonds.

The Stolen Blue Prints.

The Arrested Men Waive a Hearing at Pittsburg.

Partial List of the Stolen Drawings.

There have been no further sensational developments in the matter of the charges of conspiracy and theft brought by the Westinghouse Electric Manufacturing Company against President Coffin, E. W. Rice, W. H. Knight and M. H. Hamilton of the latter company, and Morris W. Mead and others, at Pittsburg.

It is becoming apparent to every one that the views expressed in these columns last week were correct—that the charges would not have been brought by a company of sane business men without a reasonable amount of proof at hand.

General Electric officials, from President Coffin down, deny the charges, which is the only thing they could do under the circumstances. The denials will count for little at present. No one expected them to confess their guilt to newspaper reporters. They would have used better judgment if they had maintained silence.

Their denials and statements mean about as much to the worldly-wise man as the ante-election claims of a national committee chairman.

The case will be tried in court, where denials of established facts count for little. And if the Westinghouse Company cannot present *established facts*, ELECTRICITY will be very much surprised.

At the preliminary hearing of the men who were arrested in Pittsburg on the 10th, Superintendent Morris W. Mead, of the Pittsburg Bureau of Electricity, one of those charged with conspiracy, was arraigned before Alderman McMasters. He waived a hearing and will stand a trial in court. Frank Carey, John Butler and C. C. Christian, charged with larceny, also preferred a court trial to a hearing.

The hearing was fixed for four o'clock, and the office was crowded in and outside the railing. Both sides were on hand with counsel. The prosecution was represented by Messrs. Scott, Patterson and Gordon. George C. Wilson looked after Superintendent Mead's interests, John S. Robb defended Carey and Christian, and Thomas Marshall was Butler's counsel.

Mr. Mead's bail was fixed at $2,000. Christian was held in $500 bail. Butler had to furnish the same sum, and Carey also.

The matter will now go over to the June term of court, and there is little doubt that both sides will be anxious for an early trial.

The Westinghouse Company has made the following official statement:

"Our counsel was on hand before Alderman McMasters with ample evidence to establish beyond question the charges against the defendants. We were not surprised that Mead, notwithstanding his protestations of innocence, did not dare to face a hearing before the committing magistrate; nor were we surprised that the other defendants, who have not yet been served with orders of arrest by reason of their being outside of the State, failed to respond even by counsel, notwithstanding their published boasts of innocence and of a desire and readiness to meet the charges that were made. We did not take this matter up without having in our possession ample evidence of our charges, not only against the defendants who have been served with orders of arrest, but also those who are still outside the State.

"We propose to push this matter and to exhaust every lawful means to bring the conspirators to punishment. Having discovered the extensive thefts which had been perpetrated under the direction of the conspirators, and the tremendous injury it was doing to our business, we felt it our duty to ourselves, our customers and the public generally to take the course we have pursued. The statement of those connected with the General Company that we were actuated by any other motive is simply absurd."

The New England End of It.

Specific Charges of the Bill in Equity.

Following is a portion of the bill in equity filed by Warren & Brandeis, of Boston, in the suit at Salem for the recovery of the stolen papers. The omitted portions contain simply a statement as to the positions of the Westinghouse and General Electric Companies, already familiar to our readers:

"9th. For upwards of five months prior to the first day of March, 1893, the defendants, by means of bribing various employees of the plaintiff, have been regularly obtaining blue prints of drawings, designs and sketches of apparatus made by employees of the plaintiff of the character above described and copies of specifications and proposals of the character above described.

"About August 1st, 1892, the defendant, the General Electric Company, approached certain persons in the employ of the plaintiff, who had access to the rooms in which the aforesaid plans, blue prints, specifications and proposals were kept, and through secret negotiations and the payment of large sums of money bribed them to steal from the plaintiff from time to time thereafter, and up to about the first day of March, 1893, the blue prints of the most important and novel designs for apparatus, machinery or devices which were made from time to time by the employees of the plaintiff, and also to steal specifications and proposals of the character above described.

"By means of the bribery and theft aforesaid the defendant, the General Electric Company, succeeded in securing regularly from about August 1st, 1892, until March 1st, 1893, as they were prepared, blue prints and copies of specifications and proposals made by the employees of the plaintiff. The blue prints and copies of specifications and proposals above referred to were delivered by persons stealing the same from the shops and offices of the plaintiff to the defendant and particularly to Knight and Rice, who are respectively the superintendent and chief engineer of the General Electric Company. Among the blue prints so stolen and procured by the defendant, the General Electric Company, were the following:

Five thousand horse power quarter-phase generator, designed for the proposed power plant of the Cataract Construction Company at Niagara Falls.
Electric power generator for street railway work, denominated No. 0.
Electric power generator for street railway work, denominated No. 1.
Electric power generator for street railway work, denominated No. 2.
Electric power generator for street railway work, denominated No. 3.
Electric power generator for street railway work, denominated No. 4.
Electric power generator for street railway work, denominated No. 5.
Electric power generator for street railway work, denominated No. 6.
Direct connected electric power generator for street railway work, denominated No. 1.
Direct connected electric power generator for street railway work, denominated No. 2.
Direct connected electric power generator for street railway work, denominated No. 3.
Direct connected electric power generator for street railway work, denominated No. 4.
Direct connected electric power generator for street railway work, denominated No. 5.
Street car electric motor, denominated No. 3, 20 horse power.
Street car electric motor, denominated No. 3, 25 horse power.
Street car electric motor, denominated No. 3, 30 horse power.
Street car controlling device, denominated "G."
Street car controlling device, denominated "D."
Street car controlling device, denominated "E."
Ingersoll air compressor, equipped with electric motor.
Alternating current incandescent electric light generator, denominated No. 00.
Alternating current incandescent electric light generator, denominated No. 0.
Alternating current incandescent electric light generator, denominated No. 1.
Alternating current incandescent electric light generator, denominated No. 2.
Alternating current incandescent electric light generator, denominated No. 3.
Alternating current incandescent electric light generator, denominated No. 4.
Thousand horse power dynamo designed for the World's Columbian Exposition.
Special alternating current generator designed for the Narragansett Electric Light and Power Company, at Providence, R. I.
Switchboard for electric railway power station at Chicago.
Switchboard for electric railway power station at Cleveland.
Switchboard for electric railway power station at New Haven.
Switchboard for electric railway power station at Cincinnati.
Switchboard for incandescent electric lighting station at Boston.
Switchboard for incandescent electric lighting station at World's Fair grounds at Chicago.
Switchboard for incandescent electric lighting station at Scranton.
Five hundred horse power revolving transformer.
Five hundred horse power quarter-phase generator.
Two hundred and twenty kilowatt Tesla electric motor.
Sixty horse power revolving transformer.
Sixty horse power quarter-phase generator.

"10th. All of the blue prints above described, aggregating in all about one hundred and eighty (180), passed into the manual possession of Rice and Knight as agents of the defendant, the General Electric Company, at said Lynn, and are now in the possession of said Rice or Knight as such agents, or otherwise in the possession of the company."

Bids Wanted.

The Denison Light and Power Company, Denison, Texas, has secured a franchise and will construct and operate an electric light plant for the city of Elkins, O. T. They are in the market for arc and incandescent apparatus, also for engines and other material. All purchases will be made by J. R. Cullinane, secretary and superintendent, Denison, Texas.

Current Items.

Joseph Serb, a resident of San Francisco, claims to have invented a wave-power motor that is thus described in the San Francisco *Call:*

There is a wooden flume to be placed facing seaward, into which rush the breakers and run upward twenty-five feet to a reservoir built to contain 50,000,000 gallons and raised thirty feet above sea level. To carry the water the extra five feet there is a certain complicated arrangement situated near the mouth of the flume.

At each end of the reservoir are sunk two shaftings twenty-five feet deep, whereinto open pipes from the reservoir and from which others drain from the bottom into the sea. It is in these shafts that two Pelton waterwheels are to be situated.

By means of these pumps a second reservoir higher up the beach will be filled with 10,000,000 gallons of water and again the contents of the lower reservoir will be elevated still higher into a third 25,000,000 gallon tank 100 feet or so above sea-level. The novel idea of it all is that the water running downward from these three elevations will be used to operate an electric dynamo, which in turn runs the pumps.

Mr. Serb says the idea is his, and though many have invented wave-power motors of late, none have ever considered the possibility of using the power in this drain water. By the aid of this idea he calculates that only 15 per cent. of the original wave strength will be lost, and a phase of perpetual motion produced that will last as long as the ocean waves shall continue to heave.

The New York *Evening Post* says: "One street railway company in Brooklyn reports an increase of 50 per cent. in travel since the trolley was introduced upon some of its lines as a substitute for horses. As the running expenses by the electric system are much less than with the former system, the profits of street railroading are greatly increased, and it is no wonder that financiers are putting forward strenuous efforts to consolidate and control all the street railways of the city, while ambitious politicians are seeking gain by securing franchises which will prove of great value when they are needed to extend existing lines. Meantime the work of extending the trolley is going rapidly forward. To the half dozen lines now operated by it four or five more will be added in the early summer and more by fall."

Orange and lemon growing by electricity is about to be attempted by Ralph Granger, a wealthy ranchowner in Paradise Valley, near San Diego, Cal. Just southeast of the city limits he is having an electric plant put in for his house and grounds, and on its completion will have an acre of trees supplied with incandescent lights, and over all will be placed a powerful tower light to demonstrate what there is in the theory that vegetables, trees and plants develop and mature fruit more rapidly under the constant influence of a strong light than when immersed in darkness every night.

Annual Report

Of the Westinghouse Electric and Manufacturing Company.

PITTSBURG, PA., May 17th, 1893.

Your Board presents herewith its financial statement for the year ending March 31st, 1893.

It will be seen that there has been a profit from manufacturing of $1,491,817.13, and from other sources of $112,766.60, making a total for the year of $1.604,583.73. This is after charging to operating expenses the following amounts: $84.747.31 for alterations and additions to buildings; $155,484.87 for maintaining the machinery and tools in the highest order, and $58,188.86 for interest and discount.

The year began with large orders, but with only a moderate manufacturing capacity and a proportionate stock of material on hand, so that the above earnings were made under unfavorable circumstances due to the fact that the capacity of the works and the material in stock and in process had to be more than doubled during a steadily increasing press of business.

During the year the company has manufactured and installed at the World's Fair in Chicago an electric lighting and power plant consisting of twelve generators of 15,000 lights capacity each—two of 4,000 lights capacity each, one 750 horsepower generator, and several smaller ones. Six of the large generators are driven by engines having their shafts connected directly to those of the generators. This plant is the largest ever installed.

These generators mark a new era in electric light and power distribution. They are of the "two-phase" type, designed to drive Tesla motors, and at the same time to operate both arc and incandescent lamps, thus making the one form of generator useful for three purposes.

The total capacity of the plant exceeds the contract requirements sufficiently to meet the demands that may be made by exhibitors for extra lights.

The company will also have at the Fair an extensive exhibit of its other forms of apparatus.

The stopper lamps now being manufactured in the company's Allegheny City Works are being used exclusively in connection with the apparatus at the World's Fair. It is gratifying to be able to announce that in the manufacture of the Sawyer-Man stopper lamps all of the advantages anticipated have been fully realized. The low cost of manufacture and the high efficiency of these lamps, together with the ability to renew their carbon burners, enable the company to sell lamps at lower prices than can be afforded by any other manufacturer. To meet the demand a new factory has been equipped with special machinery designed for the purpose, and already has a daily capacity of 5,000 lamps, which is being rapidly increased, and will be shortly quadrupled. The expenses incident to the establishment of this new lamp factory have been charged to the business of the past year. This branch will hereafter add materially to the volume and profit of the company's business.

The success of the stopper lamp, its low cost of manufacture, and the fact that it is the discovery, prior to Edison's patents, of inventors whose patents belong to our company, have turned a temporary check into a great business advantage.

Our competitors have copied our plans and infringed many of our patents, notably those relating to power transmission, and many important details essential to the successful operation of alternating current apparatus for the distribution of electricity for light and power purposes, for which we have brought suits for infringement.

The confidence expressed in the last annual report in the superior merit of the apparatus of the company, and in the strength and value of its patents, has been fully justified by the results of the year's operations; and we feel no apprehension as to the outcome of suits now pending or which may be brought by its competitors.

Your directors have been brought face to face with the fact that the business of the company has outgrown the present capacity of the factories, and that large savings could be effected if the manufacture were carried on in new works equipped with the latest devices for handling its product by machinery.

In view of the favorable result of the past year's business, and of the volume of orders in hand, and the future outlook, your directors have not hesitated to accept a proposition from the East Pittsburg Improvement Company to sell to your company a site of 23 acres most favorably located with reference to railway facilities. The Improvement Company has agreed to erect on this site buildings and works according to the plans and under the supervision of the officers of your company, and to sell them to the company at their actual cost, not however to exceed $500,000 above the price of the land, and have agreed to take pay therefor in quarterly payments of $25,000 and interest, beginning January 1, 1894. Your officers have estimated that the savings to be effected by the manufacture of its products in the new works, will, on a most conservative basis, be more than double the amount of the quarterly payments, Thus, these new and complete works will be acquired without the expenditure of fresh capital, leaving the proceeds from the sale of the company's present property as working capital, without taking into account the manifold business advantages that will arise from the centralization of its manufacturing operations.

The results of the past year's business have shown that our apparatus can be sold for cash to responsible parties, and that the prevailing belief that long credits must be given, or that stocks and bonds must necessarily be taken in order to secure business, is not correct. Your officers and agents have found that low cash prices and good apparatus are sufficient inducements to secure all the trade the company can care for.

Although the profits of the business might have justified the payment of dividends on all of the stock of the company, the directors have thought it wise to pursue a very conservative policy, especially in view of the large expenditures required during the past year for machinery and material, and of similar expenditures which the present prosperous condition of the company's business may make necessary in the near future. Both the results and the prospects are so encouraging that the directors believe the stockholders will uphold them in a course which places the company in a position of undoubted financial strength, and which will assure the permanent continuance of dividends when once begun.

For the Board,
GEORGE WESTINGHOUSE, JR.,
President.

Balance Sheet, March 31, 1893.

ASSETS.

Cash in banks	$212,573.85
Bills receivable	366.228.47
Accounts receivable	2,289,982.70
Material in stock and in process of manufacture (at cost of labor and material)	1,414,662.31
Advances to leased companies	138,573.06
Bonds (par value $369,100)	358,197.15
Stocks (par value $6,469,257)	4,069,439.96
Real estate and buildings	453,037.98
Machinery and tools	710,023.61
Miscellaneous	60,055.54
Charters, franchises, patents, etc	4,378,031.69
Total assets	$14,450,806.32

LIABILITIES.

Accounts payable			$569,660.48
Bills payable, issued for merchandise			376,003.64
Discounted with collateral			931,884.51
CONTRACT AND CONTINGENT LIABILITIES.			
Scrip dividend			194,562.00
Stock subscriptions			13,125.00
U. S. E. Ltg. Co.'s 6 per cent. 15 year bonds, $50.000 payable annually			600,000.00
(Bills receivable under discount, $482,054.49.)			
CAPITAL STOCK.			
Preferred, 73.378 shares		$3,668,940.50	
Assenting. 103,146 shares		5,157,331.00	
Common, 3,633 shares		181,650.00	
			9,007,921.50
(In treasury, 6.621 shares Preferred; 13,220 shares Assenting.)			
SURPLUS.			
Balance, March 31, 1892		$1,880,445.20	
Twelve months net earnings from business	$1,491,817.13		
From other sources	112.766.60	1,604,583.73	
		$3,485,028.93	
Less amount written off in adjustment of matters pending in 1890 and 1891	$321,228.05		
Ditto in current year.	98,869.65	$420,097.70	
		$3,064,931.23	
Interest on bonds	$39,000.00		
Interest on scrip	11.673.72		
Dividends	256.608 32	307,282.04	
			2,757,649.19
			$14,450,806.32

The officers of the company for the year are as follows:

Chairman, Brayton Ives; President, George Westinghouse, Jr.; First Vice-President and General Manager, Lemuel Bannister; Second Vice-President, G. W. Hebard; Assistant General Manager, W. F. Zimmermann; Secretary and Attorney, Charles A. Terry; Treasurer, Ph. Ferd. Kobbe; General Agent and Assistant Treasurer, W. C. Clark; Auditor, F. H. Ketchum; Directors: Charles Francis Adams, Lemuel Bannister, August Belmont, N. W. Bumstead, A. N. Byers, Marcelus Hartley, George W. Hebard, Henry B. Hyde, Brayton Ives, George Westinghouse, Jr.

Legal Notes.

At Norwalk, Ohio, on the 25th ult., Judge Thomas issued an order to J. W. Foster and F. H. Jones, assignees of the Incandescent Light and Power Company of Norwalk, to sell the company's property at public sale for cash. The assignees have not yet determined on a date of sale. The property was appraised a few weeks ago at $35,025.

The street-railway company in Paterson, N. J., erected poles and wires in one of the streets in the city. A property owner in the street cut the wires in front of his dwelling and the railroad company applied for an injunction restraining him from causing further damage. Vice-Chancellor Green in his opinion in the case says that the property owner had no right to cut the wire; that when a public use authorized by law takes no property, but merely affects it by proximity, the necessary interference occasioned by such use furnishes no basis for damages. It must be an interference with the rights to light and air. The Vice-Chancellor decides that the court could not grant an injunction, because the railroad company had not complied with the act of 1892 which requires that authority for stringing wires shall be obtained from the State Subway Commission.

George P. Altenberg and Rudolph Kleybolte, of Cincinnati, whose suit against the Citizens' Electric Light Company of Louisville for an alleged breach of contract, begun at Covington was transferred to the United States Court at Louisville, have received information that the demurrer presented by the Citizens' Company had been overruled by United States Judge Carney, who directed the Citizens' Company to prepare for trial within sixty days. The ground on which Altenberg and Kleybolte brought suit is that they contracted to reorganize and rebuild the Louisville Company and its plant, and were to put in $100,000 additional capital. They allege that the Citizens' Company came to a square "back down" on this contract and signed terms with the Thomson-Houston Company. The plaintiffs then tendered their $100,000, they claim, and it was refused. They sued for $101,500, the $1,500 being expenses, and the Citizens' Company presented a demurrer to the effect that the contract was only an option.

In the case of the Accumulator Company of Philadelphia against the Dubuque Street Railway Company, at Dubuque, Iowa, the jury brought in a verdict in favor of the latter. The suit was brought by the Accumulator Company to recover for the storage-battery equipment in use on the road, amounting with interest to $6,000. The president of the road filed a cross-suit for damages, claiming that the storage-battery system failed to do the work guaranteed. The case was contested by the ablest lawyers in Dubuque.

In the injunction suit brought by the Schuyler Electric Company against the street commissioners of Hagerstown, Md., to prevent them from completing a contract made with a street railway company for lighting the streets as a condition of a road grant, Judge Stake has filed an opinion denying the injunction. The case will probably be carried to the Court of Appeals.

The VanDepoele Patents.

Infringement Suits Brought in Connecticut.

The Thomson-Houston Company has brought suit for infringement against the Winchester Avenue and West Haven Electric road in New Haven, and the Westinghouse Electric Company of Pittsburg is made party defendant in the case.

The complaint alleges infringement of two trolley patents issued to C. J. VanDepoele, April 11, 1893, and assigned to the Thomson-Houston Company, for which the applications were filed in the Patent Office in 1887 and 1888. An injunction is asked for restraining the defendants from using their present trolleys, and the suit is brought as a test case.

It will probably be several months before a preliminary hearing is reached.

An Important Decision.

Judge Coxe, of the United States Circuit Court, has decided adversely to the plaintiff in the matter of Edison Electric Light Company et al. vs. the Equitable Life Assurance Society.

The suit was brought for infringement of various Edison patents on fixtures, sockets, etc.

The Court holds that since the alleged infringement was begun eleven years ago and continued until the present time without any suit having been begun, the plea of laches entered by defendants must be allowed. The plaintiff was not entitled to either a restraining order or a permanent injunction; plaintiff could only have been injured to the extent of his license fee, and the right to recover that has been lost by negligence.

Eugene H. Lewis represented the plaintiff, and L. E. Curtis the defendants.

World's Fair Department of Electricity.

For the second time since the opening of the Exposition all of the electrical apparatus in the Machinery Hall that has been completed was put to a thorough test in illuminating the grounds and buildings last Saturday evening.

The first time it was put into actual operation was on Monday, although not all of the generators were in shape to be used at the initial trial.

The first public exhibition in which the great MacMonnies fountain played the leading part was also on the programme for Saturday evening. Judging by the large crowd of visitors gathered around the fountains on the opening night, they will be one of the most attractive features of the Exposition for those who visit the grounds after sundown.

The beautiful exhibit of the Western Electric Company, which is located in the southwest corner of the Electricity Building, was also given its initial trial last week. A unique part of the exhibit consists of a column of incandescent lights of various colors running from the floor to the ceiling and branching off to the four points of the compass in the shape of zigzag lightning. Each of the series of the imitation lightning flashes terminates in a large ball covered with lamps. The different circuits of lamps are connected to an automatic switch in such a manner that the current will pass through each lamp in succession in the column, beginning at the floor and then through the lamps mounted on the zigzag board. The effect produced is a very good imitation of natural lightning.

The Ansonia Electric Company has put a number of extra men to work on their booth and expect to have it completed within the next ten days. The exhibit will be an extremely novel one, especially to the ladies visiting the building. In the booth of the company, which is located in the north wing of the gallery between the two restaurants, will be placed a number of heating devices for cooking the greater portion of the meals served at the tables.

Most of the exhibitors in Section Y, or Newspaper Row as it is familiarly called, have moved into their quarters and have representatives on hand to entertain guests.

The W. D. Graves Company.

Where the Cash Went.

Expert Accountant F. R. Merchant, who has been at work on the books of the W. D. Graves Company of Cleveland for three months, has completed his labors. He states that the Cleveland Electric Light Company is debtor to the Graves Company $11,541.95 for labor and material and $10,000 of borrowed money. Mr. Frank J. Stafford was the treasurer of the Graves Company and also of the Cleveland Electric Light Company, which latter company is a part of the Cleveland General Electric Company.

Power House Burned at Rochester.

The train house, power house and coal yard of the Grand View Beach Railroad were totally destroyed by fire on the morning of the 10th at an early hour. There were 500 tons of coal stored in the bins for the summer's business. The loss is estimated at $60,000 and is fully covered by insurance.

The equipment burned was fifteen cars, two 125 H. P. generators, three McIntosh & Seymour engines and three 100 H. P. boilers.

Long Distance Transmission.

Power from Niagara Falls to be Carried to Albany.

A syndicate was formed in New York City, May 11, with a capital of four million dollars, for the construction and equipment of a line between Niagara Falls and Albany, for the transmission of electric power generated by the Niagara Falls Power Company.

The plan is the most ambitious one yet proposed in connection with the Niagara Falls scheme, and the syndicate is said to be thoroughly in earnest.

It is as yet too early to say that the plan, carried to completion, would prove a dangerous competitor for the local central stations in the central part of the State, but that, of course, is what the promoters expect it to be.

General Electric.

What is Said of It Nowadays.

General Electric continues to display a weak tone, but the Morgan-Vanderbilt interest is so strong in this company that a powerful protection overcomes the effect of both liquidation and short sales of the stock. Purchases for insiders alone sustain the stock, as the affairs of the company are in much suspicion.—*New York Advertiser.*

More than room trading, rumored suits for conspiracy and sympathy with the other industrials is responsible for the tremendous slump in the price of General Electric stock. Stockholders have just had enough time since the publication of the company's last report to reflect on the conditions of the properties. It is pretty generally believed that under the Villard administration Edison lost money on every contract for plants on the cruisers belonging to the "White Squadron" and on many other of their larger contracts for installations outside of New York City. Only a close investigation of the books and records of the General Electric Company will show what investigators want to know. The annual report contains nothing.—*Wall Street News.*

Marked for Slaughter.

(From the Daily American.)

As for General Electric, there does not seem to be any doubt that it is booked for very much lower figures. The impression seems to be that the company is run on a ridiculously extravagant basis, and a lot of the smaller concerns that were taken in when the company was first organized were taken under an arrangement whereby their claims are satisfied before any of the earnings can be applied on the stock. There are those who profess to believe that a reorganization of the property is one of the possibilities of the near future, and, of course, in that case the price will break to 50 or below. Under present conditions it is a good stock either to leave alone or to sell for future delivery. The brilliant and triumphant bears of the Street have marked it for slaughter, and yesterday's developments show that the friends of the stock are giving it no support.

Mr. Coffin's Admissions.

The General Electric Company Has Failed to Meet Some of Its Obligations Promptly, and is not in Easy Financial Condition.

A director of the General Electric Company recently wrote to President Coffin as follows:

DEAR SIR: The stories about General Electric Company's bad financial condition and poor business still continue. Please answer categorically each of the following questions, which will suggest to you the rumors now current, viz.:

1. Has the company at any time this year been disturbed in any of its loans or been in any instances refused such accommodation as it has desired, or in any instance failed to meet all obligations promptly?

2. Has it sought any unusual accommodation during the past three months?

3. Do the company and the sub-companies owe more money to-day than on Jan. 31st, 1893?

4. Do you contemplate issuing any additional stock or bonds of the General Electric Company, or any of its controlled companies?

5. Is the company in perfectly easy financial condition, and is there likely to be any change in this respect?

6. Do you know of any reason, financial or otherwise, why stock of the General Electric Company cannot be safely and strongly recommended as a perfectly safe and sound 8 per cent. investment, or why its future should not be at least as prosperous as its annual report shows its past to have been?

Please answer by wire "yes" or "no" to each question, by number, and then amplify as much as you choose.

Mr. Coffin replied:

DEAR SIR: Your letter received this morning. I can answer categorically to each one of the questions "no," except the first part of your inquiry, and to that I answer "yes."

There are industrious reports in circulation to the effect that we are selling a large part of our apparatus with a contract to take in payment therefor stocks and bonds.

To meet this we shall publish in the financial papers this morning a statement to the effect that of $3,000,000 of railway orders now on hand—which is largely in excess of a year ago—the entire amount is sold for cash and well secured notes, about 80 per cent. of the former and 20 per cent. of the latter, with no obligations to take stocks or bonds for any part thereof.

The sales of lighting apparatus are also almost exclusively for cash or well secured notes. Very truly yours.

(Signed) C. A. COFFIN.

Attention!

Electrical Ladies and Gentlemen can Start Cheaply.

(From the New York Herald.)

$25 STARTS LADIES OR GENTLEMEN IN BIG paying professional office business; particulars free. Call Monday, W. U. Electric Co., 26 Whitehall st.

Mr. TERRILL.

Frozen Truth.

A Fact Beyond Dispute.

(Mr. C. A. Coffin in Boston Herald.)

"General Electric is worth as much money and is just as solid as it was six months ago."

Electric Stone.

The Galveston *News* prints the following telegraphic dispatch from Uvalde, Texas: "A few days since a Mexican trapper rode up to the jewelry store of J. F. Nance in this city and sold him a small stone for $5. It is pronounced by old miners and other citizens of the place to be crystallized carbon. It is either heavily charged with electricity, or else it acts as a conductor. By placing one's hands upon it distinct and almost severe electric shocks are transmitted through the body. Hundreds have visited the jewelry shop to witness this new wonder, the like of which it is safe to say, there is not another in the world. It is shaped like a disc, is transparent, flat at the bottom, about as thick as a grain of Indian corn, and about one-third of an inch in diameter, thickest in the centre, and gradually tapering to its edges. The Mexican said that it came out of a volcano in Mexico. None of those who have seen it have ever heard of or seen anything like it, but several think that it is pure carbon."

Mathematics In Place and Out of Place.

(*From The Electrician, London, April* 21.)

Mathematicians in search of new pasture, and practical men anxious to see what will happen when the "professor" is eliminated, should peruse a paper on transmission of power, recently read before the National Electric Light Association by Mr. L. B. Stillwell. "We may conveniently construct an algebraic skeleton," says the author, and he forthwith proceeds to do so. Whether this skeleton is to be kept in a cupboard, and only taken out at Institution meetings from which the professors will have already been eliminated, we are not informed. Here is the skeleton, or a small part of it: "Fh—First cost of hydraulic plant, including turbines, dams, flumes, etc. Ph—Percentage covering interest upon and maintenance of hydraulic plant. Oh—Cost of oil and waste per annum for hydraulic plant." And so on, and so on. Then we arrive at the following mathematical equation, which, at first sight, we took to be a chemical equation in which iron and carbon, oxygen and nitrogen, and several unknown elements—which, doubtless, were the undiscovered members of Mendelejeff's celebrated cycles—had got considerably mixed up: "PbFb + Cb + PhFh + Oh + Ch + AN + PeFe + Oe + Ce + PlFl + Cl = annual charges." "And now," continues the author, "what have we accomplished?" What, indeed? As a piece of anatomical mathematics this cannot compare with the efforts of the man who can cover the Institution blackboard with formula three times before members have had time to get their pencils out of their pockets; but as a piece of practical intelligence, it is a mere string of labored nothings, calculated to "amaze the unlearned and make the learned smile." Let *Sh* be the shovel at the station, *Sw* the switchboard, and so on; then the equation to the station is $Sh+Sw+MeN+BeEr+BaC^2y+$ etc., which is a parallel piece of mathematics.

If electrical engineering cannot get along without mathematical treatment, then, *pollice verso*, let the mathematician live, and let us employ him to do the necessary work. But if, forsooth, it can, where is the advantage in this spurious semblance of mathematical form, which is the mania of some un-mathematical men? The pressing of mathematics into places where they are not needed is as foolish as their exclusion from places where they are essential. Undoubtedly, there is an unfortunate tendency nowadays to overburden every branch of electrical work with mathematics, to the detriment of practice. Other subjects, other industries, might equally well be mathematically treated. We have seen a series of elaborate equations, involving trigonometry and the theory of impact and elasticity, explaining a game of cricket; and it would be quite possible to write a book full of triple integrals and slant co-efficients in three dimensions, to explain the operations involved in carving a statue. Mathematical form, unless there be in it the breath of practical life, is, indeed, a skeleton; and it would be labor ill-spent to try and galvanize it into living activity. There is not the least objection to the application of mathematics to cricket; but they remain mathematics, they do not become cricket. Prof. Tait has indeed not only applied mathematics to golf, but has done much better service in applying golf to mathematics, and with most interesting results. But these results were no longer within the province of golf; they formed a valuable contribution to our knowledge of elastic bodies and impact. To deny that mathematics are essential to progress in the higher branches of engineering, is to confess ignorance of those branches; but to burden elementary work with abstruse calculations and with pedantic definitions is likely to bring about contention between the practical man and the theorist. A pedant is all very well in his place, but he should not come into the workshop and snub the man at the vise.

A distinction should be observed between accuracy of elementary knowledge and high theoretical attainments. It is important that every engineer should have exact and clear ideas as to the relations between force, power, work, and energy, and the electrical engineer must be familiar with other electrical relations. These elementary laws have an apparent connection with mathematics, because mathematicians have defined them. But the mathematics of Ohm's law go no farther than the rule of three. If some of the simple facts of engineering and of electrical science could be divested of the mathematical garb in which professors delight to clothe them, the beginner would advance with much less hesitation. He is too often presented with a fact swathed in algebraical attire, bound with many a hard and knotted formula, and decked with streaming expanded terms, tasselled at the end with " +, etc." He ultimately makes acquaintance with the fact itself and this acquaintance continues long after the mathematical millinery has been discarded by the mind.

A sailor has a good deal to learn before he need trouble himself about taking lunar distances; and a soldier must be familiar with squad drill before he makes an acquaintance with brigade drill, and he may do excellent service as a tactician without aspiring to strategical accomplishments. Every French soldier is told that he carries a field-marshal's *baton* in his knapsack, and, with hardly more sense of fitness, young engineers and electricians are encouraged to equip themselves with a mathematical armory such as might enable them, if they had the wit, to take a hand in original research of a high order. That is where the waste and the pedantry come in. Theory, and, if need be, mathematics, in healthy co-operation with practical work, are to-day essential for real progress. The rule-of-thumb man progressed, it is true, but not fast enough for to-day. The ready mathematician, on the other hand, is apt to ignore essential conditions and to rush on wildly with loose assumptions, conjectural data, and vague hypotheses, imagining all the time that he is an engineer.

Legal Notes.

Mrs. Elizabeth Mahoney, of Elizabeth, N. J., has brought a suit for $2,000 against the Suburban Electric Light Company of Elizabeth for injuries she received by the fall of an electric arc lamp on her as she was walking along the street.

The San Francisco *Call* states that by consent of counsel, Judge McKenna, in the United States Circuit Court, has dismissed the suit of the Brush Electric Light Company vs. the Nappa Thomson-Houston Electric Light Company. The suit had been pending since 1891, when the Brush Electric Light Company, an Ohio corporation, was working with the California Electric Light Company of San Francisco. It appears that in a similar suit for infringement of patent, instituted by the California Electric Light Company against the Electric Light Company of San Jose, the evidence showed that the California Electric Light Company had been depending on the co-operation of the Brush Company. But it also appeared that the Thomson-Houston Company had, at this time, an interest in both the Brush and the San Jose Company, and that the case was quashed.

Removal Notice.

Mr. Fremont Wilson has removed his offices to the eleventh floor of the Vanderbilt Building Annex, Nassau and Beekman streets, New York City.

The Muncie Electrical Works.

One of the candidates for popular favor in the electrical line is the Muncie Electrical Works, Muncie, Ind.

The new company began business May 1 with orders on hand sufficient for a paying business for the next six months. Mr. F. C. Field is the electrician, and James Chamberlin is general manager.

Boston Notes.

Mr. Platinum Baker, lately returned from a business trip abroad, was in Boston last week.

Mr. L. J. O'Reilly, representing Alexander, Barney & Chapin, of New York, was a Boston visitor last week.

Mr. C. L. Edgar, superintendent of the Edison Illuminating Company, Boston, is visiting Chicago on business for his company.

A committee appointed by the citizens of Marblehead, Mass., visited Boston a few days ago to inspect plans with a view to their adoption for a local electric lighting plant. A municipal plant is what the town has decided upon, and work on its building is expected to begin at an early date.

The new central station of the Haverhill Electric Company was dedicated last Monday evening in the presence of a large and representative gathering of citizens.

Mr. W. R. Goodman, the live representative of the Independent Electric Company of Chicago spent a few days in Boston this week, and called upon us during his stay at the Hub. He report business in an excellent condition with his company.

The Electrical Juniors of Lynn held their first annual reception at the Scientific Club House in Lynn last Saturday evening. They entertained the Minors' Club of East Saugus and the Electrical Juniors of Boston. Mr. R. E. Willard, of Philadelphia, delivered an interesting address on the Transmission of Power.

After frequent hearings before a legislative committee and several spirited debates in the House, the bill presented by the Cambridge Storage Battery Railway Company was passed for engrossment. It now looks as if, ere long, street cars would be running by electricity but without the aid of the overhead trolley.

Boston appears to be destined to become somewhat of a centre for the electric heating business. Several companies have been organized and are getting well under way. Ere long there will be many novelties placed on the market that are intended to revolutionize the art of heating. The companies we allude to are to make a specialty of domestic heating in its various ramifications.

Mr. I. L. Matson, who recently commenced business as electrical engineer and contractor, has secured the contract for equipping the new dormitory at Harvard University with several hundred lights.

Chicago Notes.

Mr. T. S. Palmer, manager of the Electric Heat Alarm Company of Boston, has returned home after a two weeks' stay in Chicago. A Western branch of the company has been established here, and has been placed in charge of E. N. Nashold.

Mr. Albert Hay, president of the Robison Radial Truck Company, made a number of calls on the railway supply companies of Chicago last week.

Harry Bishop, Western representative of the Massachusetts Chemical Company, received the sad news of his mother's death at Springfield, Mass., on his return from Boston, last week.

The Chicago Incandescent Lamp Company, owing to the growth of its business, has increased its capital stock to $20,000.

City Electrician Barrett in pursuing his former policy of burying or bunching all overhead wires, has compelled the different electric companies using wires in the recently annexed Hyde Park district to string all their circuits on one line of poles, and at points where they cross the trolley lines they are to be run under the streets.

Morgan Brooks, of the Engineering and Supply Company of St. Paul, was in Chicago last week.

Clark & Marshall have received their first shipment of Rowley Storage Batteries, for which they are general agents. The firm have recently moved into larger quarters in the Rookery Building.

General News.

What is Going on in the Electrical World.

Erie, Pa.—The contract for lighting the city has been awarded to the Edison Company.

Baltimore, Md.—The electric railway to Roland Park is completed and cars are running regularly.

Lincoln, Neb.—The Burlington Beach electric railway has been sold to the Lincoln Street Railway Company for $45,000.

Milwaukee, Wis.—The Milwaukee and Wauwatosa Motor Railway Company have decided to equip their line for electricity as soon as it can be done.

Marshfield, Wis.—The city council has closed a contract with the Marshfield Water and Electric Light and Power Company for lighting the city with electricity.

Dunkirk, Ohio.—A charter and right of way have been secured for an electric railway between Red Key and Dunkirk. The company will also furnish electric light for both places.

New Haven, Conn.—A power house for the Morris Cove electric road is to be erected in Fair Haven. The State street road will have an electric equipment by the middle of July.

Salt Lake, Utah.—The city council has ordered the city attorney to draft an ordinance compelling telegraph and telephone companies to pay a rental on every pole erected by them in the city.

Providence, R. I.—The Union Railroad Company will probably abandon the cable on a large portion of its line and substitute electricity, retaining the cable for use on the heavy grade in College street.

Washington, D. C.—The directors of the Washington and Great Falls Electric Railway have decided to begin the construction of the new line at once. It is their intention to push the road to completion at an early day.

St. Louis, Mo.—The stockholders of the East St. Louis Electric Street Railway have authorized an increase of capital stock from $150,000 to $500,000. The avails of the new issue are to be expended for extensions and improvements.

Rochester, N. Y.—The power house of the Grand View Beach electric road was burned to the ground on the 11th inst. Thirteen cars, 500 tons of coal and all the tools and appliances were destroyed. Loss $60,000, covered by insurance.

Mobile, Ala.—The Mobile Street Railway Company are erecting a power house and preparing their road for the change of motive power to electricity. They expect to complete the electric equipment of their lines by the last of July.

Batavia, N. Y.—Mayor Sanford has made temporary arrangement with the Consolidated Gas and Electric Company for lighting the streets. This arrangement will probably last until some definite plan of lighting has been decided upon.

Muncie, Ind.—The Citizens' Electric Street Railway Company was victorious in its suit with the Muncie Street Railway Company in the injunction proceedings. The Electric Company will now proceed with work in laying track, and will be running cars in a few weeks.

Jersey City, N. J.—The new line of the Consolidated Traction Company connecting Newark and Jersey City has been completed. The road enters Jersey City at Westside and Communipaw avenues, where it connects with the electric line that runs to the Cortlandt street ferry.

Savannah, Ga.—The option of the Electric Railway Company to continue its lease of the Savannah and Isle of Hope road expires on the 20th inst., and it is considered probable that the lease will not be renewed. In that case the electric company will extend its line to Thunderbolt and also build to the Isle of Hope.

Knightstown, Ind.—A company has been organized to build an electric railway from New Castle to this city and to the Indiana Soldiers' and Sailors' Orphans' Home, two miles south of here. The line will be constructed to pass by Greensboro or Spiceland, and the work of securing the right of way will be commenced at once.

Fort Worth, Tex.—There is a prospect of the building of a rapid transit line between Fort Worth and Dallas this year. The motive power has not been fully decided upon. Electricity is preferred, but the form of motor will depend largely upon the improvements that may be made during the time the road is under construction.

Warren, Ohio.—An electric railway to connect this city with Sharon, Pa., is proposed. A. B. Minnix and John Cole, of Vienna, have already secured three-fourths of the frontage right of way between the two cities. An application for a a franchise will be presented to the county commissioners at an early day. The route is to be the direct highway, and calls for a 16-mile line.

Hackensack, N. J.—The directors of the Bergen Turnpike Company at a meeting in Hackensack last week elected Andrew C. Zabriskie president, George W. Wheeler vice-president, Charles B. Place secretary, and William A. Paepke treasurer. It has been intimated that the new directors intend to build an electric railway from Hackensack to connect with lines in Jersey City and Hoboken.

Findlay, Ohio.—The county commissioners have granted to George B. Kerper and other Cincinnati capitalists a franchise for that portion of the Put-in-Bay, Southwestern Electric Railway lying between this city and Fostoria. Work is expected to begin on the new road within a short time. The city council of Fremont have also granted a franchise for the railway to run through Fremont.

Topeka, Kan.—The $600,000 mortgage of the old Topeka Rapid Transit Railway Company which was held by the Metropolitan Trust Company of New York has been released, the Topeka Railway Company, which company purchased the line of the Rapid Transit Company and assumed its obligations, having arranged for its payment under a mortgage for $1,100,000 on all its street lines issued to the Manhattan Trust Company of New York.

White Plains, N. Y.—Hon. Samuel Conover has purchased the franchise of the Tarrytown, White Plains and Portchester Electric Railroad, and it has been decided to change the name to the Elensford, White Plains and Mamaroneck Railway Company. The directors just elected are W. P. Hix, New York; S. W. Parker, Mamaroneck; Samuel Conover, White Plains; F. W. Leonard, J. H. Vails, Harvey Dew and Josiah Brown, New York; J. H. Moran, White Plains, and U. A. Krepps, Kensico.

Leavenworth, Kan.—The Leavenworth Railway Company has been reorganized and the following officers elected: Col. H. L. Turner, of Chicago, president; Gen. A. B. Nettleton, secretary, and W. F. Putnam, treasurer. The board of directors consists of Gen. A. B. Nettleton, Col. H. L. Turner and Messrs. W. F. Putnam, Harry L'Earle, Geo. A. Baker, William Dill and W. A. Stacey. The capital stock of the company is $500,000. Work on the electric road will be hastened by the reorganized company.

Cleveland, Ohio.—It is said the new power house of the Cleveland General Electric Company will have a capacity when completed for 2,000 arc lights, 100,000 incandescent lights and 1,000 H. P. for power service. The company will use the Edison three-wire underground system for the heart of the city and an alternating and high tension direct circuit for the suburbs. It is expected not only to furnish motive power and arc and incandescent lighting, but also to supply electricity for heating and cooking purposes when the machinery and inventions for making electricity thoroughly practicable and economical for these purposes are perfected.

Manchester, Conn.—A special to the Hartford *Courant* from Manchester says: "The Waring Electric Lamp Company has been organized with a capital of $50,000 and will manufacture an incandescent electric lamp, to be known as the Waring 'Novak' lamp. The directors in the new company are N. T. Pulsifer, of Manchester; A. D. Coffin, of Boston; J. H. Walker, of Boston; and John Waring and M. S. Chapman, of Manchester. Mr. Chapman is president and Mr. Pulsifer secretary and treasurer. The lamp will be made at the factory formerly occupied by the Perkins Company and business will be begun on a large scale immediately."

Detroit, Mich.—A dispatch from Toledo to the *Free Press* conveys the information that Toledo is soon to be connected with Detroit by an electric railway, the right of way for which has already been secured. This statement seems wholly credible from the fact that an electric railway, which is doubtless designed as part of the system, already extends south of Wyandotte, and a franchise has been granted for its extension to Trenton, about one fourth the distance to Toledo. It has for some time been known that a right of way had been acquired from Wyandotte south, and the fact that no right of way was sought between Detroit and Wyandotte lends probability to this utilization of the Detroit and Wyandotte road.

Willimantic, Conn.—The Women's Club of Willimantic, Conn., held their last regular session for the season on Tuesday evening of last week. In its report of the meeting the *Journal* gives the following particulars: "The regular programme was opened by Miss Maud Remington with two gracefully rendered violin solos. Miss May Davison discussed the Telephone in an interesting manner, illustrating her talk by drawings done by Miss Houghton. The next subject, 'Electric Lighting,' was presented by Mrs. Beede in a brief practical talk. Mrs. Hamlin's paper on 'Electric Railways' was excellent. Mrs. Nellie Crane read an article on 'The Electrical Department at the World's Fair,' written by W. W. Prime, engineer of that department."

Wrought Iron for Field Magnets.

The Commercial Electric Company of Indianapolis have issued a new catalogue describing their lines of dynamos and motors which include some refinements in construction worthy of attention. One of the principal points in these machines is the exclusive use of wrought iron for their fields. The all forged iron construction has heretofore been considerably employed where the sizes of the machines permit the use of drop forgings, but beyond this it has not so far been generally adopted on account of its extra cost, although its superiority for this purpose is well known. Somewhat less than half the necessary section of cast iron is sufficient for wrought iron fields as the same magnetizing force generates more than twice the number of lines of force in the latter as it does in the former at the point of saturation generally chosen. This, of course, means a great reduction in the weight of wrought iron in the fields, and a saving in the copper on the fields due to their smaller section.

In these machines up to the ten horse power sizes, large Gramme ring armatures are used, requiring but one layer of wire for 110 volt and two layers for 500 volt machines. This is of advantage in two ways as it not only reduces the armature resistance but decreases the magnetic resistance by diminishing the length of the air gap. In larger sizes drum armatures are used, in the construction of which the same principles are followed, and the mechanical details throughout have been carefully perfected.

Motors and dynamos of standard voltages and for various kinds of work are described in the company's new catalogue, to which they invite attention.

Enterprise is Appreciated.

The Star Electric Lamp Company is receiving many letters congratulating them on the energy and push which have enabled them to produce a commercial lamp and get it ready for the market so promptly. This company, it will be remembered, was the first one to announce a non-infringing lamp. The lamps that have been delivered are proving highly satisfactory and orders are coming in very rapidly. This must of course be very gratifying to the Star Company, who have been to great expense in pushing their experiments forward, and no doubt pleases them to see that the electrical fraternity appreciate their efforts by the liberal reward in the way of orders.

Large shipments are now being made, and the universal verdict is that the New Sunbeam is superior in every way to the vacuum lamp.

The Cutter Specialties.

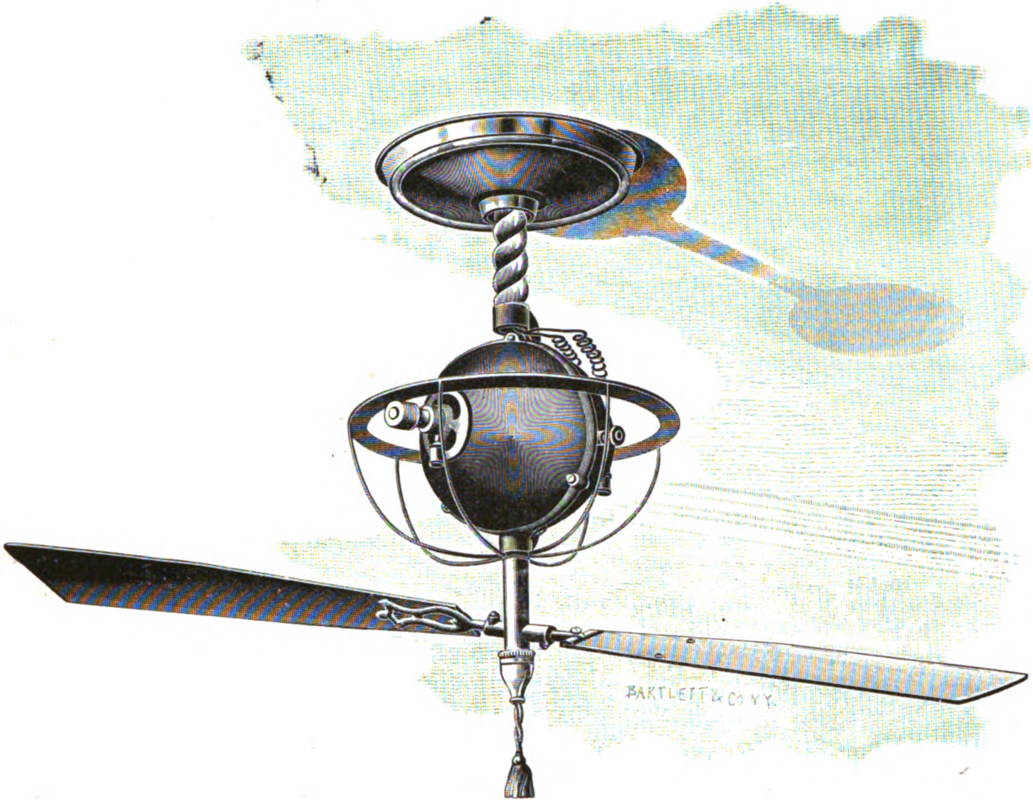
The following notice is issued to the trade by Mr. H B. Cutter:

> This is to advise you that we have opened a New York office at 136 Liberty street, and that Mr. Chas. D. Shain will represent us as selling agent in your vicinity.
>
> Please be kind enough in future to send all orders for our specialties to Mr. Shain, and you may feel satisfied that your wants will be carefully looked after, and the best possible quotations made to you.
>
> Thanking you for past favors, and requesting a continuance of your trade, we are,
>
> Yours very truly,
> THE CUTTER ELECTRICAL AND MFG. COMPANY.

Mr. Shain has also made arrangements with the Eastern Electric Cable Company of Boston and the Lake Girard Mica Mines for exclusive territory in this neighborhood.

The Lundell Ceiling Fan Motor.

We illustrate below an ingenious combination of a big two-blade fan and a small compact motor. The device is so constructed as to depend from any ceiling at the correct distance for the required effect, whether a heavy blast, a gentle breeze, or any gradation between the two extremes is wanted. The blades of the fan are constructed of hard wood and the pitch of them can be changed to suit requirements by loosening the screws which hold them in position and resetting them.


BARTLETT & CO N.Y.

THE LUNDELL CEILING FAN MOTOR.

The method of transforming the motion of the commutator shaft of the motor into a motion at right angles to it, is worked out so cleverly as to obtain an absolutely noiseless result at maximum speed. Upon one end of the motor shaft a small friction wheel is attached. Encircling the motor and resting on this wheel is a thin circular ring plate which receives its motion by friction from the small wheel. This circular ring plate is in turn connected with the fan shaft by four curved metal braces, making a solid and strong construction.

The relation of the speed of the fan to that of the motor thus becomes as one to eight. To operate this outfit only six-tenths of an ampere of current is required, or about the same amount as is required for an ordinary 16 C. P. lamp. The economy in working this outfit, therefore, is readily appreciated. The motor is the invention of Robert Lundell and the outfit is placed on the market by the Interior Conduit and Insulation Company.

H. Ward Leonard & Co.

This company has met with a success in its peculiar line of Bulk Electric Contracting which is most astonishing in view of the general dulness in business during the past year.

The business of the company amounted to $530,000 during its first year, that is '91-'92, and is increasing rapidly both in this city and throughout the country.

Since the first of January the capital of the company has been doubled, the fully paid capital of the company now being $120,000.

As this company has no agencies or affiliations with any manufacturing companies, and uses dynamos, engines and specialties made by all first class makers, it has an exceptional familiarity with all apparatus and methods on the market, and can use them in its work to secure the best possible plant the state of the art will permit of.

Among the important contracts now under construction by this company are the following:

Cayadutta Electric Railway—Bulk contract for complete railway 17⅛ miles long, joining Gloversville, Johnstown and Fonda, New York state.

Broadway Power House—Bulk contract for steam and electric plant for 5,000 lights.

Betz Building, Philadelphia—Bulk contract for steam and electric plant for 4,000 lights.

Broadway Cable Road, 50th Street Power Station—Bulk contract, steam and electric plant for 424 incandescent and 22 arc lights.

Scott & Bowne Building—Bulk electric contract for 1,500 lights.

Cammeyer Building—3,100 lights.

Puck Building—1,000 lights.

New Netherlands Hotel—Ventilating fans, motors, etc.

New York, New Haven and Hartford Railroad Building—1,500 lights.

Hawthorne Apartments—300 lights.

Home Life Insurance Company—1,900 lights, dynamos and engines.

Church Mission House—900 lights.

Johnson Building—Wiring for 70 arc lamps.

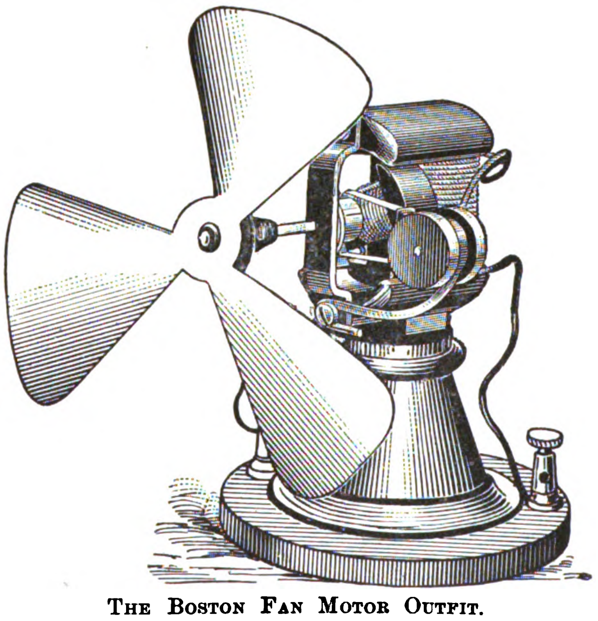
Princeton Inn—Tubing for 232 outlets.

Decker Building—1,200 lights.

The Boston Fan Motor Outfit.

The sudden advent of summer has set everybody perspiring and scurrying round for apparatus that will help in making life bearable during the hot waves which threaten to overtake us. Following the trend of things the makers of electric motors have likewise started up, and are rushing work along to meet the demand that has already set in. One of these firms is the Boston Motor Company, 17 Battery March Street, Boston, whose specialty we herewith illustrate.

We believe we are right in stating that this is the smallest outfit now on the market, and as good as it is small. The makers claim it to be the best and cheapest before the public, and are prepared to guarantee it doing all that is claimed for it. It is scientifically made, of the best material and workmanship. As will be seen, it is mounted on a highly polished pedestal, with nickel plated binding posts, and provided with an adjustable brush regulator. The fan itself is made of polished aluminum, the only one made, and can be operated with any ordinary battery, attaining a high rate of speed with only a single cell. It is just the very thing for a desk, table, office, sick room, or in fact any place where a soft, gentle zephyr-like breeze is required. For these various purposes it has been tried and proved a success, and the demand increases daily. The motor itself is a special favorite with students, amateurs and others for experimental and illustrative purposes, and is now being used in many scholastic institutions throughout the country. It can be run as high as 2,500 revolutions per minute. The very moderate price at which it is sold—fan and motor complete for $1.25—places it within the reach of everybody, and everybody is buying it. The Boston Motor Company will furnish an improved Fuller battery when required that will operate the motor for several days at a trifling cost.



THE BOSTON FAN MOTOR OUTFIT.

This motor gained an award for its many good features at the recent Mechanics' Fair held in Boston.

The Buckeye Lamps.

It affords us no small degree of pleasure to refer to the resumption of lamp manufacturing by the Buckeye Electric Company, and likewise to the fact that the company, according to our best information, are not only regaining old customers but adding new patrons daily to their list. The merits of the Buckeye lamps have been so frequently set forth in our columns that it is needless to say more than that the lamps remain unsurpassed in the qualities that have commended them to the trade and the public. The pure white light that is emitted by the coiled filament is of itself a prepossessing characteristic, and when to this are added the increased light and unimpaired efficiency of the lamp during its life of from 1,000 to 4,000 hours, together with its comparatively low operating cost, it seems to us to fulfil all the requirements demanded by the most exacting user of electric light.

Convention Exhibits Pay.

The small but interesting exhibit of their special line of goods made by the Gould Packing Company of East Cambridge in the ladies' parlor of the Southern Hotel, St. Louis, during the February Convention of the National Electric Light Association has proved to be an unusually profitable exhibit. The various sizes of steam and water packing shown, and the unique substance and finish of the material used, attracted the attention of all the visiting electricians and engineers, with the result that the company is now shipping consignments daily to all parts of the country, from the Atlantic to the Pacific. The fact that the Gould specialty is the original Ring Packing, which was on the market long before any other imitation make, coupled with the continued high quality of stock used, which is the very best, ensures this line of goods greater popularity and a bigger demand among the electrical and engineering fraternities than any other packing now manufactured.

The American Incandescent Lamp.

By a reference to our advertising pages it will be noticed that the "American" incandescent lamps, made by the American Electrical Manufacturing Company of St. Louis, are again on the market. This company, although comparatively new in the field, has established a place for itself, and the "American" lamps are already well known the country over. Business is opening up nicely, and the company looks for a busy summer.

The Logan Storage Battery.

The attention of electricians is being attracted to the Standard Electric Company of Detroit, Mich., which owns the patent rights and is just beginning to turn out Logan Storage Batteries in large quantities.

The claims made by the Standard Company for the Logan battery are most sanguine in view of the many complete failures in the past of storage batteries to perform anticipated work. This company has made a large number of contracts, giving guarantees such as have never before been tendered by storage battery manufacturers.

Mr. J. W. Johnston, the General Manager of the company, has entered into a contract with the Citizens' Street Railway Company of St. Louis for furnishing batteries for three motor street cars. These motor cars are to be placed upon the railway as a test, to demonstrate the utility of storage batteries as a motive power for street railways.

For this reason Mr. Johnston made his proposition on an advertising rather than a commercial basis. The conditions upon which the batteries are placed upon the cars of the Citizens' Railway are that they shall propel the cars sixty or eighty miles per day for one year without cost to the railway company save that of re-charging the battery once in twenty-four hours. At the end of the year if the batteries have demonstrated their utility to the entire satisfaction of Captain McCulloch, superintendent of the company, the Standard Electric Company is to receive $1,000 for each battery. This figure is made very low in order to demonstrate to the world that a successful storage battery has at last been devised.

Mr. Johnston has for his company also contracted with Mr. John Scullin, of St. Louis, to furnish a battery for an owl car for the Union Depot street car line of that city, on equally favorable terms to those given the Citizens' Railway Company. This car is now being constructed in St. Louis, and the battery to propel it is about completed at Detroit.

Contracts have been made by the Standard Electric Company to light the Central Block in Pueblo and the Kaiser Block in St. Louis. The Detroit House of Correction has been lighted, with perfect success, for ten months by this system.

The economy of the battery system is that the steam or other power used to run elevators or other machinery during the day time will also, without extra cost, furnish the power to drive a small dynamo during the day, which will store enough electricity to light the building during the night and drive the machinery also in extraordinary cases.

The Standard Electric Company bases its claims and guarantees upon actual tests made with the Logan Battery at Detroit, Mich., where it has been in constant use in various capacities for twenty-eight months. In that time it has been used for driving small machinery, such as sewing-machines, fans, drills, lathes, riveting machines, for lighting factories and residences, lighting and decorating churches during unusual ceremonies or festivals, operating alarm and fire bells in hotels and factories, connecting the keys with the valves of a large church organ in which the two were separated some two hundred feet, and in propelling a street car.

The features upon which the managers of the Logan Storage Battery place their claims for its superiority over other storage batteries are that the construction of the plates is such that they are practically indestructible; that by no possible usage in charging or discharging, or accident to machinery, or by jarring as on street cars, can the red lead or active material of the plate be shaken from its position, or the plates be short-circuited.

The Standard Company has for twenty-eight months been actively engaged in putting the Logan Storage Battery plates to all manner of possible tests, and after this long time spent in experimenting the company has as yet not had one single plate destroyed or injured.

Their tests have also, they claim, demonstrated the fact that it is possible to take from the battery as high as ninety-seven per cent. of the energy of its charge, and that ninety per cent is a fair average of the power it will discharge.

COMMERCIAL PARAGRAPHS.

As an indication of the phenomenal success achieved by Insullac, the new preparation introduced by the Massachusetts Chemical Company of Boston, it may be stated that after enlarging its factory the entire works are having to run night and day, and even then cannot keep up with the demand. Insullac has made fast friends everywhere, and holds them right along, besides adding new ones daily.

The Boston Braid Company, whose high grade silks for incandescent lamp filaments have proved themselves without a peer and enjoyed almost a monopoly for several years, is now deluged with orders, its manufacturing facilities being taxed to the utmost. Since the lamp business opened up again with so much vim, the Boston Braid Company has been favored with large orders for silks, and the necessity for enlarging its facilities is now under consideration.

That the "Novak" lamp has struck it rich is settled beyond doubt by a record of 20,000 sold in a little more than a week. One salesman is averaging 1,000 lamps sold per diem. In popular phraseology they sell like hot cakes. One plant in Boston is using 800 lamps of this type, and everybody is in love with them.

W. R. Brixey, manufacturer of Day's Kerite Wires and Cables, has contracted to manufacture and lay for the Metropolitan Telephone and Telegraph Company two No. 18 conductor submarine cables, similar to the nine previously furnished, and which are now in service between New York and Jersey City, under the North River. Mr. Brixey has just returned from an extended visit to Chicago, where he has been looking after the preparing of his exhibit which is now completed, being the first wire exhibit in the Electricity Building in readiness.

INCORPORATIONS.

The Waring Electric Company, at Hartford, Conn. Capital stock, $5,000. Incorporators E. D. Robbins, C. T. Robbins and R. H. Robbins, all of Wethersfield. The company is to do all kinds of business connected with the use of electricity, except telegraph, telephone, electric light or power business.

The East End and Sharpsburg Electric Railway Company, at Harrisburg, Pa. Capital stock, $300,000. The officers are: J. R. Davis, New York, president; S. D. Hicks, Edward Fell Lukens, William J. Wagenknight, Charles E. Perkins, Philadelphia.

A charter has been issued at Harrisburg, Pa., to the Philadelphia and Pittsburg Railroad Company. Capital stock, $1,500,000. The road will be forty-five miles long, and run through Clearfield, Cambria, Jefferson, Indiana and Armstrong from Mehaffey, Clearfield County, Pa., to a point near Kittanning, in Armstrong County. The president is William J. Wagenknight, of Philadelphia, and the directors are S. H. Hicks, C. F. Lukens, Theodore P. Farrell, F. S. Purnance and Charles E. Perkins, all of Philadelphia, and Robert C. Belleville, of Trenton, N. J.

A company has been formed at Hoosic Falls, N. Y., to build an electric railway at that place, and to be incorporated under the general railroad law of the State as the Hoosic Railroad Company, with a capital stock of $60,000. C. B. Story, through whose efforts the success of the project is assured, will be one of the company's directors and will also act as superintendent of the road.

The Dubuque Light and Traction Company, successors to the Dubuque Light and Power Company, Dubuque, Iowa. Capital stock, $600,000. The officers of the new company are as follows: President, G. H. Wheeler, Chicago; vice-president, W. J. Ballard, Chicago; secretary and treasurer, E. W. Duncan, Dubuque.

The Post-Glover Electric Company, Cincinnati. Capital stock, $50,000.

The Camden, Gloucester and Woodbury Electric Railroad Company, at Trenton, N. J. Capital stock, $600,000. Incorporators: William J. Thompson, Henry M. Harley and Abraham Townsend, of Gloucester City; Senator George A. Barker, of Woodbury; Ex-Sheriff David Baird, Sheriff Henry J. West, J. Willard Morgan and Thomas P. Curley, of Camden, and Gustavus A. Miller, of Philadelphia. The road is to be in operation by July 1. The electric power is to be supplied from a station at Gloucester.

The Franklinville Electric Light Company, Franklinville, N. Y. Capital stock, $12,000. Incorporators: S. A. Spring, W. H. Ferris, Dr. H. D. Walker, E. E. McNall, A. and G. E. Spring, A.W. Kingsley, J. K. Button, Jr., and J. C. Bowen.

The incorporators of the Buffalo, Tonawanda and Sanborn Electric Railroad, to run from North Tonawanda to Sanborn, are Wilmer Brown, Louis F. W. Arend, Martin F. Meyers, Thomas S. Belden, Lee R. Sanborn, Fred W. Strasburg, William O. Huggins, Harvey Hoag, John T. Witkopp, Edward G. Riesterer, Lewis T. Payne, Herbert P. Bissell, John H. Bissell, John H. Pardee, Christian F. Goerss and Frank T. Brundage.

The Jenney Electric Light and Power Company of Peoria, Ill., has announced an increase of capital stock to $200,000. In addition to this the name of the corporation has been changed to the Peoria General Electric Company.

The Dansville Electric Railway Company, for the construction of an electric road three miles in length in Dansville, Livingston County, N. Y. Capital stock, $50,000. Among the directors are S. N. Blake, of Elmira; D. O. Batterson, Charles H. Rowe, William Kramer and James E. Crisfield, of Dansville.

The Townsend Gas and Electric Company, at Seattle, Wash. Capital stock, $150.000. Incorporators: Frank A. Bartlett, John Lillie, E. B. Downing, N. J. Grambs and S. Z. Mitchell. The company will engage in the business of furnishing public and private light, heat and power.

The Grand Island Rapid Transit, Light and Power Company, Grand Island, Neb. Capital stock. $250,000. Incorporators: A. S. Vest, Chas. G. Ryan, E. G. Stolley, W. H. Thompson, of Grand Island; Moses Stern, Elmer Sommers and G. R. Furr, of Denver, Col. An electric plant will be established by the company and a street railway constructed by it.

The Sheridan Electric Company, Sheridan, Wyo. Capital stock, $30,000. Trustees: G. C. Smith, A. M. Holbert, L. H. Brooks, J. P. Robinson, B. F. Perkins, L. Casper and E. E. Lonabaugh. The company was organized to build a street railway and for manufacturing purposes.

The Livingston, Independence and Cooke City Telephone Company, to build a telephone line from Livingston to Boulder and Cooke City, Mont., and other points. Capital stock, $10,000. Incorporators: W. J. Anderson, George L. Carey, John R. King, F. A. Krieger, A. W. Miles, Herman Orschel and James S. Thompson, all of Livingston, Mont.

The Western Electric Power and Light Company of Topeka and El Reno, Oklahoma. Capital stock, $50,000. Directors: A. F. Chesney, E. E. Chesney, Joseph Reed, O. M. Chesney and Wm. Dignon of Topeka; Charles Stackhouse of Osage City.

The Wilkes-Barre and East Side Railway Company, Wilkes-Barre, Pa. Capital stock, $50,000. Directors: John Graham, G. R. Bedford, W. S. Biddle, W. G. Eno and H. H. Welles, Jr. The company is chartered to build an electric line in Wilkes Barre.

The D'Unger Electrical Telephone Manufacturing Company, Chicago. Capital stock, $100.000. Incorporators: J. F. Greene. W. D. Johnston and H. S. Folger.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED MAY 9, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

496,896. Contact for Underground Electric Railways. William Q. Prewitt, Lexington, Ky. Filed May 19, 1892.

497,024. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company of Connecticut. Original application filed June 21, 1886. Divided and application filed June 20, 1889. Again divided and this application filed May 14, 1890.

497,025. Overhead Electric Railway. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company of Connecticut. Original application filed Sept. 23, 1886. Divided and application filed June 1, 1887. Again divided and this application filed Sept. 18, 1890.

497,061. Electric-Railway Switch. Edward F. Stone, Hyde Park, Mass. Filed Feb. 1, 1890.

497,293. Trolley-Wire Support. Henry A. Hamlin, Minneapolis, Minn. Filed June 18, 1892.

ELECTRIC LIGHTS AND APPLIANCES.

496,882. Electric-Arc Lamp. Martin Kruegar, Chicago, Ill. Filed Oct. 5, 1891.

497,038. Electric Lamp. John Waring, Manchester, assignor to the Waring Electric Company, Hartford, Conn. Filed Jan. 4, 1893.

497,104. Automatic Switch for Mast-Arms. William A. Turbayne, Detroit, Mich. Filed Nov. 5, 1892.

497,200. Electric-Lamp Support. James Nortney and Frank Schefold, New Albany, Ind. Filed Dec. 23, 1892.

497,251. Coupling for Electric-Light and Gas Fixtures. George Peeples, Philadelphia, Pa., assignor to the Thackara Manufacturing Company of Pennsylvania. Filed Nov. 19, 1892.

DYNAMOS AND MOTORS.

497,110. Multiphase-Electric Motor. Paul A. N. Winand and Carl O. C. Billberg, Philadelphia, Pa. Filed March 22, 1892.

497,113. Transformer-Motor. Otto T. Blathy, Buda-Pesth, Austria-Hungary. Filed March 24, 1891.

497,123. Commutator for Electric Generators or Motors. Midbury W. Hassan, Rochester, N. Y. Filed March 16, 1892.

497,144. Pedal-Switch for Electric Motors. Levi Teal, Philadelphia, Pa., assignor to the S. S. White Dental Manufacturing Company, same place. Filed Jan. 16, 1893.

BATTERIES.

496,878. Galvanic Battery. Charles W. Holtzer, Brookline, Mass. Filed Nov. 14, 1891.

TELEPHONE AND TELEGRAPH APPARATUS.

496,859. Transfer System for Telephone-Switchboards, Emery A. Clark, Sioux City, Iowa. Filed June 24, 1892.

MEASURING INSTRUMENTS.

496,871. Electric Meter. Oscar Ericsson, Sioux Falls, S. D. Filed May 6, 1892.

496,962. Dynamometer. Joseph A. Wade and John Cherry, Hornsea, England. Filed Nov. 9. 1891.

496,963. Dynamometer. Joseph A. Wade and John Cherry, Hornsea, England. Filed Aug. 1, 1892.

SWITCHBOARDS, ETC.

496,901. Switchboard for Electric Circuits. Albert L. Rohrer, Lynn, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed June 20, 1892.

496,904. Multiple-Switchboard Apparatus. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Feb. 7, 1890.

496,905. Multiple-Switchboard System. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed March 1, 1890.

496,906. Multiple-Switchboard Testing Apparatus. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed March 1, 1890.

496,907. Testing Apparatus for Multiple-Switchboard Systems. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed March 24, 1890.

MISCELLANEOUS.

496,863. Apparatus for Electrolysis of Salt. Thomas Craney, Bay City, Mich. Filed Jan. 4, 1892.

496,864. Electrolytic Apparatus Thomas Craney, Bay City, Mich. Filed April 7, 1892.

496,865. Electrolytic Apparatus. Thomas Craney, Bay City, Mich. Filed Aug. 18, 1892.

496,918. Safety Connection for Induction-Coil Systems. Elihu Thomson, Lynn, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Oct. 8, 1888.

496,945. Electric Traveling Crane. William H. Morgan, Alliance, Ohio. Filed June 13, 1892.

497,004. Animal Trap. John W. Glover and Edmond C. Glover, Randall, Ark. Filed Nov. 30, 1892.

497,117. Magnetic-Ore Separator. Charles G. Buchanan, New York, N. Y. Filed May 17, 1892.

497,120. Electrical Circuit. Charles E. Chinnock, Brooklyn, N. Y. Filed Dec. 17, 1891.

497,129. Electroplating Apparatus. Albert R. Reams, Elmira, Cal. Filed Oct. 15, 1892.

497,197. Portable Electric Abrading Device. Aaron J. Nellis, Pittsburg, Pa. Filed Dec. 12, 1892.

497,203. Electric Time Stock-Feeder. Herbert S. Page, Medford, and Livy Spear, Boston, assignors to Edmund D. Spear, Boston, Mass. Filed Oct. 12, 1892.

497,263. Electric Cigar-Lighter. William P. Carstarphen, Jr., Denver, Col., assignor of two-thirds to James E. Gregg, same place, and Richard W. Webb, Santa Fe, New Mexico. Filed Nov. 7, 1892.

497,281. Signal-Transmitting Apparatus. Morris Martin, Malden, Mass., assignor to the United States Electric Fire Signal Company, Portland, Me. Filed Aug. 20, 1892.

ELECTRICITY.

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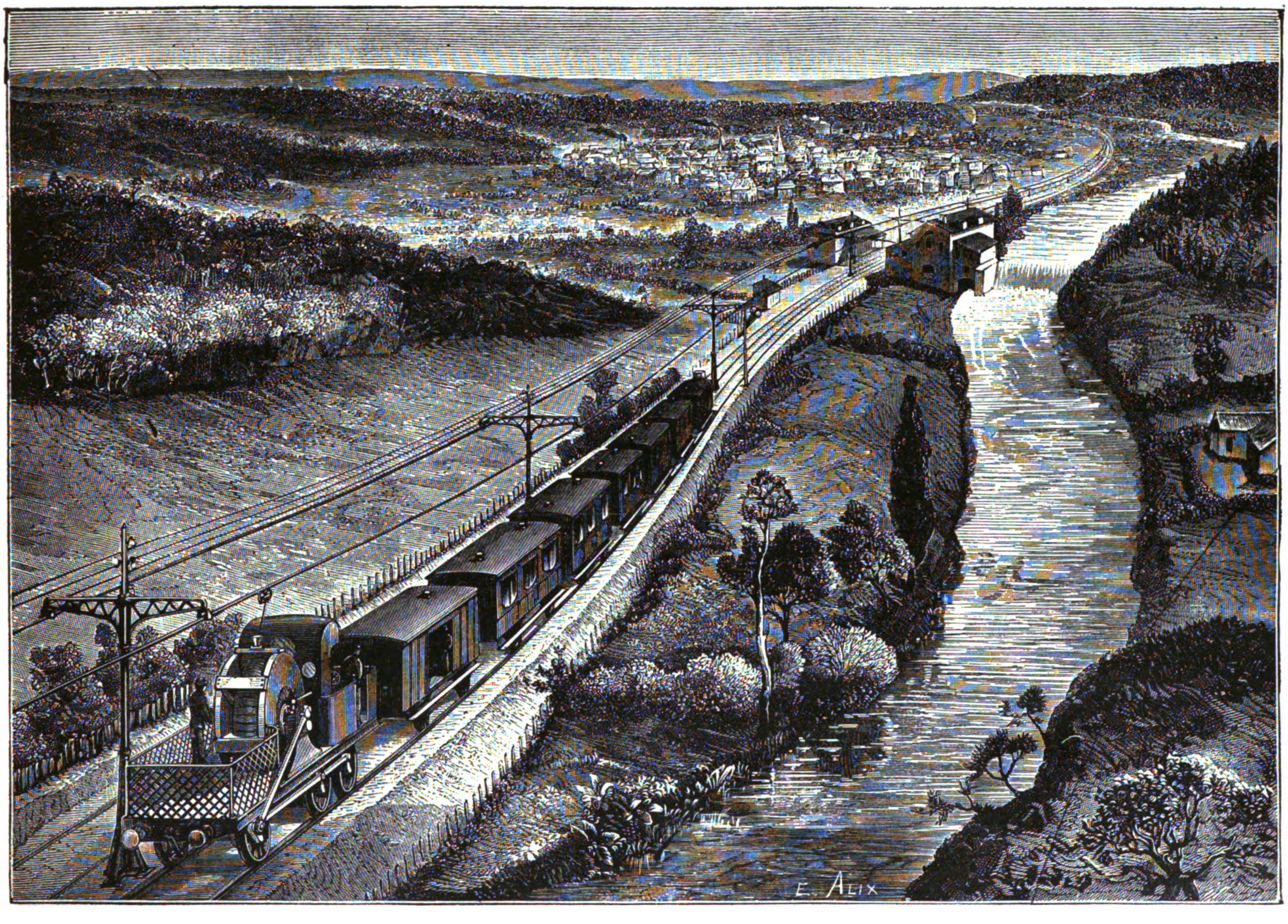


AN UNDERRUNNING TROLLEY OF 1884. (SEE PAGE 255.)

Atomic and Molecular Motions.

III.

BY A. E. DOLBEAR.

If the movements that cause such waves were of an oscillatory, or free path, or translatorial motions of the atoms and molecules, there could be no such thing as definite and continuous wave lengths such as we find, for an atom moving thus would be going now in this direction, now in that, with varying velocities and distances, and if waves were formed at all they would be of all imaginable lengths, and what we call spectrum analysis would be impossible. But the vibrations that set up such waves as we see and measure, we call heat. If the number of vibrations does not equal four hundred million of millions per second we cannot see them because the eye is not adapted to perceive longer waves, but with other devices longer waves can be found. Photography has shown us the existence of waves very much longer, and Prof. Langley has measured their wave length with his bolometer, so we are certain of their existence. Not very long ago it was thought that there were three different kinds of waves—a hot body gave out heat waves, light waves, and atomic or chemical waves, but it has been found for certain that there are no such distinctions. Every wave, long or short, will heat matter, and every kind of a wave can do chemical work; it simply depends upon what kind of a substance it falls on. So these terms have dropped out of use. Indeed it has been found that the same ray that can heat matter or do photographic work may excite vision if it falls upon the eye, so that the term *light* is slowly dropping out of use as belonging anywhere except in the physiology of vision, and ether waves of all wave lengths are called simply *ether waves*.

It has been discovered that such waves as an atom can produce when it vibrates can make the atom vibrate when it falls upon it, just as a sounding tuning fork can make another fork sound if the time of vibration of the latter is the same as that of the former. This is called sympathetic vibration, a property that belongs to atoms as well as to bigger bodies. Every atom, then, that has any temperature is setting up waves in the ether, and when these waves fall upon other matter having similar rate of vibration, the latter are thrown into vibration—that is to say, they are heated, for heating consists in giving vibratory motion to the atoms of a body. Such exchange of motion is going on all the time between masses of matter of all degrees of temperature, and in physics is called Provost's Law of Exchanges. If the body receives a wave having greater energy than the wave itself sets up, then it becomes hotter, and vice versa. This is the reason the sun heats the earth. The latter is a cooler body, but it sends back waves to the sun, though such waves are not so energetic as those it receives. Heat, then, is the true vibratory motion of atoms and molecules by which they are able to set up waves in the ether, as translatory motion cannot do, and light or ether waves result from such vibratory motions; there has been a transformation of one kind of motion in one substance, matter, into another kind of motion in another kind of substance, the ether. As such kind of motion in matter involves a kind of energy called heat energy, by which it is able to do work in the sense in which that term is used in the arts, so when the motion is transformed into a warm motion in the ether it still possesses the same energy it had, and it is now called *radiant energy*. As the amount of energy or the ability to do work is not altered by the transformation, whatever it may be, we have a general statement or doctrine, now well established in science, called the conservation of energy, which means that the amount of energy in the universe is constant, and does not suffer change in any degree in the endless series of phenomena which the energy produces.

The common properties of a magnet by which it attracts iron, sets itself in a north and south position when free to do so, has a mechanical choice of position with reference to other magnets, and induces currents of electricity in conductors which are moved in its neighborhood These are well known, and these properties are of such a high degree of importance to our civilization that one may reflect upon how much of civilization of to-day is dependent upon the property of that element iron. There would be no mariner's compass, no telegraph, telephones, or electric lights. When men began to try to explain this action of a magnet, they imagined fluids for the sake of a hypothesis. But a fluid that should act as magnetism acts would be as wonderful as the magnet; and at any rate would be entirely unlike any fluids we have any knowledge of. Seeing that the action of a magnet takes place freely in the most perfect vacuum we can make, it is plain that ordinary matter is not essential to it. The space about a magnet, within which such magnetic phenomena take place, is called its magnetic field. It extends indefinitely from it, and may be said to be as extensive as is the universe, for its strength when measured is found to vary inversely as the square of the distance.

Suppose this object to be a straight bar magnet with its poles and field: if there were a number of delicately-poised magnetic needles in this room, every one would be disturbed from its position each time I changed the position of this, only the nearer ones would suffer more disturbance than those more remote. That would signify that the magnetic field of the magnet extended through this room, and if means were properly arranged it would be possible to learn from the movements of magnets hundreds of feet from here changes in the position of a magnet in this room. If one can think of a magnet as affecting the ether of space in such a way as to produce it in a condition of stress, it may be easier to understand how it is possible for it to affect another body at a distance, for if the ether that surrounds a body is thrown into a stress in any way, one would expect some sort of an effect to be produced upon other bodies by it. Especially sensitive would be another body which had its own magnetic field, which is the case under consideration. When the field is disturbed, the body must change its position. Imagine, then, this magnet with its north pole here and its field stretching out indefinitely in each direction. It is to be supposed it extends to the moon—indeed to the stars and beyond, if there be a beyond. Now let us reverse the position of the ends of the magnet, and consider what has taken place. The magnetic field about it will have been quite reversed in direction, and all needles in its neighborhood would have indicated the change. The field then as a whole would be changed, but the whole means the whole of space. But the change in the field brought about by reversing the position of the poles will not instantly be felt throughout space. It takes time for a magnetic field to travel in the ether. It has indeed been found experimentally that a change in a magnetic field travels with the same velocity as the common waves in the ether which we call light; namely, 186,000 miles a second; so if I should reverse the ends of the magnet at the rate of once per second, I should set up an ether wave that would be 186,000 miles long. If twice a second, it would be half as long, and if I could change it 186.000 times a second it would be only one mile long. Every change in the form of a magnet causes a corresponding change in its whole field. Wind a few turns of insulated wire about the bend of a U magnet, and connect it in circuit with a distant telephone. These strike the magnet so it will ring, giving out a sound with a definite pitch. The sound will be heard with great distinctness in the telephone. If another similar magnet be held near to the first magnet, and struck so as to sound, the pitch of the second magnet will be heard in the circuit of the first magnet, which shows that magnetic waves were formed in the ether whose length must be equal to 186,000 divided by the number of vibrations of the magnet per second. The experiment is interesting as it helps to make clearer the underlying factors which probably set up waves we call light waves.

When an ordinary magnet is broken into two parts, each part possesses the same polar qualities, and this division and sub division can be carried on indefinitely until one comes down to molecular magnitudes. This has led physicists to the conclusion that the atoms of iron and certain others of the elements are magnetic, with the fair probability that such is the case with the atoms of all the elements. But to suppose that an atom of any sort is a magnet is to consider it as having poles and an individual magnetic field as extensive as any magnetic field. When such atoms are so arranged in a solid that all their similar poles face one way, we have what constitutes a magnet; indeed, such an one would be the strongest possible magnet, for it is now generally conceded that what we call magnetism, or rather a magnetic field, is due solely to the arrangement of the atoms of the magnet. If these atoms are not similarly arranged, but are in magnetic disorder, they naturally destroy each other's fields, so one would not discover the presence of magnetism in such a body.

Suppose, therefore, we have to do with a single atom of iron—that it is a magnet by virtue of its inherent quality. It has its poles and its magnetic field, as extensive as any field, that is, it extends throughout space. If such a magnet should be made to vibrate, by impact or in any other way, its magnetic field would be made to change in a corresponding way and waves would be propagated with the speed of light in every direction about it. How many times per second can such a body vibrate per second? The number of vibrations a body will make depend upon its size, its elasticity and its density.

The smaller it is the more rapid these are. If the size be in the neighborhood of the one-fifty millionth of an inch, and its elasticity such as is possessed by the ether, it will vibrate hundreds of millions of millions of times. Its field will be varied as often, and the length of such magnetic waves produced will be such a small fraction of an inch as are those which we call light; and there is every reason to believe if one could make a magnet of any size to vibrate so many times per second it would become luminous, we should say it gave out light, though its temperature were that of a freezing body.

I have already mentioned the number of vibrations a heated body must make in order to be luminous, and also the mechanical conditions of impact which are antecedent to such heat phenomena. If you will add to those conditions the conception of atoms as individual magnets, each with its own magnetic field, you will be able to understand the expression, now beginning to be frequently heard, "Light is an electro-magnetic phenomenon."

Lastly, a current of electricity, however produced, is capable of bringing about the same kind of magnetic phenomena as are produced by what we call a permanent magnet. A conductor with a current of electricity in it possesses a magnetic field about it and concentric with it. It extends indefinitely distant from it, following the same law.

Any change in the strength of this current brings about a corresponding change in the field of the current and is propagated outwards with the velocity of light. When such a conductor is coiled into a ring, the ring possesses all the qualities of a magnet. If free to move it will set itself so as to face north and south. It will react upon a magnet in precisely the same manner as if it were a magnet, and all this without there being any iron or steel in the neighborhood. As the poles of the ring depend upon which way the current is going in it, it follows that if one could conceive of atoms as being conducing rings with permanent currents of electricity in them, he would have a conception that would explain the phenomena of heat, of light and of magnetism. Such a conception of the cause of magnetism was proposed by Ampere about seventy years ago, and it has been growing in probability, especially since renewed attention has been given to electrical and magnetic phenomena.

The vortex ring theory of matter lends itself easily to this idea, for it assumes that atoms are revolving rings of ether in the ether—that is, they are made of ether and exist in it as smoke rings exist in the air. If it shall at last be proved, as it may be, that a whirl of a certain kind in the ether constitutes what we call a current of electricity, and is embodied in what we call matter, we shall then have reduced to various forms of motion all the various phenomena which are traceable to matter, including all its properties, for it has already been shown that what we call electricity may be explained as the results of certain kinds of motion, and as the various kinds of motion in matter are transformable, directly or indirectly, into kinds of motion in the ether, it leaves us with the conclusion that, after all, the factors in all phenomena are the ether and motion, and that what we call matter is at last only a particular kind of motion in the same illimitable and mysterious substance, the ether.

The Official Badge

Adopted by the American Institute of Electrical Engineers.

The official badge herewith illustrated embodies the following characteristics:

Franklin's kite, which demonstrated the identity between lightning and electricity, and represents static electricity. It is a recognition of America's first electrician and philosopher, Benjamin Franklin.

A diagrammatic representation of Wheatstone's bridge, one of the most important pieces of electrical testing apparatus.

The galvanometer, another equally important piece of testing apparatus and which represents Magnetism and Induction.

The amber of which the galvanometer is made represents the first conception of electricity, dating back to 600 years B. C., when Thales, the Greek philosopher, recorded the fact that amber when rubbed attracted light particles to it; and the Greeks worshipped it, believing the gods had endowed it with life and that it possessed a soul.

In 1600 A. D., Dr. Gilbert, court physician to Queen Elizabeth, coined the work electricity from the word elektron, the Greek name for amber.

A. I. E. E. represent the initials of the American Institute of Electrical Engineers.

$C = \frac{E}{R}$ represents Ohm's law—a fundamental law in electrical work.

The pin is made of white enamel with the lettering and front portions in 18 karat gold and the back in 14 karat gold. Apply to the secretary, Ralph W. Pope, 12 W. 31st street, New York.

SOCIETY NEWS.

American Institute of Electrical Engineers.

Annual Meeting and Election.

The general meeting of the Institute for the reception of reports and election of officers was held on Tuesday afternoon. After hearing the reports the meeting adjourned pro tem. While the ballots, which were cast under the new system by mail, were being counted, the large number of candidates which this system allows made the vote somewhat difficult to count, but after over two hours' work the tellers announced the following ticket elected: Edwin J. Houston, President; H. Ward Leonard, P. B. Delaney and William Wallace, Vice-Presidents; Ralph W. Pope, Secretary; Geo. M. Phelps, Treasurer. The new members on the Board of Managers are Charles Hewitt, W. J. Hammer, Horace J. Ryan and J. J. Carty.

After short addresses by President Houston and Ex-President Sprague the members assembled at THE ARENA, where the evening was pleasantly spent in appeasing the inner man and listening to the flow of wit and eloquence responsive to the numerous toasts.

On Wednesday the reading of papers and discussions took place as announced except the paper on "Electrical Resonance" by Dr. Pupin, which was postponed until 4 o'clock in order to permit an adjournment to Columbia College, where apparatus was available to illustrate the experiments which the paper described.

In the evening a number of the members assembled again at Columbia College at the invitation of the New York Electrical Society to listen to a lecture by Dr. William J. Morton on "A Brief Glance at Electricity in Medicine," an abstract of which will be found elsewhere.

On Thursday afternoon a visit was paid to the new works of the Crocker-Wheeler Company at Ampere, N. J., to inspect its plant, which is a departure from the usual practice of running shafting. The company provided special cars for this trip, and those members who were able to accept this invitation enjoyed an extremely pleasant and instructive tour of inspection.

The officers of the company placed themselves and the factory at the disposal of the visitors and every department was thoroughly investigated by them. The chief feature of the plant is the almost entire absence of shafting and belting, and the substitution of copper conductors in their place. The machines are nearly all of special design in which the motive power is supplied by electric motors which are built in the machines and connected directly to the moving parts without the use of belts wherever possible.

The usual noise of a machine shop is almost entirely lacking in this case, and the saving in power over what would be necessary to constantly run lines of shafting must amount to an important item, which was generally remarked among the visitors.

New York Electrical Society.

The last meeting of the Society for the season was held on Wednesday last, at which Dr. William J. Morton delivered a lecture on "A Brief Glance at Electricity in Medicine." At the close of the lecture one hundred tickets to the illustrated lecture "Urania" were kindly placed at the disposal of the Society in addition to an invitation to look into the details of apparatus by means of which the wonderful scenic effects are produced.

At the close of the lecture on Friday evening the stage of the Music Hall was overrun by the members of the Society, and the ingenious mechanism used in this production was examined and explained.

National Electric Light Association.

The lecture delivered by Mr. Tesla before the St. Louis Convention of the N. E. L. A. is shortly to be printed in book form in the Transactions of the Association, and is considered the most valuable work ever published by it. The lecture was an experimental one on the subject of high frequency and high potential alternate currents, and the manuscript is illustrated by forty-six illustrations of the experiments performed.

The Under-running Trolley.

Regarding the date of the appearance of the under-running trolley, which we have had occasion to refer to before, we reproduce this week in our Frontispiece an illustration of such a device, taken from *La Lumière Électrique* of March 14, 1885. The cut is included in a series of articles by MM. Deprez and Leblanc, reviewing the status of electric railway work up to the close of the year 1884. The present illustration is but one of a number which clearly show the under-running trolley with spring adjustment. The latest installation of this character is described in these articles as having been made in the early part of 1884 by the house of Siemens, between Frankfort and Offenbach, and a number of other roads in operation previous to this date had made use of the same device.

In view of these public uses of the kind of trolley described, it appears difficult to understand how this same apparatus can be considered an American invention in 1887 and 1888, as claimed by the Thomson-Houston Company in their impending patent infringement suit.

Electrical Experiments on the Erie Canal.

The Superintendent of the State Department of Public Works has issued an order providing that all persons desirous of experimenting with electricity or other power for propelling boats on the canal must have their applications for such privilege on file in his department by June 5. This order was issued in pursuance of a law passed by the last Legislature authorizing the Superintendent to designate certain sections of the Erie Canal on which experiments may be made for testing the efficiency of such devices as may be offered for improving by electrical or other means the present system of canal towage, such experiments to be conducted at the expense of the parties making them.

Proposals Wanted.

Sealed proposals will be received for an electric light plant for the Masonic Temple, Philadelphia, until 3 P. M. June 10, 1893. Specifications and drawings will be delivered to bidders between the hours of 9 A. M. and 3 P. M. May 29, 1893. Security will be required before specifications and drawings are delivered. For particulars address Dr. W. A. Drysdale, Consulting Engineer, 20 Hale Building, Philadelphia.

Personal.

Mr. W. S. Barstow, General Superintendent of the Brooklyn Edison Company, delivered an interesting address before the Brooklyn Institute of Arts and Sciences on Friday evening last, presenting briefly his conclusions in regard to European lighting practice as compared with our own.

The Green Trolley Patents.

Suit Begun in Ohio.

A suit has been begun in the United States Circuit Court at Cincinnati, in the name of Oliver S. Kelly and the General Electric Company against the Springfield (O.) Railway Company and its officers, for infringement of the Green trolley patents, purchased a few months ago by the General Electric Company.

A Historic Group.

The Men Who Established the Claims of Henry Goebel

And Put an End to the Monopoly of the Electric Trust.

WILLIAM C. WITTER.

William Clitus Witter is a descendant of the Witter, Bingham, Bass and Waldo families, who were among the earliest settlers in New England. He was born November 13, 1842, in Willimantic, Conn. His academic studies were pursued at Woodstock, at Bacon Academy, Colchester, Conn., and at the Marion Collegiate Institute, at Marion, New York. He entered Brown University in the fall of 1861.

In 1862 he served for three months with a majority of his classmates as a Union soldier in Company K of the Tenth Rhode Island Regiment, returning in time to proceed with the studies of the sophomore year. In the summer of 1863 he again enlisted, and served six weeks in the Union army as non-commissioned officer. Subsequently entering Yale College as Junior, he was graduated in 1865, and shortly after entered the Columbia College Law School. Two years later he presented himself, prior to graduation, for examination before the Supreme Court, and was successful. Mr. Evarts offered him a place in the office of Evarts, Southmayd & Choate, where he remained for two years. For ten years thereafter he was associated with George Gifford, Esq., in a large and varied practice in the United States Courts in causes dealing with patents, copyrights and trademarks. While with Mr. Gifford he was appointed by the Court a United States Examiner in Equity. In 1879 a partnership was formed with Mr. Causten Browne, under the name of Browne & Witter, afterwards Browne, Witter & Kenyon, and now Witter & Kenyon.

WILLIAM H. KENYON.

Wm. Houston Kenyon is of Scotch parentage, and was born in Hartford, Conn., January 5, 1856. He went to the Old South School in Hartford, and from there to the Hancock Grammar School in Philadelphia, and later to the Central High School of that city. He finally entered the College of the City of New York, and was graduated in 1876, receiving the degrees of B. A. and M. A. in course. On graduating, he held the Third Honorary Oration, and was appointed tutor in Latin at the college, and continued there for four years. Meanwhile he attended the Columbia Law School, and was graduated in 1879.

Selecting patent law as a specialty Mr. Kenyon became associated with Causten Browne, of Boston, and Wm. C. Witter, of New York, in 1880; five years later the firm became Browne, Witter & Kenyon, and in 1887 Witter & Kenyon. The firm now consists of Wm. C. Witter, Wm. H. Kenyon, Alan D. Kenyon and Robert N. Kenyon. It has been engaged in many of the important patent cases of the last decade—with the telephone cases in the early days, with the Brush Arc Lamp and Dynamo Cases, the Brush Storage Battery and the Edison Incandescent Lamp Patents. Through this firm a new law as to design patents was drafted, argued, briefed through Congress, and finally approved on the 5th of February, 1887.

LOUIS D. BRANDEIS.

Mr. Louis D. Brandeis, the Boston counsel of the Beacon Company, was born in Kentucky thirty-six years ago. He was educated at Harvard, and was graduated from the Law School in 1877. After residing in St. Louis for one year, he returned to Boston and began the practice of law in 1879. He built up a lucrative business, and is a leading member of the Massachusetts bar. He is Eastern counsel for the Wisconsin Central Railroad, and has appeared frequently of late in the interests of stockholders against the directors of the New York and New England Railroad. He has been retained as counsel for the Westinghouse Electric Company in the case of conspiracy against the General Electric Company, and is likewise counsel for the Milford and Hopedale Railroad in its suit with the Brush Electric Company on the storage battery question. He enjoys a most enviable position among his legal brethren and in Boston society.

A. S. FOWLER.

Mr. A. S. Fowler was born in Washington, D. C., in April, 1857. He grew up in Washington, and studied civil and mechanical engineering at the Rensselaer Polytechnic Institute, Troy, N. Y., and was graduated in the class of 1878. He practised for a season, and for a year or so was engaged in mining in Colorado. Then he returned to Washington and passed a competitive examination for examiner in the Patent Office, and for nearly four years was in the Electrical division. In 1885 he resigned, and took up the practice of patent law in New York City. Early in 1888 he removed to St. Louis, where he has since made a specialty of patent law cases.

Mr. Fowler is at present interested as counsel for plaintiff in the suit of the Electric Railway Company vs. Lindell Railway Company. As a patent lawyer, and especially on subjects connected with electricity, Mr. Fowler is regarded as the peer of any man in the West.

ELMER B. ADAMS.

Judge Elmer B. Adams was born in Vermont fifty years ago. He was educated at Harvard University, and completed his course at the college Law School, being graduated in 1865. He at once settled in St. Louis, where he has resided continuously ever since. From 1879 to 1885 he was a Judge of the St. Louis Circuit Court. Upon retiring from the bench he resumed the practice of law. He is regarded as one of the ripest lawyers at the St. Louis bar, and his firm (Boyle & Adams) has doubtless the largest practice and the management of more large cases than any other firm in that city. Judge Adams's contribution to the overthrow of monopoly in the case against the Columbia Incandescent Lamp Company was powerful and effective.

HENRY S. KALISKE.

To Mr. Henry S. Kaliske is due, perhaps, more than to any other individual member of this group, the development of the Goebel defense into a winning case. Mr. Kaliske's quick perception of the strong points in the case, his readiness to spend a large sum of money to back his judgment, will not be forgotten.

He was born in New York City in 1862, was educated in the public schools, and when yet considerably under twenty began his commercial career in the leather business. He was one of the original incorporators of the Beacon Vacuum Pump and Electrical Company, and has been from the beginning the manager and a member of the Board of Directors. Though a young man, Mr. Kaliske has already achieved success. He still retains an interest in a very profitable leather business. His push and energy have brought him to the front, and he is recognized as a man of sound business judgment.

JACOB HEILBORN.

Mr. Jacob Heilborn, President of the Beacon Company, is a Boston boy, born in that city thirty-seven years ago. He received his education at the Brimmer School, and afterwards went into the shoe business, with which he is still identified, being Boston representative of Henry Stern & Company, New Orleans, one of the leading firms of the South. Mr. Heilborn is noted for his many fine social qualities, being deservedly popular with a wide circle of acquaintance. At his office or at his home he always makes his visitors welcome, and strangers having business with Mr. Heilborn are sure to be favorably impressed with his pleasant manner.

J. H. RHOTEHAMEL.

Mr. J. H. Rhotehamel, President of the Columbia Incandescant Lamp Company, was born in 1857, in Miami County, Ohio. He was educated in the public schools, and afterwards took a partial course at Antioch College, Yellow Springs, Ohio. Subsequently he taught school for a few terms, and speculated some in real estate.

He went to St. Louis in 1889 and organized the Columbia Company. That Mr. Rhotehamel is a successful business man and has built up a splendid trade for his company is well known.

When the Beacon case was finally decided adversely, all the other lamp manufacturers save Mr. Rhotehamel considered any further legal action to be hopeless. The general sentiment in the trade was that, whatever the merits of Goebel's claims, it would never be possible to win on them. Mr. Rhotehamel thought differently. He was a close listener at the proceedings in Boston, knew the weak points in the evidence and what was needed to make a complete and unanswerable argument in favor of Goebel's claim to precedence.

He wisely engaged the same counsel who had made the splendid fight for the Beacon Company, and then, against the judgment of nearly every one in the business, set to work to gather further evidence. His faith never weakened, and by his persistence and courage he has performed a real service to the entire fraternity.

The names of President Rhotehamel and the Columbia Company must be inseparably connected with the overthrow of the unjust and arrogant monopoly of the General Electric Company.

EDWARD E. CARY.

Mr. Edward E. Cary has been for some time the Superintendent of the Lamp Department of the Beacon Company. He is the youngest man in the group, being twenty-eight years of age. He was graduated from the Brooklyn Collegiate and Polytechnic Institute, after which he had a valuable experience as assistant in the laboratory of Mr. Edward Weston, and subsequently was with the Sawyer-Man Company. Mr. Cary's testimony in the Beacon case showed a wide fund of information and a thorough knowledge of the art.

FRANKLIN LEONARD POPE.

Mr. Pope was born in Great Barrington, Mass., on December 2, 1840. He was educated in his native town, and in 1857 became a telegraph operator, and in 1862 was made assistant engineer of the American Telegraph Company.

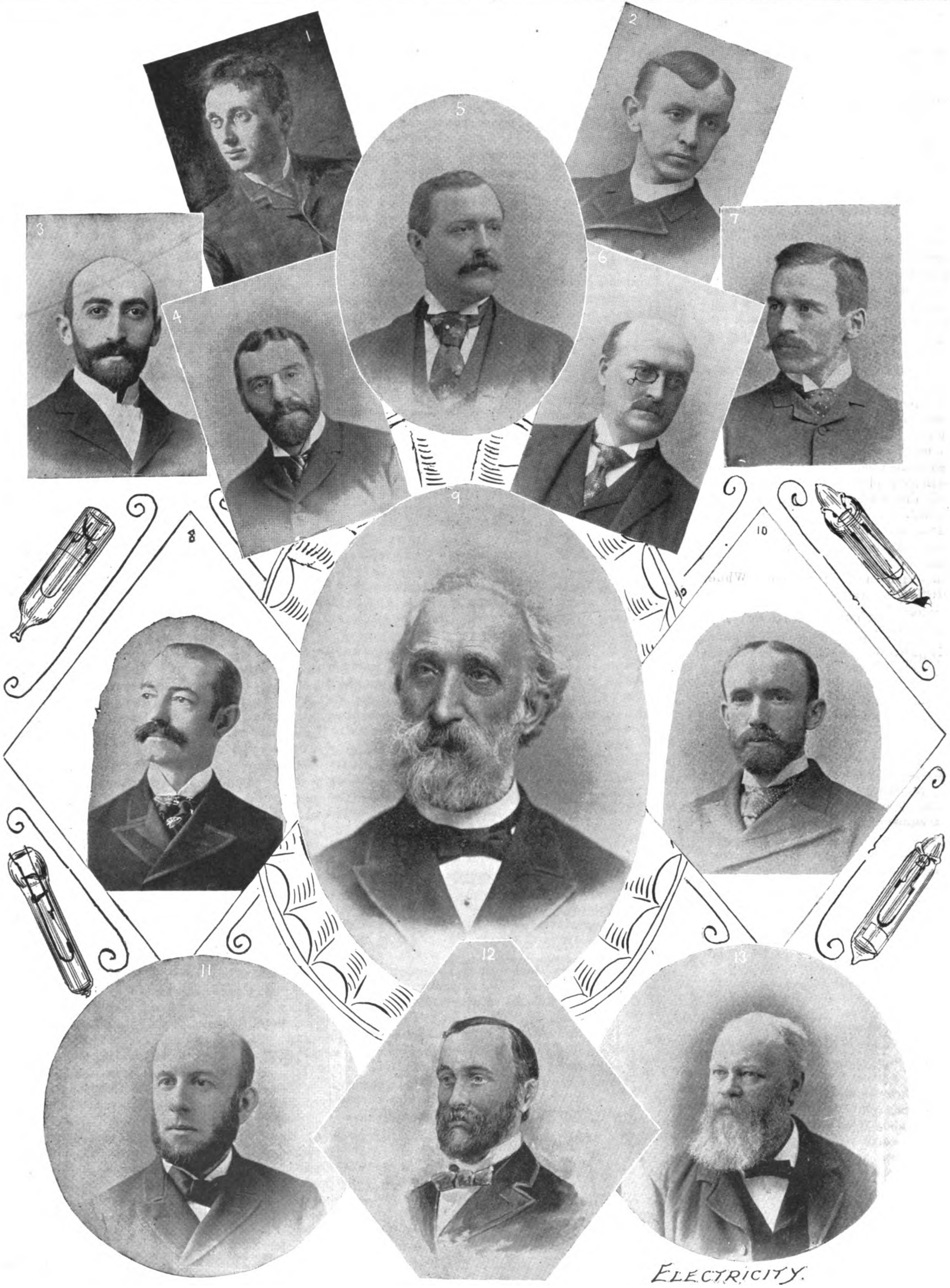
He was called to occupy the same position in 1864 with the Russo-American Telegraph Company, and while in this service made some explorations of the territory between British Columbia and Alaska. Subsequently he settled in New York City as an electrical engineer, where he has since resided.

With Edison, in 1870, he invented the one-wire printing telegraph or "ticker," and in 1872 he invented the rail circuit for automatically controlling block signals, a patent largely in use on the principal American railroads at present. Besides these he secured a number of other patents on railway and telegraph apparatus.

In 1885 he was elected president of the American Institute of Electrical Engineers and for several years was editor of the *Electrical Engineer*. He is also the author of "The Electric Telegraph," and "Life and Work of Joseph Henry."

The defeat of Edison's claims to the invention of the incandescent lamp is in the nature of a personal victory for Mr. Pope, he having from the first consistently maintained that Edison's incandescent lamp work was not wholly original.

Mr. Pope was thoroughly convinced, after a brief study of the Goebel matter, that Goebel's work was at least equal to the early work of Edison in the same direction, besides having been done nearly thirty years earlier.



A HISTORIC GROUP.—THE MEN WHO ESTABLISHED THE CLAIMS OF HENRY GOEBEL.

1. Louis D. Brandeis. 2. Edward E. Cary. 3. Henry S. Kaliske. 4. Jacob Heilbron. 5. J. H. Rhotehamel. 6. Judge E. B. Adams. 7. A. S. Fowler. 8. W. C. Witter. 9. Henry Goebel. 10. W. H. Kenyon. 11. Charles R. Cross. 12. Judge Moses Hallett. 13. Franklin L. Pope.

CHARLES R. CROSS.

Charles Robert Cross, Thayer Professor of Physics, Massachusetts Institute of Technology, was born at Troy, N. Y., March 29, 1848, his parents being of good old New England stock. He graduated at the Institute of Technology in 1870, and was thereupon appointed Instructor in Physics and assumed charge of the Department of Physics in 1877. It was entirely at the suggestion of Professor Cross that the course in Electrical Engineering was established at the Institute. This department since its establishment in 1882 has always been under Professor Cross's charge, and some of the best known electrical engineers in the country owe their success to their training under him. It is interesting to make note of the fact that this was the first course of the kind in the country, and one of the first in the world. It is now among the most comprehensive, having one of the very best equipped laboratories and largest number of students. Up to June, 1892, 131 students had been graduated in this course.

Professor Cross has contributed many interesting and valuable papers on electrical and acoustic topics to various scientific journals and magazines, more particularly to the American Academy of Arts and Sciences. For many years he has been the electrical expert for the Bell Telephone Company, having given testimony and carried out elaborate experiments in connection with the different lawsuits the Bell Company has had.

Professor Cross has a singularly lucid manner of speech, and is a scientist who can make the most learned dissertations intelligible and instructive even to a layman or a United States Circuit Court Judge.

JUDGE MOSES HALLETT.

Judge Hallett is one of the most prominent and able jurists of Colorado, now holding the position of District Judge of the United States for the District of Colorado to the entire satisfaction of his State and county, whose able and careful decisions upon grave and important matters have become the valued property of the State and are considered as authority wherever they are known.

He was born July 16, 1834, in Jo Daviess County, Ill. Receiving an academic education, he began the study of law in the fall of 1854, in the office of E. S. Williams, of Chicago, and in the fall of 1857 was admitted to the bar and immediately began the practice of his profession in that city. In the spring of 1860, charmed by the gilded accounts of Pike's Peak, he went to Colorado, and for a short time engaged in mining. It did not take long to convince him that he was better adapted to the practice of his profession than to the unearthing of mineral wealth, and in accordance with this conviction he located in Denver and resumed the practice of law, continuing until April, 1866, when he had acquired sufficient prominence in his profession to warrant his appointment as Chief Justice of the Territory of Colorado. He continued in this responsible position for about ten years, being twice reappointed.

At the expiration of this time, the Territory having taken its place as a State in the American Union, Judge Hallett was called upon to accept the more responsible position of District Judge of the United States for the District of Colorado, which office he has since held. He has lately been assigned to the United States Court of Appeals as one of the judges, for a term of one year. His judicial record is universally respected. Besides his judicial honors, he has served two sessions in the Council of the Territorial Assembly, where he rendered efficient service. In short, he has aided very largely, not only in settling many of the disputes that have come up in the Territory and State, but he has also done a great deal toward establishing justice and dignity in the Colorado courts.

HENRY GOEBEL.*

Heinrich Goebel was born in the little village of Springer, a few miles from Hanover, Germany, on the 20th of April, 1818. His father, Friedrich Göbel, was a manufacturer of chocolate, and a man of some prominence in the community in which he lived. He was for a time, about 1819-20, consul for the Netherlands in New York. Heinrich received a tolerably good education in the Lutheran Church school of his native village. He was not content to pursue his father's business, but preferred that of a watchmaker and optician.

Having in the course of his business frequent occasion to repair philosophical apparatus for the instructors in the Technological School of Hanover, he soon became much interested in physical research, in which he was aided and encouraged by one Professor Mönighausen. In 1846 the technical journals of Europe published accounts of the now well-known electric lamp invented by J. W. Starr, of Cincinnati. As Goebel was well skilled in the construction of barometers and thermometers, Professor Mönighausen often discussed with him the possibility of making an electric lamp on this principle, and they even went so far as to make some experiments in this direction, but without successful results.

In 1848, being then thirty years of age, Goebel determined to seek his fortune in the United States. Within three or four years after his arrival in this country he had constructed a zinc-carbon battery of about 80 large cells, by the aid of which he astonished the neighborhood one dark night by exhibiting from the roof of his house an electric arc formed between two pieces of carbon.

He had noticed, in trying to burn a piece of wood cut from the ferrule of a broken walking-stick that some portions of the wood from which the air was excluded by the ferrule were carbonized, and upon testing a piece of this carbonized wood he found it to be a conductor of electricity. This suggested to him the employment of wood fibre, carbonized in a similar manner, for the light-giving conductor of the lamp. Among various woody materials tried were splinters from a bamboo pipestem, which were found to answer admirably. As early as 1855 Goebel had succeeded in making quite a number of lamps, which, by the use of about 30 cells of zinc-carbon battery, emitted, for a short sime, a brilliant and beautiful light.

He made many forms of lamps from time to time, some of which were almost constantly in use in his jewelry shop in this city from 1855 to 1880.

In 1881 Mr. Goebel entered the employ of the American Electric Light Company, where he first learned of a dynamo electric machine.

Although seventy-four years of age, Mr. Goebel's figure is as erect, his eye as bright, and his hand as steady as a man's in the prime of life. Few can excel him, even at his age, in delicacy, skill and accuracy of touch in the finer processes of handicraft. Of an unassuming, cheerful and kindly nature, nothing delights him more than to converse upon topics relating to his favorite pursuits of optics and electricity, or to relate with a humorous twinkle of the eye some of the scientific practical jokes that in younger days he was wont to play upon his unscientific and unsuspecting associates. After a long, industrious and well-spent life, he is passing his declining years in comfort and contentment in a quiet home in this city, enjoying the respect and regard of his family and friends.

THE GOEBEL DEFENSE.

On Monday, January 16, 1893, the Edison Electric Light Company et al. moved for an injunction against the Beacon Vacuum Pump and Electrical Company before Judge Colt in the United States Circuit Court at Boston. Acting on the assertion of defendants' counsel that they had new evidence to introduce, Judge Colt granted an extension of one week.

Accordingly, on January 23, the case was formally opened, and then was presented, for the first time, what has passed into history as the "Goebel Defense."

Plaintiffs were represented by Frederick P. Fish, Dyer & Seeley and Clarence A. Seward and defendants by Witter & Kenyon of New York and Louis E. Brandeis of Boston.

The electrical experts were Franklin L. Pope, Charles R. Cross and Edward E. Cary.

The affidavits introduced by defendants showed that at least twenty-five years before Edison began experimental work on the incandescent lamp Henry Goebel had made scores of successful lamps on practically the same lines as the lamp for which Mr. Edison finally received a patent. Several of these early Goebel lamps were offered in evidence. While Goebel was not entirely unknown, the full extent and the importance of his work had not been appreciated by the few who knew of it, and it had remained for Messrs. Witter & Kenyon to gather the facts and make a presentable case. The electrical world was startled when the full report of the trial was sent out in an extra issue of ELECTRICITY and the results of the establishment of Goebel's claims were properly understood. Several lamp factories had already been enjoined for infringement of the Edison patent, and it had been believed that nothing could break the monopoly of the General Electric Company before the expiration of its patent.

The sympathies of the entire trade were with the Beacon Company at the start, and when the case was concluded the opinion was prevalent that the injunction would not be granted. Defendants' case, however, had been of necessity prepared in a hurry, and there were, in the opinion of Judge Colt, fatal omissions in the chain of evidence. The injunction was granted on February 18.

The Columbia Incandescent Lamp Company of St. Louis was among the previously enjoined companies. Immediately upon the conclusion of the Beacon case, President Rhotehamel of the former company engaged Witter & Kenyon of New York and Adams & Fowler of St. Louis as counsel, and immediately went to work to complete the evidence in the Goebel Defense, and to establish the identity of the various lamps exhibited.

The final hearing in the suit for a preliminary injunction in the case against the Columbia Company came up before Judge Hallett at St. Louis on the 11th of April and was concluded on the 14th. Plaintiff was represented by Frederick P. Fish, Clarence A. Seward and P. Dyer of New York and Henry Hitchcock of St. Louis.

The Goebel Defense was thoroughly established, and Judge Hallett refused to grant the injunction prayed for.

The Columbia Company, however, was placed under bonds pending the final trial of the case and the examination of witnesses.

The bond was filed within twenty-four hours, and the Columbia Company at once resumed the manufacture of incandescent lamps.

NOTE.—Copies of "A Historic Group," printed on heavy paper, with wide margin, for framing, can be supplied by ELECTRICITY, at fifty cents each.

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* From a sketch by Franklin L. Pope in the *Electrical Engineer*.

The Action of Continuous and Alternating Currents on Fuse Metals.*

BY C. P. MATTHEWS.†

For the protection of electric circuits from the passage and consequent heating effects of currents of abnormal intensities, no device is in more general use than the so-called safety-fuse. Commercially the fuse appears in a variety of connecting devices and inclosing boxes, classed as thermal "cut-outs," and familiar to all having to deal with the distribution of electric energy. The protective element in all such consists of a wire or strip of some easily fusible metal of such current carrying capacity that it will melt under the heat developed by an excessive current. In points of simplicity, cheapness, ease of adjustment and low resistance, the safety-fuse possesses advantages over most, if not all, electro-magnetic safety devices. Experience shows, however, that unless certain conditions for successful working are carefully observed, the safety-fuse may fall far short of furnishing satisfactory and reliable protection.

With a view of studying these conditions, and of obtaining at the same time reliable data on the fusion of conductors under circumstances closely approximating those of actual practice, a series of experiments, some of the results of which appear in this paper, were recently made in the physical laboratories at Cornell University.

This experimental work, which was undertaken by several persons, may with propriety be divided as follows:

Part I. On the behavior of various alloys under the action of direct currents, with special reference to their use in thermal cut-outs.

Part II. On the *disintegrating* effect of the alternate current on fuse metals.

PART I.

The first experimental work of any extent on the electric fusion of wires was performed by W. H. Preece, F. R. S., in 1884.[1] He showed that the relation between diameter and fusing current is parabolic,[2] being

$$C = a\,d^{\frac{3}{2}},$$

where a is a constant for any given metal or alloy. This relation is obtained as follows: The rate at which heat is developed by a current C flowing in a wire of resistance R is

$$H = \frac{C^2 R}{J}$$

in thermal measure. The resistance of the wire may be expressed in terms of its dimensions and the specific resistance ρ of the material thus:

$$R = \rho\,\frac{l}{\frac{1}{4}\pi d^2},$$

By substitution,

$$H = C^2\,\frac{4\rho l}{J\pi d^2} = K\,l\left(\frac{C}{d}\right)^2. \tag{1}$$

Now, as the temperature rises, there are heat losses by radiation and by convection into the surrounding medium, and also, to a greater or less extent, by conduction into the terminals. Neglecting this last, and assuming the radiation and convection to be proportional to surface (to what extent this is justifiable will be presently considered), we may write for the rate at which heat is thrown off

$$H' = \pi\,d\,l\,\varepsilon(T - T^1), \tag{2}$$

where $T - T^1$ is the excess of temperature of the wire above that of the envelope, and ε is the emissivity of the surface, or the number of water-gram-degrees emitted per second, per square centimetre of surface, per degree rise of temperature. Equation (2) may be written

$$H = K'\,d\,l$$

for any permanent temperature. With a constant current a condition of affairs is soon reached when heat is lost at the same rate as that at which it is generated by the current, and a constant temperature obtains. We then have

$$H = H', \text{ or}$$

$$K\,l\left(\frac{C}{d}\right)^2 = K'\,l\,d,$$

from which

$$C = a\,d^{\frac{3}{2}},$$

where

$$a = \sqrt{\frac{K}{K'}} = \sqrt{\frac{\pi^2 J\varepsilon T}{4\rho}}.$$

This result shows the fusing current to be independent of the length of the conductor. Evidently a is the current necessary to fuse a wire of unit diameter. The emissivity is here assumed to be a constant quantity for a given surface. The valuable experiences of Kennelly[1] on the "Heating of Conductors by Electric Currents," in which the radiation and connection losses were separated, and the results of Ayrton and Kilgour,[2] indicate that such is not strictly the case. These latter investigators found that for any temperature the emissivity is the higher the finer the wire. The rapidity with which fine wires heat and cool is a matter of common observation. Mr. Kennelly's results indicate that the convection is proportional to the temperature elevation for small differences of temperature, and that moreover losses occurring in this way increase slightly with the diameter, and are dependent on the form of the conductor. For the purposes of calculation of the fusing currents of wires, however, it is sufficient—as both the results of these investigations and those of Mr. Preece show—to consider only the total heat loss, and to assume the emissivity a quantity independent of the diameter and temperature elevation.

Mr. Preece's first experiments with platinum wires of small diameter do not appear to confirm the foregoing relation. He says: "Platinum wires—especially those of small diameter—are liable to flaws which practically reduce their effective diameter to a great extent; and also the larger wires from their greater weight necessarily tend to part asunder at a lower temperature than those which are lighter, and in which the strain is less."

In 1887[3] Mr. Preece presented the results of an elaborate series of experiments on wires of different metals, showing that the theoretical relation is quite strictly borne out in experiment except for wires of extremely small diameters. The following year "final and corrected" values of a were announced for the following metals:

Copper	10244
Aluminium	7585
Platinum	5172
German Silver	5230
Platinoid	4750
Iron	3148
Tin	1642
Alloy (Tin 1, Lead 2)	1318
Lead	1379

In determining these constants, Preece used six inch lengths of wire, while to ascertain the value of the same metals as cut-outs 1¼ inch lengths were used. It will be noticed that a value of a is given for only one alloy of lead and tin. In the course of experiments of which this paper treats, a redetermination was made for lead and for tin, and at the same time values of the constants were determined for various alloys of these metals. These latter are, it is believed, now announced for the first time. These metals were dealt with especially, because of their extended use in the manufacture of fuse-wires.

To determine to what extent the fusing current is influenced by the cooling effect of the terminals, pieces of wire of given diameter and composition but of varying lengths were successively tested. The marked variation in current is shown graphically in Fig. 1, Curve A. It will be noted that while an 8 inch piece fused at 6.6 amperes, a ½ inch piece of the same wire carried 12.5 amperes, or an excess of nearly 100 per cent., before yielding. For lengths of this wire greater than 6 inches, the conduction losses are practically nil in their influence on the value of the fusing current. The reader is referred to a formula deduced by Lord Kelvin[1] for the loss of heat occurring in this way. The practical point to be observed at this juncture would seem to be this: manufacturers cannot accurately rate their fuse-wire unless the length of the specimen to be used is specified. In the fuse-blocks in common use it is impracticable to use extreme lengths, yet if 3 inch pieces were used, the cooling effect would not be serious. Fuse-blocks are on the market employing from ½ inch to 3 inch lengths of wire, and all the variation indicated by the curve may be expected.

In the experiments to determine a for alloys of lead and tin, ordinary commercial metals were used, for, although the fusing current is affected by the presence of impurities, yet it was considered better to experiment with such grades of metal as would be used in practice. The alloys were cast in the form of cylindrical slugs, and these were drawn into wires varying in diameter from 10 to 100 mils. These were tested with great care. A Thomson graded ammeter was used to measure the current, the instrument being frequently calibrated during the work. For varying the current strength, a liquid resistance was used. The box containing the electrolyte was provided with a sliding contact, such that the current could be increased or decreased continuously without break or undue fluctuation.

There is an important *time element* to be considered in connection with the phenomena of fusion. A certain interval elapses before the wire reaches the permanent temperature corresponding to a definite current. The duration of the current in this portion of the work was 60 seconds, experience showing that if a wire of moderate diameter did not fuse in that time under the action of a certain current it would not fuse at all. Curves A′ and B′ of Fig. 5 illustrate the magnitude of this effect in a particular case, the time intervals being as 1:2. The variation in fusing current exceeds 5 amperes for the larger sizes. It should be noted in this connection that unless massive terminals are used they may themselves become heated, thereby checking the flow of heat through the ends of the wire, and tending to promote ultimate fusion.

The limits of this paper do not allow the insertion of the complete data on these alloys. The curves of Fig. 1 (B and C), however, may be taken as representative, and indicate that the "three-halves power law" was quite closely followed, a result which was obtained in all the other cases. From each observation of the current and diameter a value of the quantity a was computed; the mean of these values was taken, and a curve of calculated fusing currents drawn for each alloy. These curves appear in Fig. 2. It will be noted that while the temperature of fusion of tin is considerably lower than that of lead, its *fusing current* is about 24 per cent. higher. This is undoubtedly due to the difference in the resistance of the two metals. The

(Concluded on Page 262.)

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* An abstract of two theses, viz., "Safety-Fuses for Electric Circuits," by J. S. Peck and C. P. Matthews, and "The Action of Alternating Currents on Fuses," by W. S. Rugg and C. R. Sturdevant.

† Read at the Tenth General Meeting of the American Institute of Electrical Engineers.

[1] "On the Heating Effects of Electric Currents," Proc. Roy. Soc., April 3, 1884.

[2] This law had been previously enunciated by Prof. Forbes before the British Association in 1882. [See Rept. B. A.] See also paper by same author, Jour. Soc. Telegraph Engineers, xiii, 236.

[1] London *Electrician*, xxiv: 142, 169, 194.

[2] "The Thermal Emissivity of Thin Wires in Air." Abstract B. A. paper, London *Electrician*, xxviii: 119.

[3] Proc. Roy. Soc., Dec. 22, 1887.

[1] In J. T. Bottomley's paper "On the Permanent Conductors Through which an Electric Current is Passing." Proc. Roy. Soc., June 20, 1884.

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The Trust in Cleveland.

There seems to be a slight misunderstanding in Cleveland in regard to the exact status of the Cleveland General Electric Company.

ELECTRICITY knows little of the gentlemen who pose locally as the controlling element in this company, and we are willing to assume that they are patriotic citizens, with the best interests of their city at heart.

We do know, however, that whatever else these gentlemen may be, they are only dummies as regards the conduct of the Cleveland General Electric Company. This company is controlled absolutely by the Electric Trust, whose chief offices are at 44 Broad street, this city.

It will be well for the city officials and the taxpayers of Cleveland if they inform themselves as to the exact condition of affairs before any further concessions are granted.

A little study of history would not be out of place, and the original stockholders of the Brush Company can furnish the points.

The citizens of Cleveland ought to be informed by the daily press of that city that the Boston speculators who wrecked the Brush Company have now attempted to control absolutely the public electric lighting of the town, and to render any competition impossible.

When we speak of the Brush Company as having been wrecked, we do so advisedly. From the day when a controlling interest in this company was purchased by the Thomson-Houston people it has been used simply as a convenience and nothing else. It has been a respectable dummy bidder for certain contracts which it was never intended it should get, and it has been allowed to sell some plants in towns where the Thomson-Houston people had given exclusive licenses, and where, to do any further business, some other name had to be used. But where there has been a really profitable contract, the Brush Company has been sidetracked every time. Thus the magnificent property has been reduced from a proud and leading position in the electrical field to one of no consequence whatever—the plant incurring an actual loss now of about $30,000 per year, and being in imminent danger of being closed down for good. It is only justice to state that the local management of the Brush Company is not responsible for this condition of affairs, and that Mr. Hamill and his associates are powerless in the hands of the Thomson-Houston wreckers.

An attempt is now being made by these Boston squeezers, who are in full control of the Electric Trust, to place the city of Cleveland at their mercy; to secure such privileges as will render their new position impregnable, and then to demand what price they see fit for any kind of service they choose to give.

Cleveland is not the only town where this scheme has been tried. Philadelphia is now wrestling with the problem through a legislative inquiry into Trust methods, and Detroit has already concluded that the only redress is to be found in a municipal plant.

We predict that sooner or later Cleveland will have to face the matter squarely, and either install a municipal plant for the street lighting or be robbed to the tune of thousands of dollars a year.

Cities and towns throughout the United States should give their attention to the matter of public lighting before any further contracts are made or concessions granted. Wherever the Electric Trust or its sub-companies are in the field, robbery may be expected.

The manufacturing plants, real estate, etc., of this Trust do not aggregate over $12,000,000 in value. On this foundation a $50,000,000 combination has been formed. Interest must be paid or the whole scheme collapses.

And the only possible way of getting the interest is to squeeze it out of the taxpayers of the various municipalities through straw companies, which the Trust controls by the dozen, like the Cleveland General Electric Company.

The Cleveland *Press* has already taken this matter up, and it behooves the *Leader* and the *Plaindealer* and all the rest, regardless of politics, to stand up for the best interests of the city.

* * *

A Pleasant Incident.

The visit to the new factory of the Crocker-Wheeler Company at Ampere, N. J., proved of the greatest interest to the large party which assembled there, owing to the entire novelty of the new plant, and it may be said without doubt that the operation of the direct-driven machine tools exhibited there produced a most favorable impression upon all who visited the works. Aside from the question of economy, the simplicity of the general arrangements and the facilities which these machines afford for procuring power at any point independent of belts and shafting constitute advantages which are entirely lacking in other shops. In other words, each machine is an independent unit and can be operated in any location by simply connecting it by wires to a system of overhead conductors which are run from the main generators through all the shops.

It would appear that considerable economy of power should result from this system also, not only in the first cost of the plant but in the operating expenses as well, although of course no actual figures are available for a comparison of the two methods. It is well known, however, that in a factory, especially where the shafting is distributed over a wide area, a considerable amount of power is required to run this even when the connected machinery and countershafts are running idle. And it may also be noticed that only when a heavy machine is thrown on does it become apparent at the engine. In the present case this constant load is entirely eliminated, and with even but a moderate efficiency at the motors it seems as though considerable saving in power must be accomplished.

* * *

THE claims of the Trust to fundamental trolley patents are so flimsy that we predict they will never push the case to trial. The action was unquestionably brought solely with a view to its immediate effect on the stock market.

It may be prudent, however, to investigate the methods by which such alleged "patents" are issued. Patents covering the same device were applied for seven years earlier and have not yet been issued.

* * *

Industrials or Frauds? Mr. Russell Sage is quoted as follows by the New York *World* in regard to the causes of the present crisis in the financial world:

> "Industrial stocks are at the bottom of all this trouble; industrial stocks are good for nothing. I wouldn't have any of them. . . . Industrial corporations are illegitimate. . . . As for the Trusts, they are the worst things this country ever developed. Every one is illegitimate and pernicious to the real interests of the country. What do you think of a Trust that guarantees commercial paper? They had one like that out West. It broke up—yes, of course it did. But don't you worry about Trusts. They have got to go in the end. They will be abolished. Public sentiment will destroy them if the law does not."

Mr. Sage's remarks are perhaps too sweeping, as there are stocks of many manufacturing companies for sale in Wall Street which are sound in every particular, and really gilt-edged investments.

He doubtless had in mind Whiskey, Cordage and General Electric—three Trusts which present several features of marked similarity.

First of all, of course, comes the immense over-capitalization; next the problematical value of the assets. But what is the weakest spot of all is the fact that the executive heads of these Trusts have given their entire attention to stock gambling and manipulation, and not to the large manufacturing interests represented.

No Trust on the Street, with the possible exception of Whiskey, stands on so flimsy a footing as General Electric—none so nearly approaches a barefaced swindle; and this because it has the support of banking houses of reputation like Drexel, Morgan & Co. and Lee, Higginson & Co. The very fact that these concerns have assisted in forcing watered stock of the company above par, and then unloaded on the humbugged public, makes the fraud the more reprehensible and disgraceful.

Of course electrical men are not deceived at all by the emphatic statements put forth by these bankers. It is well known in the trade that Drexel, Morgan & Company and Lee, Higginson & Company were both involved for millions in the Edison and T.-H. Companies. They are making a desperate but disgraceful effort to get their money out, with as little regard to the actual value of the stock they are selling as the green-goods man has for the value of the package of bricks shipped to his victim.

The fact is that the only object in the forming of Trusts like Cordage, Whiskey and General Electric was a wholesale fraud on the public, an attempt to sell something for five or ten times its value.

It is a wholesome sign of the times that the days of Trusts are about over. One more year will wind them all up. Meantime thousands of small investors have been humbugged and swindled out of their few hundreds of savings in order that Trust magnates like Waterbury and Greenhut and Coffin may grow rich.

Our Group of Portraits. On another page of this issue will be found a group of portraits of the leading men connected with the recent litigation which resulted in establishing the validity of Goebel's claims to priority of invention of the incandescent lamp.

The electrical trade generally certainly owes a debt of thanks to these gentlemen for carrying to a successful conclusion a case which in many ways appeared almost hopeless and which offered at first little encouragement for further opposition to the Edison claim with the prestige gained from a series of successful suits.

Their victory for these reasons is the more worthy of congratulations from the electrical fraternity, coming as it did at a time when defeat meant at least a temporary destruction of this line of business and its relegation to the hands of an extortionate monopoly.

* * *

The Institute Meeting. At the general meeting of the American Institute of Electrical Engineers held on Wednesday last some discussion was heard on the provisional programme for the World's Electrical Congress to be held this summer at Chicago. The programme, which was printed in the January and February numbers of the Institute Transactions, relates largely to the nomenclature of standard electrical units, about which some confusion exists at present. Even in a case so apparently simple as the naming of the poles of a magnet it is ambiguous, as the north pole of a magnet is commonly known as the pole which is attracted to the north pole of the earth, although we know that these poles must be of opposite polarity for the reason that they are mutually attracted. The standard of illumination is another unit which has no well defined value. The discussion, which related to mooted points of this character, will be published in the electrical journals previous to the meeting of the Congress, according to a resolution which was passed, in order to familiarize the absent members of the Institute with the subject under discussion, and draw out a full expression of opinion upon the suggestions to be made.

* * *

IT IS just about ten years since the Thomson-Houston people started in on what has become a conspicuous career. Mr. Coffin was from the start the controlling head. He surrounded himself with subservient dummies and inaugurated an entirely new practice in the management of a large manufacturing enterprise.

From the first his interest centered in stock manipulation. Up to a little over a year ago, while his operations were confined to Boston and vicinity, his success was marked. His company paid large dividends—on paper—and he secured to a remarkable extent the confidence of the New England investing public. When the General Electric Trust scheme was launched he found ready backers.

Then the field of his operations was enlarged, and he came to Wall Street. His path here has not been strewn with roses, and for the best of reasons. Wall Street had already made the acquaintance of several Napoleons of Finance, like Ward and Ives, and was not too favorably impressed with Napoleon Coffin.

Paper dividends and paper values don't go in this locality. And when Mr. Coffin, with the aid of two of the most unscrupulous manipulators in the Street, White and Keene, began his campaign, the rank and file of Wall Street smiled—and waited.

They did not have many months to wait, when an opportunity came to place General Electric stock at somewhere near its actual value.

Mr. Coffin is now aware that a big man in Boston is not necessarily a big man in New York. He will be remarkably fortunate if he carries away from Wall Street all that he brought there, to say nothing of adding to his pile.

* * *

Electricity in Medicine. The interesting paper on the above subject by Dr. W. J. Morton, which we give as fully as space permits in this issue, explains very clearly the difficulties with which the physician is confronted in the use of electricity as a therapeutic agent, and it is to be noted that the lecturer avows frankly that its introduction in medicine was premature and its application was too often a matter of experiment in the hands of those whose knowledge of this science was but vague. There can be no doubt of its efficiency in many cases, but unfortunately for the science the use of electricity has become so thoroughly associated with the advertisements of medical quacks that the public have come to look upon it with suspicion, and often this opinion is well founded.

There are, however, legitimate and well proved uses for electricity in medicine, and they are practised by the most conservative physicians, while on the other hand the men who have enthusiastically considered it a universal panacea have been the ones to throw the greatest obstacles in the way of its progress.

One point of Dr. Morton's lecture is to be especially remarked, viz., the general application of the electric current in distinction to the local applications which have been generally used. The operation of submitting a patient to a bath of atmospheric electricity, so to speak, which recent inventions have made possible, appears to offer a field worthy of careful study.

* * *

WE ARE gratified to know that the Hon. Tom Marshall, of Pittsburg, will appear for one of the defendants in the Pittsburg larceny case. He may not prove the innocence of his client, but he is certain to furnish entertainment and an intellectual treat to those who hear his argument. We will endeavor to print the latter in full.

* * *

IT CANNOT be said that the whiskey business has been disgraced by the Whiskey Trust. It can be said, however, that the electrical industry has been disgraced by the Electric Trust.

* * *

AS WE go to press news is received that a receiver has been appointed for the National Electric Manufacturing Company of Eau Claire, Wis.

(*Continued from Page 259.*)

specific resistance of tin is 13,360; that of lead 19,487 (C. G. S). There is possibly also some difference in the emissivities of the two surfaces. Curve C, Fig. 1, illustrates the effect of enclosing the fusible wire in glass tubes. As would be expected the convection is thereby checked, and the fusing current very appreciably lowered. This is a point which should not be overlooked in practice, that is to say, the nature of the fuse-block, whether closed or open, should be considered. The constants obtained were :

Alloys	Per Cent. Lead.	a	Preece's Constant.
Tin...............	0	1592	1642
Tin 2, lead 1......	33.3	1441	
Tin 1, lead 1.....	50	1328	
Tin 1, lead 2......	66.6	1156	1318
Tin 1, lead 4......	80	1131	
Lead.............	100	1283	1379

Platting these constants as ordinates, with per cent. of lead as abscissæ the curve shown in Fig. 3 was obtained. From this curve the constant for any alloy of lead and tin whatsoever may be taken, and the current necessary to fuse a wire of any diameter readily calculated.

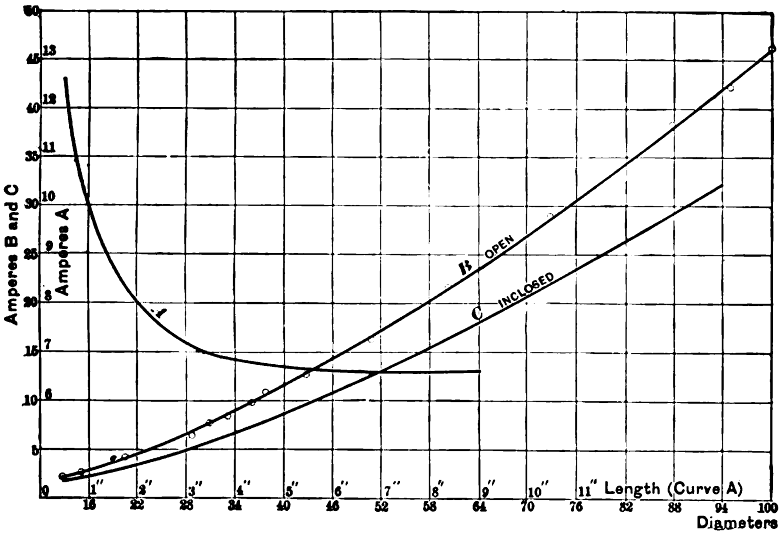

FIG. 1.

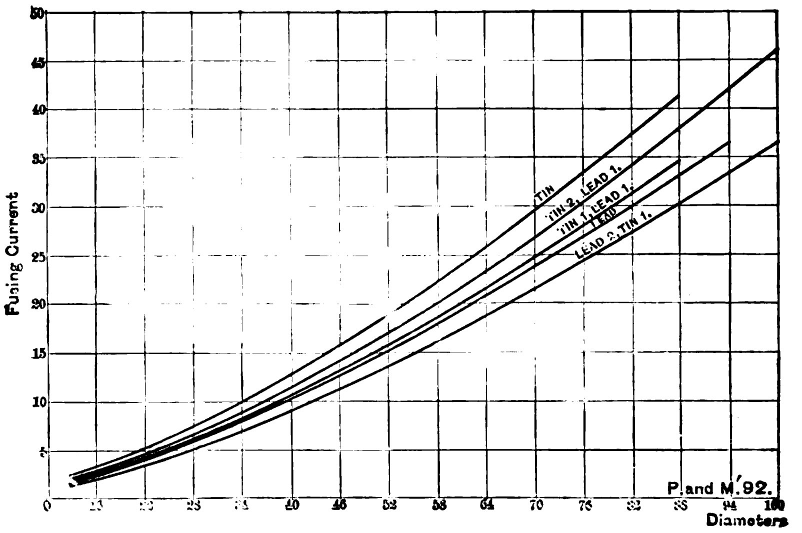

FIG. 2.

TABLE A.

DATA FOR FIG. 4.

Rating.	Diameter.	2 in. piece Current.	½ in. piece Current.	½ in. piece in Fuse-Block.
1	.0149	4	5.37	12.03
3	.020	5.72	9.9	17.68
5	.0305	9.65	23.4	32.16
7	.0351	12.76	27.5	35.37
10	.0395	15.78		

Attention is called to the fact that those values of a which may be considered as redeterminations are all lower than the values announced by Mr. Preece in 1888.

Comment on this fact is made in the original report in the following words : "Had they been higher, we should have ascribed the difference to the fact of our using wires of shorter lengths. As it is, we can only say that Mr. Preece doubtless experimented with chemically pure metals, while our wire was drawn from the commercial article. He gradually increased the current until fusion occurred ; we endeavored to find *what current, when it had plenty of time to bring about a permanent state, would fuse the wire.* In increasing the current continuously from zero to that which melts the wire, there is danger of getting too high current readings. Mr. Preece's first determinations were entirely too high, as his later investigations show."

TABLE B.

DATA FOR FIG. 5.

Rating.	Diameter.	Current.	
		10 seconds.	20 seconds.
1	.0155	3.08	2.93
2	.0248	6.20	5 64
5	:0374	12.6	10.81
10	.0533	21.24	18.29
20	.0804	42.61	36.18

In order to ascertain the status of marketable fuse wire, a number of samples were obtained from different manufacturers and tested under conditions similar to those already described. The results were represented graphically by curves, only two sets of which are here reproduced. In Fig. 4 curve A is that obtained where 2 inch specimens were tested, and, as will be seen, is not far from a ⅔ power curve. When, however, ½ inch pieces of the same wire were tested, curve B, much higher and distorted, was obtained. The marked cooling effect of the terminals is here apparent. Curve C is the most remarkable of all. One-half inch lengths of the same sizes of wire were successively fused in a porcelain ceiling cut-out block. This block was so constructed that the wire came in contact throughout its length with the cooling surface of the porcelain. The heat was conducted away so rapidly that the current reached the abnormal values shown before rupture occurred. For example, a 7-ampere fuse did not "blow" until more than 35 amperes were flowing in the circuit. Curves A', B' and C' in Fig. 5 represent the behavior of the best sample of wire tested. This wire was quite uniform in diameter, and gave evidence of careful rating. The curve of rating should be of the same general equation as that of fusion, since both represent isothermal conditions.

The requirements for an efficient safety fuse may be summed up as follows :

1. Promptness of action.
2. Low fusing point.
3. Permanency under normal conditions.
4. Moderately low resistance.
5. Firm and lasting contact.

Promptness of action requires that the temperature of fusion should not be too far removed from that attained when the wire is being worked at its rated capacity. Moreover, it is important that the metal should not undergo chemical changes produced by the action of the heat which may appreciably alter its melting point. The formation of oxides may or may not promote prompt fusion. In the case of pure tin and some of its alloys, a coating of oxide is often formed which retains the molten metal some time after the temperature of fusion has been passed, ultimate rupture usually occurring with considerable violence. On the contrary, the rapid oxidation of iron and copper wires seems to favor prompt fusion.

The question of low fusing point is one with which the fire underwriters are concerned, since wires fusing at high temperatures introduce an element of danger from fire. With fuses enclosed in properly constructed blocks, the danger from this source is not great, and the necessity of employing a metal of low melting point is not so important as might be imagined. Experience shows that fuses made of nearly all the metals available for such purpose, will melt without dangerous scattering of particles or liberation of hot gases, when the current is gradually increased until the break occurs. This, however, is a condition which rarely obtains in practice. Mr. Preece experimented with various metals to determine their behavior on short-circuit. He made for each metal a verbal description of the character of its fusion, such as : "Scintillating particles flew in all directions to a great distance." His results are unique and comprehensive as regards the variety of metals experimented with, but suffer from the inadequacy of the English language to express with proper shading the nature and degree of the disturbance in each case. The author of this memoir hit upon the plan of surrounding the fuse with a paper cylinder about 3½ inches in diameter and 10 inches in length, and then exploding the fuse by an excess of current. In this way a series of autographic records were obtained, showing with considerable accuracy what happened in each case. These records are perhaps more curious than valuable, but they are undeniably interesting, and it is to be regretted that some of them can not be reproduced here. Owing to the cylindrical form of the paper, the particles of molten metal striking it, in any way but normally, traced out sinusoidal curves of continually decreasing amplitude. The vapors liberated colored the paper quite beautifully in many cases, and usually in characteristic tints, while an idea of the temperature attained was given by the degree to which the paper was burned. In most cases when ½ inch pieces were used an arc was established across the terminals, the intense heat of which was far more destructive than anything resulting from the temperature of the metal. The reader is referred to the original thesis[1] for these curious records, as well as for much other matter pertaining to a subject which, it is believed, is too liable to be regarded of trivial importance.

PART II.

What has been said in Part I will doubtless apply equally well to fuses on either direct or alternating current circuits, but in the latter case a new and annoying phenomenon, well worthy a special investigation, confronts the electrician. Reference is had to the subtle effect of the alternating current on fuse metals by reason of which they often yield when carrying currents well within their rated capacities. This phenomenon was mentioned in the editorial columns of the New York *Electrical Engineer* of September 16, 1891. Referring to a paper previously read before the Providence Convention of the Electric Light Association, the following words were used:

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[1] In Cornell University Library. T 1893. 216.

"Perhaps the most important (point) was the nature of the fuses employed in the alternating current system, and the difficulties which accompany their use as described by several members. It would thus seem that the action of the alternating current has a disintegrating effect upon the fuses, which causes them to 'blow' after comparatively short use, and thus necessitating a constant renewal and supervision of the circuits."

The discussion following the paper above mentioned showed that this trouble had been experienced by many, and the hope was expressed that a careful investigation of the matter should be made. To cite a particular case: In the lighting system of the Cornell University Library eight 50 volt circuits were supplied with fresh fuses and a record kept of their behavior for a period of three months. During this time it was found necessary to furnish six of the circuits with new fuses, one circuit requiring three such renewals. In this last case the fuse was badly corroded, owing to water dripping from the floor above. The others were in dry and airy places, the contact being bright and firm. One of the fuses had the appearance of being simply cut, the opening being so narrow as to require close examination to detect it.

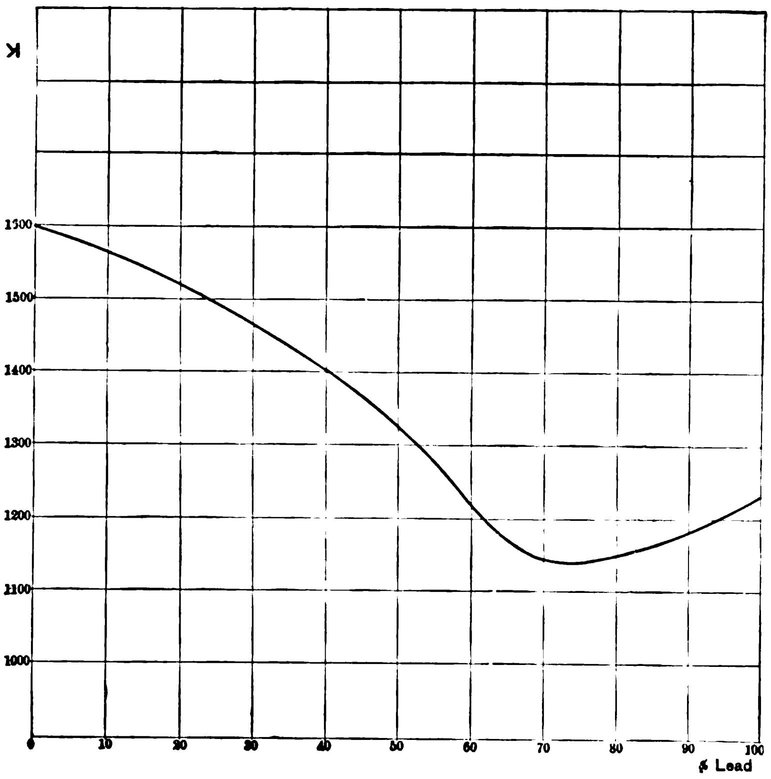

FIG. 3.

In their attempts to study this peculiar effect of the alternating current, the chief difficulty encountered by the experimenters was the fact that their reports had to be submitted in a comparatively short time. The subject is peculiarly one requiring long periods in which the action, whatever its nature, may proceed far enough to yield results of definite and quantitative value.

For the purpose of systematic investigation it was assumed that the effects of the current might be one or more of the following:

(*a*) A change in the resistance of the metal. It was thought that this would likely be a rise, with a result of lowering the value of the fusing current.

(*b*) A change in the physical properties of the metal. It was thought possible that a molecular change, such as crystallization, might take place, caused by alternate contraction and expansion from the heating effects of a varying current.

(*c*) Poor contact. This might be due to the loosening of the binding screws or other holding device, because of the frequent alternations. Imperfect contact due to electrolytic action would be more likely to occur with direct than with alternating currents.

(*d*) The effect of the current upon various metals and alloys was thought likely to be different, and consequently some alloys might be of just the right composition to overcome most of the difficulties mentioned.

The following results deal particularly with, and tend to corroborate, the first and second assumptions:

Samples of wire of various rated capacities were obtained from four different manufacturers (hereafter designated by i, ii, iii and iv), and of this wire fourteen pieces were chosen for use in the tests. The sizes and disposition of these several pieces were as tabulated.

No.	Make.	Rated Cap.	(Cms.) Len'th.	(Cms.) Diam'r.	(Squ're cms.) Area.	(Legal ohms) Resist.	(Microhms.) Specific Resist.
1	i	2	188	.0635	.00316	1.276	21.4
2	iv	2	105	.0476	.00178	.8727	14.76
3	i	3	299.5	.0797	.005	1.3271	22
4	iv	3	113.3	.053	.00218	.7188	13.5
5	iv	5	98.1	.0824	.00534	.2420	13.2
6	iii	10	196.5	.1224	.01172	.3326	19.29
7	i	18	178	.1585	.0197	.1153	12.76
8	i	36	70.4	.1585	.0197	.0229	12.76
9	ii	18	113	.1585	.0197	.0756	12.76
10	iv	10	109	.1063	.00886	.1674	13.59
11	i	18	129.2	.1585	.0197	.0872	12.76
12	ii	18	126	.1585	.0197	.0786	12.76
13	ii	25	198	.1913	.0287	.0866	12.55
14	ii	25	240	.1913	.0287	.0916	12.55

There is some difficulty in accurately measuring the diameter of a wire of soft material. The foregoing values were obtained from a large number of measurements, the variation being never greater than 2 per cent., and this very seldom. Pieces of wire from each sample, varying in length from 2 to 10 feet, were wound into helices and mounted on wooden blocks. The ends were soldered to copper terminals of negligible resistance, the metal itself being used as a solder and resin as a flux. The joints were allowed to stand at least twenty-four hours before any measurements of resistance were taken. For the determinations of resistance, a "fall of potential" method was chosen as being best adapted to these small values. The standards used were a one ohm coil standardized at the Cavendish Laboratory in 1885, and a smaller compensated resistance composed of copper and carbon, accurately tested and compared with the standard coil.

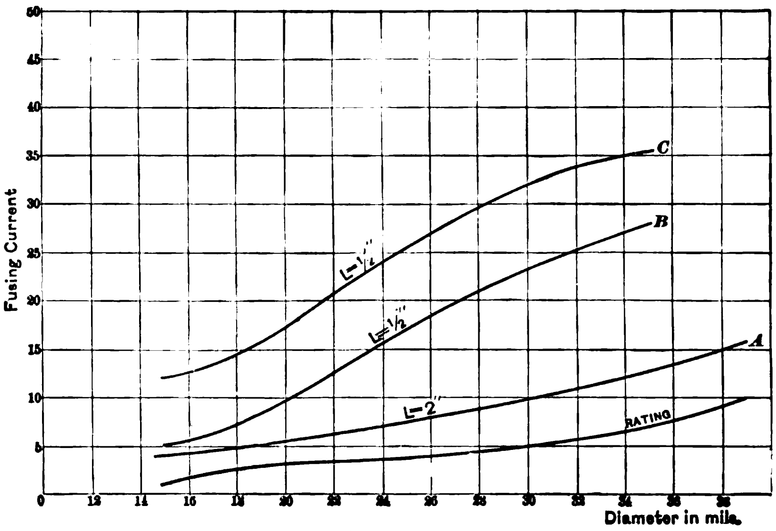

FIG. 4.

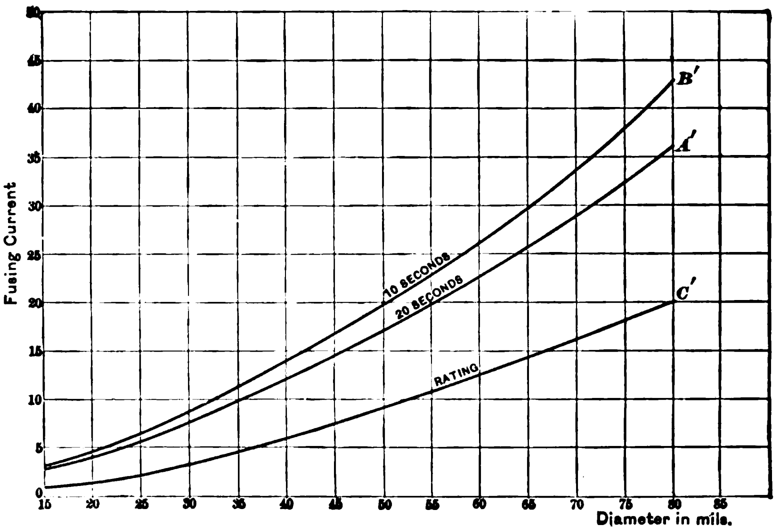

FIG. 5.

After the fuses were mounted as above described, their resistances were found, and they were placed on the circuits available in the laboratory as follows:

Nos. 1 to 6 inclusive. Alternating ∼ = 250.
" 7 " 9 " " ∼ = 132.
" 10 " 14 " Direct ————

These fuses were subjected to the action of the current for periods ranging from 83 to 487 hours—this variation being due to the fact that the circuits were used intermittently for lighting and for general laboratory purposes. From time to time additional resistance measurements were made. In the original report the change in resistance is exhibited graphically by means of curves. These curves are so widely different in form that their interpretation becomes a difficult matter, and the determination of any law impossible. They indicate, however, that a distinct rise in resistance occurred in all of the fuses on alternating circuits except No. 6, which shows a somewhat anomalous behavior. The maximum rise occurred in the case of No. 8, amounting to 29.6 per cent. in 105 hours. Of the fuses on direct current circuits, all but one showed a slight decrease in resistance, the maximum change being only 3.5 per cent. The figures for each specimen appear in a succeeding table.

That some molecular change actually took place was shown in the following way: It being practically impossible to test wires of so soft material for tensile strength, it was considered best to subject them to an alternate torsional stress of a given amount, continuing the alternations and noting the number until the specimen gave away. A simple piece of apparatus was constructed for this purpose, and it did its work very well. Twenty pieces of each of the fourteen specimens were tested in this way. Ten of these had been subjected to current action, and ten had not. The change in brittleness in the case of the fuses which had been on alternating circuits was quite marked, being in no case less than 7 per cent., while the change in those which had been on direct circuits was, with one exception, negligible. These results, together with some data on the fusing points before and after the passage of the currents, are given in the subjoined table:

No.	Rated Cap.	Fusing Current. Before.	After.	Per ct. Change	Torsion Test. Before.	After.	Per ct.	Hours Run.	Per ct. Change Resist.
1	2	8.83	8.56	3.06	14.4	10.9	24	487	0.2
2	2	7.96	7.86	1.26	21.6	19.9	7.9	169	0.5
3	3	12.6	12.15	3.56	14.9	13.2	11.14	487	15
4	3	8.46	8.24	2.6	28.8	22.4	21.4	169	0.4
5	5	17.96	17.46	2.55	21.7	18.5	14.8	170	2.2
6	10	27.4	25.3	8.3	13.3	11.7	12	487	2.0
7	18	52	46.4	10.8	14.8	11	26.4	209	11.3
8	36	52	45.4	11.9	15.2	18.6	10.5	105	29.6
9	18	52	49.5	4.8	16.9	18.9	17.8	88	3.5
10	10	26.8	26.8	.3	24.1	23.9	.8	170	−2.9
11	18	52	51.5	.9	13.8	13.7	.7	200	−3.5
12	18	52	51.4	1.1	13.8	12.3	10	296	−0.1
13	25	65.06	65.02	.061	11.1	11.0	.9	300	−2.8
14	25	65.06	65	.092	11.4	11.3	.8	264	−1.5

While these results may be considered as only a beginning along a line of work which is of both theoretical interest and practical value, yet they would seem to warrant the following conclusions: (1) There is a distinct although irregular rise in the resistance of a fuse on an alternating circuit. (2) This is perhaps to be accounted for by a change in the molecular structure of the metal. (3) This results in a decided lowering of the fusing current, in some cases at least easily sufficient to affect the reliability of the fuse.

A Brief Glance at Electricity in Medicine.

The Properties and Applications of the Different Currents.

Changes in Modern Practice of Electrical Treatment.

BY DR. W. J. MORTON.*

Electricity presents itself to physicians for medical use in three conventional modalities, termed respectively Galvanism, Faradism and Franklinism. The electrical engineer knows no such terms; to him electricity differs in volts and amperes only. And practically we also work upon the same lines. But time-honored uses and convenience justify us, I think, in retaining for the present our crude classification, since our apparatus consists almost entirely of voltaic cells, volta induction coils and electrostatic machines.

From the galvanic battery we obtain a high current strength and low voltage; the current is continuous or constant, though often used also as an interrupted current. Its effects upon the human tissue are mainly electrolytic and cataphoric—the tissue is affected chemically and physically, just as inert matter would be, and, in addition, is affected physiologically; the thousandth part of an ampere, viz., a milliampere, is the practical unit, and therapeutic dosage is expressed in terms of *n* milliamperes passing for *n'* minutes. Current strength is measured by a milliampere meter. Administrations are percutaneous, and through the mucous membrane, or by needle puncture. In the former case, the resistance offered by the skin is high—varying from one thousand to forty thousand ohms—and we require from 40 to 60 high voltage cells to overcome it. Two important features come into play—one, current density, which is a question of the size of the electrode, and the other the practical fact that the degree of pain excited in the nerves of the skin with accompanying injury to the skin erects the real barrier to increasing the current strength. Ten milliamperes to a square inch of skin is about the limit of endurance, and from 15 to 25 an average percutaneous current. Current density is therefore as essential an element of expressing the dosage as is the reading of the needle, for it is evident that, having 10 milliamperes to a square inch, the electromotive force and resistance remaining the same, an electrode 10 square inches in area would afford a galvanometer reading of 100 milliamperes. Physicians rarely mention the size of their electrodes, and should reform in this respect.

From a faradic apparatus or induction coil we obtain a current of much greater electromotive force but of decreased current strength. The salient feature of this current is that it is an interrupted current; from the primary winding of the coil is obtained a pulsating current—its flow is always in one direction, thus resembling an interrupted galvanic current, plus the current of its self-induction and that of the magnetic induction of the iron core. From the secondary winding is obtained an alternating current, whose electromotive force may be very high. An instrument to measure this current is greatly to be desired.

From a franklinic apparatus or electrostatic machine we obtain a current of enormous voltage and very low current strength. The physical and physiological effects are largely due to electromotive force and instantaneousness of current flow rather than to current strength.

There is still another form of electric manifestation of energy, which is a newcomer to electrotherapeutics—in fact, in its present guise a newcomer to electrical science; I refer to high frequency, high potential currents.

They fall out of line of our medical classification, for they are neither faradic nor franklinic alone—their production requires alternating current dynamos, transformers and condensers, they far transcend our volta induction coil products in frequency of interruption and electromotive force and our franklinic machines in current strength.

The fame of the high frequency high potential current is already invading the quiet domain of electro-therapeutics, and it is to that branch of our subject that I shall ask some attention tonight.

From the great initial difference in voltage, amperage, and absence or presence of interruptions of the three forms of current in medical use arises a corresponding difference in their physical and physiological effects upon the human organism, and from a study of these differences the physician must decide upon which form of current to use in given cases.

In using electricity to cure disease the physician may be said to resemble a huntsman who has a certain number of arrows in his quiver, each adapted to different purposes. He selects an arrow—a property of the current—some special thing it will do, and projects it against a disease or morbid condition. At least this is what he should do, but it is unfortunately a fact that physicians are wofully ignorant about what electricity will do upon inanimate matter, and more so upon what it will do upon animate. The general impression seems to be that electricity is to be injected into a human being by a small sponge electrode much as one would inject a medicated fluid in through the skin by a hypodermatic needle, and that the electricity was then to run about the system, hunt up the diseased spot, make a diagnosis, and chase out the disease, much as a ferret might run a rat out of a hole. I am not sure that this is not the idea of the electrical engineer.

Heat may be employed indirectly to heat small metallic loops with which surgical operations may be performed. This is known as galvano-cautery.

The actual heat produced in the body by its resistance to currents of the current strength commonly in use is inappreciable.

The franklinic current modifies bodily temperature, according to my experiments, in a marked degree.

High frequency high potential currents raise the temperature of the body.

Light may also be used indirectly in incandescent lamps to illuminate the cavities of the body—to transillumine the tissues, and thus detect foreign bodies, or dead tissue; it has also been used successfully to cure neuralgia.

The magnetic property of currents is also indirectly made use of to actuate mechanism, like surgical drills and saws, to cause mechanical vibration, transferred to tissue, etc.

Magnetism itself, whether from permanent magnets, the most powerful of electromagnets, or from solenoids, seems to have little or no effect upon the human tissue. The wonder is that it has ever been expected to have such an effect, since no one would select the ingredients of a human body as suitable ones to collect the electromagnetic lines of force. Possibly its advocates select patients of an initial iron constitution.

Induction effects due to the passage of currents through the body have received little attention. It must be supposed that there are a very great number of closed inductive circuits.

Chemical or Electrolytic. This is one of the most important properties of the current, and in connection with it a passing glance must be given to the nature of the electrolyte. The human body, for practical purposes of the administration of electricity may be considered as a semi-fluid mass, whose conducting power is due to its salts, held in solution. As a conductor of electricity, it is practically about a two per cent. solution of common salt. It is at once evident how important a part electrolysis, or chemical decomposition, and cataphoresis, or electric transfer of fluids, must play in this human electrolyte.

And, finally, we cannot close our leaflet upon electrolysis without a word in regard to one of the greatest extensions of electricity into the domain of medicine, that of the treatment of diseases peculiar to women by the methods devised and advocated by Apostoli, of Paris. The labors of Apostoli have worked a revolution in gynecological practice by means of a dispersing pad electrode whose current density is large applied externally on the skin, and a small metallic electrode whose current density is small applied internally.

Next to electrolysis, cataphoresis is undoubtedly the most important property of the galvanic or continuous current. Human tissue is well adapted to cataphoric action. Fluids flow to the negative pole and remain there owing to the membranous character of the meshes of tissues which inclose them and which resemble in this respect the porous diaphragm. Like electrolysis, cataphoresis is inseparable from every application of the continuous current. In inflammatory exudations of all kinds, in rheumatic thickenings of tissue, in tumors like fibroids of the uterus and others, the fluid in the mass is increased by the negative pole, thus creating a physical change, while by electrolytic decomposition the same diseased tissue is impoverished in the salts so essential to its vitality.

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* Abstract of lecture given at Columbia College before the New York Electrical Society, May 17, 1893.

Cataphoric Medication. The cataphoric property of the current renders available, also, a very interesting practice of introducing medicines into the human body and blood stream through the skin or mucous membrane.

The reverse statement is interesting, and that is, that by cataphoric demedication medicines, like, for instance, arsenic and mercury, may be removed from the patient, and be visibly deposited upon the negative electrode according to the usual rules of electroplating.

PHYSIOLOGICAL PROPERTIES OF THE CURRENT.

The gross physiological phenomena with which we are familiar is that muscles are caused to contract. If the electrical impulse is instantaneous, the contraction is instantaneous, and immediately subsides. Up to about twenty impulses per second this rule holds good, but beyond that the muscle has not time between the impulses to subside from its state of contraction, and remains in permanent contraction so long as the varying current continues to flow. The excitation of the muscle is primarily effected by means of the nerves which supply it, but it may also be caused to contract independently of its nerves. Using a galvanic current, muscles contract more or less quickly to single impulses, according to which pole is used, and according to whether the circuit is made or broken.

Nerve Excitation. The nerves of the body are mainly of two kinds, the motor, which convey outward from the brain and other centres those neutral impulses which lead to muscular movement, and the sensory, which carry inward to the brain and other centres the sensations of pain, touch, temperature, etc., from the external world.

Electricity affects both classes of fibres, as well also as the special cellular nervous substance in which they start or in which they terminate. The positive pole diminishes the excitability and the conductivity of a nerve while the negative pole heightens them. The former is therefore sedative, as for instance, in neuralgia, while the latter is stimulating, as in a paralysis.

Again, living muscular tissue becomes acid by fatigue, and alkaline in repose or rest. It is evident that a positive pole will increase fatigue by increasing acidity, while the negative pole will overcome fatigue by neutralizing the acid.

Electricity enables the physician to decide if the muscle and its nerve is impaired, and adds greatly to the certainty of a diagnosis. The test is simple. An electrode is applied at a point on the skin previously determined and mapped out on charts, by aid of dissections upon the dead subject just over where the nerve plunges into the bulk of the muscle; if the faradic or induced current is turned on, it will be found that the muscle, if degenerated, has lost in a greater or less degree its power of contracting, simply because in its changed condition no single electric impulse lasts long enough to affect it.

If the galvanic or continuous current is turned on, the muscle contracts to single impulses, because they last longer, but this singular fact now appears, viz., that, whereas in the healthy muscle the negative pole causes the greatest contraction, in the diseased muscle the positive pole causes the greatest contraction.

Nutrition. No general fact associated with the administration of electricity is more familiar than that the general health, the nutritional processes, are promptly and greatly improved. The exchanges between the blood and the tissues are augmented, the patient absorbs more oxygen and excretes more carbonic acid and urea, and he gains in weight and comfort.

The trouble is, not that electricity does so little in our human bodies, but that it does so much we cannot classify, systematize and properly direct our power. We pause confused in the multiplicity and in the interwoven character of tissues and their functions, become bewildered in the problems of biology, the processes of vitality, the processes of disease. If we falter, let us not blame our noble agency, which is more than ready to do all that we require of it, but blame rather the shortcomings of our own knowledge.

In using the Influence machine the patient is placed upon an insulated platform by the older and classical method; or uninsulated by my method of employing condenser currents. The platform in the former case is connected to whichever prime conductor is desired, commonly the positive. He is now simply an extension of the conductor, and enlarges its static capacity.

In this position the static charge escapes from the charged patient either by leakage, by a brush discharge established by a pointed electrode, or by a disruptive discharge or spark, established by a ball electrode.

The electrodes are provided with insulated handles, and their conducting portion is attached to a chain which is in turn attached to the other prime conductor in the direct method, or led to the ground in the indirect method.

The direct method is commonly employed, but gives a painful, irritating spark, and should never be used. The indirect method, by grounding, gives a long, clear spark, and is by far less painful.

In working with electricity of this high E. M. F., the mere act of grounding seems to me to be superior, because it affords a large capacity surface in surrounding objects, rather than because it supplies an earth circuit in the ordinary acceptation of the term.

When the patient is treated by the static induced current, the output of the machine at its terminals is simply a current, and no longer a spark. The patient is not submitted to a "charge," but is treated as if by a galvanic or faradic apparatus.

PHYSICS AND PHYSIOLOGICAL ACTION.

The lightning is a great spark; its effects are mechanical, physical and physiological. Mechanically it often moves great masses, displaces and transports them; it performs, in short, on a large scale a cataphoresis, just as on a small scale we transport medicines through the skin, or move about fluids in the tissues. The spark of an Influence machine produces a molecular perturbation at every point where it strikes, a sort of molecular gymnastics, so to speak, or displacement of tissue parts, accompanied by corresponding changes in nutrition—new blood flows to the part, the lymphatics increase in activity, and carry off effete material; there is a local revivification.

Again, the great spark kills people, and upon their bodies are found marks indicating mechanical rupture of their tissues. If they recover, there frequently remains extensive paralysis of parts of the nervous system; if they die, no evidence of the cause of death is ascertainable beyond the organic injury mentioned. What has caused their death? The same question has been asked, and not yet answered, in regard to the death of criminals "electrocuted," and in regard to "linemen" who fall from a telegraph pole, shocked by the electric current. Picture to yourselves the amœba, the little cellular organism, and recall the experiments which demonstrated that with successive severe shocks of a varying current the amœba first assumes a spherical form, and then perhaps regains it, but finally remains, as the shock is increased, without power of motion. Live protoplasm has, in short, become dead protoplasm; the living animal has become a dead animal; the effect of an electric shock has been to deprive the protoplasm of the power of contractility.

HIGH FREQUENCY, HIGH POTENTIAL CURRENTS.

In view of the prodigious progress of electrical science and progress in recent years, it is evident that medicine, conservative as it may be, cannot long remain without the pale of the new advances. No one science can stride forward without dragging the others with it. There is a correlation of sciences, just as there is of energies. To-day medicine is occupied—is preoccupied—with bacteriology. And no less fascinating is this study than substantial the benefits which it has already conferred upon humanity. Electricity in medicine has had its "inning," and an unsatisfactory one. Its advent was premature, the nature of the agency itself and its phenomena were uncomprehended, and electro-therapeutics became a synonym for a "vasty deep" of speculative deductions, ignorant methods, and more unfortunately still, of crafty practices of charlatanism and quackery. The old electro-therapeutics still labors under antiquated physics, confused electro-physiology, and observations colored by the fancies of the observer; the new is being built upon experimentation in the physiologist's laboratory, and in the electrician's. The old relied upon *local* applications at the tip of small sponges—by local treatment it sought locally to cure disease; the new, while not neglecting the localizing method, goes further, and by a general application affects the entire organism, the pulse, the temperature, the lungs, and the excretions; in short, all that constitutes the nutrition of the individual. It seeks by exciting the highest degree of the health of the individual to make human tissue an unfit habitation for disease and morbid conditions.

The Morton currents of high frequency and high potential were described and published in 1881. The Influence machine has relatively little energy as compared with the Rumpfkorf coil, since so successfully used, or a primary circuit supplied by an alternating dynamo, and hence, Influence machines required to produce the condenser currents, in order to give good results had two Leyden jars attached to the prime conductors, so that their respective inner coatings were in connection with the respective prime conductors. To the outer coatings was attached a circuit of highly insulated wire, either in solenoid or straight form. The current was taken from the induction current. To produce and to regulate the strength of the current, the discharging rods were approximated to a point where sparks continuously passed.

Any of the ordinary forms of electrodes may be attached to the terminals, and the current may thus be used externally and internally as in ordinary galvanic and faradic administration. Owing to the relatively minor degree of pain it produces, while still producing strong muscular contractions, and the cubic area through which it acts, it is peculiarly useful in reaching into the deeper parts of the body, as for instance when it is desired to reach the brain, spinal cord and internal organs. I have found it of great value in diseases of the brain, spinal cord and nerves, in rheumatism, gout, goitre, etc.

Starting from this fundamental fact that when a current passes through the human organism the excitations are due to variations in its strength, D'Arsonval first studied the effects of a single wave of known form and then the effects of periodic waves. For careful physiological investigation his first form of apparatus was an alternating dynamo without iron, capable of furnishing 10,000 alternations per second. The current thus produced was passed through the primary of an induction coil having no iron core. With low frequencies neither pain nor muscular contraction was produced, but the current thus generated increased the tissue absorption of oxygen and the excretion of carbonic acid. It also acted as a sedative to pain.

He next adopted the method involving the continuous discharge of sparks between the discharging rods of a powerful Rumpfkorf coilconnecting two Leyden jars to each terminal by their interior tinfoil coatings, and connecting their outer coatings by a thick copper wire solenoid of from 15 to 20 turns. A wire led off from each end of the solenoid furnished the currents for his experiments in extreme frequency.

We are now entering upon the new era of the non-medicinal treatment of disease, especially chronic diseases. The leaven that has worked toward this end was implanted in this country away back in 1860. by one of the ablest men of his day, Dr. Jacob Bigelow, of Boston, in a treatise upon "Nature in Disease." It was a protest against expecting that every disease had its medicinal antidote. The days of a general and comprehensive antidotal treatment are numbered. The first dawns of light were the recognition that many diseases were self-limited, and could be left largely to Nature's processes. Then came the recommendations for fresh air, for exercise out-of-doors, for congenial surroundings, and appropriate food. Next the recognition of the importance of massage, of Swedish movement, of hydrotherapy and of electricity, viz., of treatments which essentially produce an increased demand for the oxygen of the air, for an increased capacity on the part of the blood to convey it to tissue, and a correspondingly increased oxidation of the tissue and assimilation of food. The patient's "respiratory circulation" is improved, consequently his nutrition improves, and finally his so-called disease disappears. Electricity leads the way in the advance; its dosage is measureable with precision; its effects are equally precise; they constitute the objective evidence of the treatment, viz., acceleration of the heart action, of the blood circulation, regulation of the temperature, and increased absorption of oxygen, with a corresponding increase of waste products like urea, creatinin, carbonic acid and water.

The law of life is motion—light, heat, chemical affinity all are motion; possibly material matter itself is ether in motion; the processes of life are chemical processes, the resultant energy developed is the mechanical force displayed by our muscles, the neural impulses conducted by our nerves the action of what we call our mind. Muscles, nerves and brain are but organic foci for the development of these energies by physical processes.

Electricity, judiciously employed, promotes the activity of the physical processes underlying life and health. It may even constitute the motive power which drives the machinery of life. Be that as it may, we know that we can alter the running of the vital machine for weal or for woe by turning an electric current in upon it.

We physicians, when we use electricity, are also electrical engineers; but our workshop holds its problems of health and of life and death. Do you, the members of this Society, ever pause to realize that you are relieved from this responsibility? Do you wonder that those who would grasp this problem are ever striving for aid, and that you, with your trained minds and special researches, may be of vast aid?

Are not our pathways parallel and often harmonious? That they may be, is my devout wish.

World's Fair Notes.

The third week of the Exposition since its opening day finds the majority of the exhibitors in the electrical section still at work on their exhibits. On the main floor of the Electricity Building not over a dozen exhibits are in place and complete for inspection by the throngs of visitors that are in daily attendance. The blame for this delay is hard to trace out, as one department points to the other when an explanation is sought. The value of each exhibit as an advertisement to the company making the display will be lessened by one month's time unless more progress is made in the next week than during the past three weeks. The exhibitors who have completed their display are making vigorous protests to the Chief of the Electrical Department about the delay in their neighbors' exhibits keeping visitors away from the section of the building in which they are unfortunate enough to be located.

The construction department has put the greater part of their wiremen to work stringing wires and hanging lamps in that portion of the Park known as Midway Plaisance. The managers owning the different concessions have made a number of protests against being left in darkness while the rest of the Park is brilliantly illuminated. Current has at last been turned into the mains leading to the Transportation Building. This is the last one of the Exposition buildings proper to be connected with the generating station. It is now expected that exhibitors will do the greater portion of the work on their uncompleted display after dark.

One of the most interesting dynamos of the direct coupled type, exhibited in the generating station in Machinery Hall, is that built by the European firm of Siemens & Halske. The machine has a capacity of 1,000 horse power and generates its current at a pressure of 500 volts. The armature shaft is coupled direct to the crank shaft of a triple expansion vertical engine of the marine type built by F. Schichaw, Elbing, Prussia. The current generated by this machine is transmitted to the Wooded Island, the German Village and the German exhibit in the Electricity Building. The firm of Siemens & Bros., of London, is installing an 18 kilowatt direct coupled dynamo as a portion of the British display in the Machinery Hall.

The American Bell Telephone Company's display in the south end of the Electricity Building is undoubtedly the leading attraction for visitors in that portion of the building. One of the entertaining features is a loud talking telephone, which can be distinctly heard in any part of their booth. The company have placed a long distance telephone directly connected with New York City at the disposal of the visitors.

Boston Notes.

Monday, June 5, is the day appointed for a hearing in the United States District Court at New Haven, Conn., of the case of John Cheney, of New Jersey, who is suing for an injunction against the directors of the Winchester Avenue Electric Railway, restraining them from using certain devices which Cheney claims belong to him. It is generally supposed that this is the next step in the litigation begun by the General Electric Company against the Westinghouse Company.

The street railway track between Beverly and Danvers, Mass., has passed into the hands of the Lynn and Boston Railroad Company.

The Swedish Electric Singers, a company of accomplished vocalists composed of employees in the General Electric Company's factories at Lynn, are to take part in the Singing Festival at the World's Fair, Chicago, July 21, 22 and 23.

Work is progressing on the extension of the Qunicy & Boston Electric Street Railway to North and East Weymouth. Hitherto the company has hired power from the local electric light company, but it has been decided to erect a large power station near Quincy Point bridge, and the undertaking will commence shortly.

The Legislative Committee on Mercantile Affairs has reported a bill to the Massachusetts Legislature in favor of placing underground all electric wires but the trolley wire, which has been omitted from the bill, it is believed, because of the opinion that the trolley wires will be entirely superseded in a few years at most.

Two recent fires in Boston played havoc with the establishments of at least three electrical concerns, and singular to say these fires occurred the same night. The building where the Electrical Forging Company has its extensive works, corner of Oliver street and Atlantic avenue, came near being gutted Sunday night about nine o'clock. The flames were extinguished but the deluge of water ruined a good deal of property. Between two and three o'clock in the morning fire was discovered in Fort Hill Square, only a block away, and before the flames could be subdued something like $100,000 damage had been done, including the utter ruin of the extensive and finely equipped laboratory of the Massachusetts Electrical Engineering Company and the works of the Shawmut Fuse Wire Company.

A length of wrought iron gas pipe was shown the writer a day or two ago that after a very short term of service underground had been entirely destroyed by electrolytic action. It was badly corroded throughout its entire length, while every two or three inches were holes from one inch to two inches long and up to three-quarters of an inch wide. When one considers the quantity of gas escaping by way of such a disintegrated pipe it is not to be wondered at that Bostonians are becoming somewhat alarmed and demand that the West End Railroad shall do something to stop the danger.

The attention of capitalists and street railway men in all parts of the country is turned to Boston at present, where the storage battery problem is being discussed by lawyers, judges, legislators and experts.

General News.

What is Going on in the Electrical World.

Boston, Mass.—Ground was broken last week for the new battery shop for the Hopedale Electric Company.

Toronto, Can.—The Toronto and Scarboro electric railway is nearly fully equipped and ready for opening.

Baltimore, Md.—The Carey Street railway has been completely equipped with electricity, and the horse cars removed.

Scranton, Pa.—The contract for the construction of the roadbed for the electric railway to Carbondale has been awarded.

Harmony Grove, Ga.—The company which is to erect cotton mills here intends to put in an electric light plant and run it in conjunction with the factory.

Buffalo, N. Y.—The American Electric Supply Company was awarded the contract for a dynamo and other electrical apparatus required by the new fire-boat.

Hoboken, N. J.—The North Hudson Railway Company have applied to the city council for permission to apply the trolley system to all their surface lines.

Rahway, N. J.—The work of constructing the electric street railway is now in progress. The road is expected to be in full operation by the 1st of August.

Carondelet, Mo.—It seems probable that the Sixth Street electric railway will be extended to Jefferson Barracks, a distance of three miles from the present terminus.

Wyandotte, Mich.—The extension of the Wyandotte and Detroit River Electric Railway from this city to Trenton will be completed about the 1st of June.

North Bergen, N. J.—The Township Committee has granted the application of the North Hudson Railway Company to run electric cars on Bergenline avenue.

Pensaukin, Pa.—The wires of the Merchantsville Electric Light Company will probably be extended to Pensaukin, in response to the demand of the people for electric light.

Montreal, Can.—At a late meeting of the directors of the Bell Telephone Company it was decided to increase the capital of the company from $2,200,000 to $2,640,000.

Jersey City, N. J.—The directors of the Jersey City and Bergen Railroad have decided to introduce electricity as a motive power on all the lines in Jersey City as soon as possible.

Kirkwood, Mo. — The Suburban Electric Lighting and Power Company of St. Louis have been granted a franchise to construct and maintain an electric plant in Kirkwood.

Quincy, Fla.—W. H. Ellis, A. L. Wilson and H. L. Shaw have been appointed to enter into communication with parties desiring to contract for furnishing electric light to this place.

Havre de Grace, Md.—A committee of council have been investigating the workings of the electric light plants in neighboring towns to aid them in determining on the establishment of a plant here.

La Junta, Col.—The plant of the electric light company was completely destroyed recently by the explosion of one of the boilers. Two of the employees were killed. The plant was valued at $20,000.

Jackson, Miss.—W. E. Hayne, of Jackson, W. R. Gravely, of New Orleans, and their associates have been granted a franchise by council to lay tracks and run electric cars in six specified streets in this city.

Ogden, Utah.—The city council has passed an ordinance extending the franchise of the Salt Lake and Ogden Electric Light and Gas Company for twenty-five years. Upon this measure depended a large number of extensive improvements.

Middletown, Md.—The prospects for the proposed electric railroad between Middletown and Frederick are brightening. The right-of-way has been secured along the national pike, and options have been obtained for the terminal points.

Pittsburg, Pa.—The Suburban Rapid Transit Company intends to extend its line to connect the South Side with White Hall, and has made a contract with the Westinghouse Electric and Manufacturing Company for a number of 30 H. P. motors for new cars.

Richmond, Va.—The Richmond Railway and Electric Company have just purchased the property known as Brown's Island, and will erect a building and remove their plant thither. Additional apparatus will be put in, and many improvements made in the equipment.

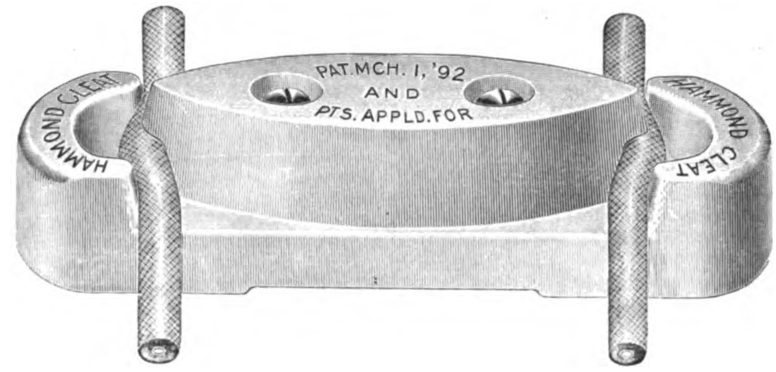
Woonsocket, R. I.—When the street railway lines in Woonsocket and Blackstone are equipped with electricity, the Blackstone line will be extended to Millville and probably to the Uxbridge town line. It is expected that the Blackstone line will be running by electricity by July 1.

Saranac Lake, N. Y.—Work on the Saranac and Lake Placid Railroad has begun, and will be completed by the middle of July. The building of this road is thought to ensure the construction of a road to the top of Whiteface Mountain. Charles E. Arnold, president of the Saratoga Electric Railroad, is to be president of the Saranac and Lake Placid line, and Jesse L. Mott will be chief engineer.

Parkersburg, W. Va.—The Parkersburg Gas and Electric Company, lately reorganized, having purchased the franchise and electric plant of the old company of the same name, will put in $12,000 in improvements. The officers elected are the same as those of the old company, viz.: President, C. H. Shattuck; vice-president, J. V. Rathbone; treasurer and secretary, J. M. Jackson, Jr.

Waukegan, Ill.—Contracts have been let for an electric street railway, for the accommodation principally of employees of the Washburn & Moen Company.—The Washburn & Moen wire works at South Waukegan are undergoing extensive improvements, adding largely to their facilities. It is generally understood that the capacity will be doubled during the present season. The smelting of copper ore and the production of copper wire with making of steel ingots is contemplated.

Bethlehem, Pa.—The Philadelphia and Allentown Electric Railway Company have awarded to Silverman & Stern, of Philadelphia, the contract to build 17½ miles of railway between Allentown and Hellertown, at $15,000 a mile, or a total of about $255,000. Work is to be begun at once and the road must be finished and in running order by September 25. They will build a single track of railway, with turnouts between the northern limits of Allentown, along Fifth street to Lawrence, to Lehigh, thence through South Allentown, Salisbury, and Aineyville, to and through South Bethlehem, Lower Saucon, and Hellertown.

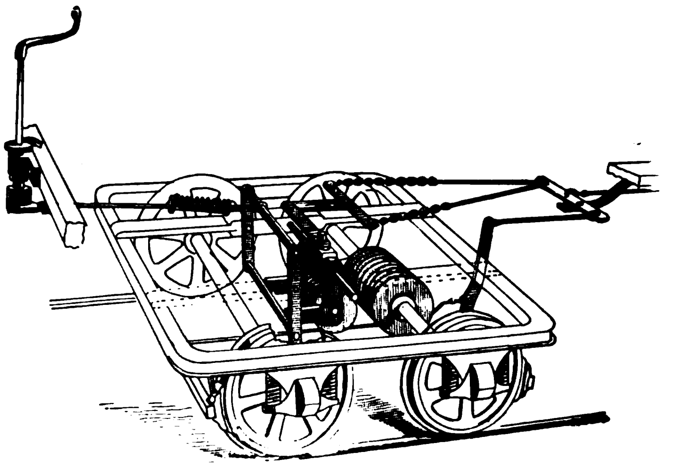


THE HAMMOND CLEAT.

The Hammond Cleat.

We publish herewith a cut of a new device that is destined to become very popular not only by reason of its own intrinsic merits which are many, but further, because it so admirably fills the conditions laid down or imposed by fire underwriters all over the country. As will be seen, this cleat is made in a single piece of the finest grade glazed porcelain, and being simplicity itself in design, it furnishes the quickest and easiest method of wiring possible. By its use the unsightly tie wire is unnecessary, and can be supplied with one, two or three openings which are adapted for receiving all the ordinary sizes of wire without injuring the insulation. Its unique character enables it to hold the wire firmly, and as the wire binds on the insulator and not on the retaining points, all breaks are avoided, and what is more the slack is easily taken up, so that by its adoption and use the neatest, safest and best kind of wiring can be done.

All who are engaged in electrical construction work will promptly and fully appreciate the foregoing advantages, which mean greater economy by saving of time and material, and the preservation of the insulation intact, a most important consideration.



THE ELLIOTT CAR BRAKE.

Although a first class device in every respect, and made of the best quality porcelain, the Hammond Cleat and Insulator Company, 220 Devonshire street, Boston, sell it at a remarkably low figure so as to bring it within the reach of all.

The Elliott Car Brake.

Although there have been innumerable car brakes invented for street cars, the form generally in use to-day is one of the oldest.

The brake invented by Mr. G. R. Elliott, of Boston, Mass., is the embodiment of simplicity and efficiency, and is constructed on sound mechanical principles.

A chilled iron cylinder having a screw thread cut upon its surface is firmly fixed upon the axle of one pair of wheels of the truck of a car; a like cylinder of smaller dimensions is hung in bearings at the lower end of a lever frame in such a manner as to bring it parallel to that upon the axle; the fulcrum of this lever frame is an iron rod having loose bearings in the woodwork of the truck frame, and with this rod the lever frame carrying the smaller screw cylinder reciprocates.

To the upper end of the lever frame is attached the rod leading to the brake handle, which rod is divided and has a spiral spring interposed at the junction in such a manner as to make the pull of the brake handle elastic.

A half turn of the brake handle draws this rod forward, causing the lower part of the lever frame which bears the small screw cylinder to move toward the larger screw cylinder fixed upon the axle of the wheels with which it engages and by which it and the lever frame carrying it are moved toward one side or the other of the car according to the direction in which the latter is moving. A link arm, one end of which is attached to the lever frame, and which moving with it is connected by its other end to the end of one arm of a three-armed rocking lever fulcrumed at the junction of its three arms and operating in such a manner that whichever direction the lever frame takes by reason of its small screw cylinder engaging with the screw cylinder on the axle, the three armed rocking lever will be moved so as to cause one of two links connecting two of its arms to an ordinary straight lever at one end of the touch frame to draw inward, thus causing the other end of the last mentioned lever to move outward carrying with it the rod connecting it with the beams of the brake shoes, and thus bringing the brake shoes against the tread of the wheels against the stress of springs which withdraw the shoes the instant the brake handle is released.

A very slight turn of the brake handle will bring the screw cylinders into engagement and the smaller cylinder will immediately begin to move in a direction at right angles to the length of the car and parallel to the axis of the axle upon which the fixed screw cylinder is located, and it will continue to move in this direction until the strain upon the brakes exceeds the pressure exerted upon the brake handle when it will disengage and fly back toward its former position, engaging again instantly with the excess of pressure, and repeating this action until the car stops. This is accomplished so rapidly that the effect upon the car is the same as would result from a continuous pressure of the brake shoes against the wheels, yet the several pressures have the effect of destroying the sudden jerk resulting from the locking of the wheels, and, while avoiding the friction and consequent flattening of the peripheries of the latter, is none the less effectual in bringing the car to a stop.

While putting on the brakes turns off the current, throwing off the brakes does not turn on the current, but leaves the car at a stand-still until the motor man chooses to start it, when the brakes are in a position not to retard its progress. It is also equally adapted to horse cars.

Considering the fact that the greatest power necessary under any circumstances only requires that the brake handle be turned one-half of a revolution, it is clear that the action of the brake is almost if not quite instantaneous, and that its lack of the rigid characteristics of the ordinary brakes makes the wear upon the wheels uniform.

Removal Notice.

We beg to inform our customers that owing to the recent fire in our office and factory at 161 and 163 High street, we have been obliged to remove our office temporarily to 85 Water street, and our factory and storeroom to 54 Pearl street, Boston.

We are well equipped in our new quarters, and shall have no difficulty in giving orders our usual prompt attention.

Thanking our customers for past patronage, we remain,

Yours very truly,

Shawmut Fuse Wire Company.

The Curtis Motor.

A trial of the Curtis railway motor has lately been made on the Morris Cove Road. New Haven, Conn. The trial was a thorough success, and the directors of the road, who were present, expressed their satisfaction. It is probable that the new motors will be placed on all the cars of this line, including the Winchester avenue branch.

COMMERCIAL PARAGRAPHS.

That there is merit in the Sterling Water Tube Safety Boiler is proven by the fact that during the last twelve months the company has sold 58,000 porse power, a showing that compares favorably with any boiler now on the market. And that the public is appreciating the high character of these boilers more and more is further proved by the fact that from the 5th to the 12th day of the present month of May no less than 4,000 horse power were sold. Mr. J. Bradford Sargent, 620 Atlantic avenue, Boston, who represents this popular boiler in the East, reports that the outlook for future business is even more promising than the past.

Since opening their new and commodious factory on Dover street, Boston, the Electric Gas Lighting Company has been in far better form than ever before for handling its ever growing business, but with increased facilities has come an increased demand for its varied specialties, with the result that already a feeling begins to be felt in every department as if partition walls were in the way, or additional floors would have to be leased ere long, if the demand continues as at present.

The Brown Electric Company, whose attractive and well stocked store, corner of Federal and Summer streets, Boston, contains about everything of an electrical nature, reports business as first-class in every department. This company is being appointed agent for several new electrical devices and is pushing them successfully.

The Consolidated Electric Manufacturing Company will have another of its unique 60-arc light machines, equipped with Elkins automatic regulator, running in its factory next week. Those already sold and in service to-day are making an excellent record for themselves.

Mr. G. W. (Happy) Adams, whom everybody knows as the genial manager of the Boston Electric Protective Association, which takes care of nearly $100.000.000 worth of property in Boston alone, has recently secured a patent on a watchman's lock which comes as near being perfection as any one could wish.

The Boston Motor Company, 17 Battery March street, Boston, has received the following letter from the proprietors of that popular paper, *The Youth's Companion:*

Gentlemen: We have carefully examined and tested the $1.00 motor which you manufacture and believe it to be superior to any other low priced motor now on the market. Our patent attorney has also completed his examinations and pronounces your claims valid and strong. We shall now be pleased to offer your motor as a premium in our premium list. Very truly,

Perry, Mason & Co.

The new W.-W. Lightning Arrester is gaining the best of success, and the Ansonia Electric Company, formerly the Electrical Supply Company, are prepared to furnish them in large quantities on short notice.

The Ansonia Electric Company, formerly the Electrical Supply Company, recently secured an order for the entire equipment of the Columbia [Missouri] plant for Stanley Transformers.

The recently organized firm of Acker & Loveland have moved into offices in the Monadnock Building, Chicago, and are now making a specialty of the General Incandescent Arc Light Company's lamps in the West and Southern States. They also have a number of second hand dynamos for sale.

The firm of Cutler & Hammer of Chicago have just received the contract for building the complete switchboard equipment, consisting of indicators, rheostats and switches for the American Storage Battery Company's factory which has recently been built. The C. & H. firm have also built the switchboard for the Columbus Building, one of Chicago's new sixteen story buildings.

The exhibit of magnet, line and rubber covered wire in the Ansonia Electric Company's booth at the World's Fair will give their customers some idea of the complete line of wire which they carry.

A handsome specimen of artistic work is the new catalogue of the Interior Conduit and Insulation Company. In addition to a description of the many devices applicable to interior wiring, the catalogue contains complete specifications for the installation of the Interior Conduit system and also a code for customers who may wish to order by telegraph or cable. The Johnson switch, the Lundell motor and all devices are constructed to conform to standards and are particularly applicable to the Edison system of distribution. As it is practically impossible to catalogue at any given time all the improvements and new developments, the Interior Conduit and Insulation Company therefore respectfully solicit inquiry as to any device, method or apparatus which may not appear in the catalogue before excluding them from the opportunity of supplying the same.

The Railway Equipment Company of Chicago have issued an elaborate catalogue, giving specific information to intending purchasers in this line. The list of supplies carried by this company includes everything needed for a complete equipment.

INCORPORATIONS.

The Piqua Electric Railway Company, Piqua, Ohio. Capital stock, $100,000.

North Chicago Electric Railway Company, to construct, lease, and purchase and operate horse, dummy and street railroads in Chicago and Cook County, Ill. Capital stock, $2,000,000. Incorporators: Charles H. Gurney, John E. Burke and Alexander M. Savage.

The Pumpelly-Sorley Storage Battery Company, Chicago. Capital stock, $500,000. Incorporators: Harriet M. Gibbs, Jessie Rowe, George H. Jenney.

The Frederick and Middletown Electric Railway Company, to erect an electric railway for passenger and freight traffic between Frederick and Middletown, Md. Capital stock, $125,000. Incorporators: L. N. Downs and Livingston Norman, of New York City; T. E. Bowne, of Brooklyn; George William Smith, C. V. S. Levy, U. A. Sharretts and E. L. Miller, of Frederick.

The Northwestern Electrical Manufacturing Company, at Milwaukee. Capital stock, $10,000. Incorporators: John Z. Westervelt, Daniel L. Case and Lee Peck.

The West Jersey Traction Company has filed articles of incorporation in Camden for the purpose of running a network of rapid transit trolley lines throughout Camden and Burlington Counties, N. J. The capital stock of the company is placed at $3,000,000. The incorporators are Heulings Lippincott, of the National State Bank, Camden; Howard Parry, of Cinnaminson; Mitchell B. Perkins and Henry Van Brunt, of Beverly; Samuel E. Stokes, Charles Tomlinson, George A. Aldrich, Dillwyn Wistar and John P. Logan, of Philadelphia.

The Monmouth County Sea Shore Electric Railway Company is about to file articles of incorporation with the county clerk at Freehold, N J. The capital stock of the company is $1,500,000, and J. C. Shafer, president of the Sea Shore Electric Railway, is said to be the leading spirit in the enterprise. The road contemplated will extend from Pleasure Bay, near Long Branch, to Point Pleasant, passing through Long Branch, West End, Elberon, Deal Beach, Loch Arbor, North Asbury Park, Asbury Park, Ocean Grove, Key East, Belmar, Spring Lake, Como and Point Pleasant.

The Texas Electric Burglar and Fire Alarm Manufacturing Company of Corsicana, Texas. Capital stock, $50,000. Incorporators: A. C. Sloan, A. T. Wood, B. Zadex and J. Schwartz.

The Waco Electric Railway and Light Company of Waco, Texas, has filed an amended charter increasing the capital stock to $300,000.

The Cincinnati and Covington Electric Railway Company, Covington, Ky. Capital stock, $25,000. Incorporators: F. P. Helm, John Dorsel, J. H. Mersman, J. J. Dulaney, W. B. Wilson, B. E. Talbott, O. J. Carpenter.

The Utica Subway Company of Utica, N. Y., to construct, excavate and maintain subways, ducts and conduits for laying, containing, holding and conducting telegraph, telephone, electric light, fire alarm, police and other wires, and electrical conductors underground, in the streets and highways of the city of Utica. Capital stock, $10,000. Directors: William B. Crouse, John R. Baxter, Thos. F. Baker, Clifford F. Marklove, Charles W. Mather, William W. Fowler, Horatio S. Moore and Francis M. Kendrick.

ELECTRICAL PATENT RECORD.

Letters Patent Issued May 16, 1893

ELECTRIC RAILWAYS AND APPLIANCES.

497,337. Overhead Electric Railway. William D. Patterson, Keokuk, Iowa. Filed Nov. 1, 1892.

497,356. Electric-Car Truck. George S. Strong, New York, N. Y., assignor to James N. Gamble, Cincinnati, Ohio. Filed Jan. 25, 1892.

497,377. Trolley for Conduit-Railways. Paul C. Just, Chicago, Ill. Filed April 20, 1892.

497,394. Conduit Electric Railway. George Westinghouse, Jr., Pittsburg, Pa. Filed April 8, 1892.

497,408. Electric-Railway Signal. William H. Jordan, Brooklyn, N. Y. Filed Sept. 10, 1892.

497,436. Sectional Contact-Conductor for Electric Railways. George Westinghouse, Jr., Pittsburg, Pa. Filed April 11, 1892.

497,585. Closed Conduit for Electric Railways. Archibald J. Martin, Philadelphia, Pa. Filed Sept. 13, 1892.

ELECTRIC LIGHTS AND APPLIANCES.

497,438. Arc Electric Lamp. John C. Wray, Peoria, Ill. Filed March 21, 1892.

497,450. Electric-Arc Lamp. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Sept. 22, 1892.

497,491. Automatic Cut-Out for Electric Light Circuits. Charles Cuno, Wauwatosa, Wis. Filed April 16, 1892.

497,494. Electric-Arc Lamp. James Einstein, Munich, Germany, assignor to Paul Lemaire, New York, N. Y. Filed Nov. 23, 1892.

497,558. Electric-Arc Lamp. Frank H. Thompson, Philadelphia, Pa. Filed Jan. 19, 1892.

DYNAMOS AND MOTORS.

497,361. Commutator Brush-Holder for Dynamo-Electric Machines. Elihu Thomson, Swampscott, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Nov. 2, 1891.

497,468 Dynamo-Electric Machine or Motor. Walter K. Freeman, Boston, Mass. Filed Nov. 3, 1892.

TELEPHONE AND TELEGRAPH APPARATUS.

497,335. Manufacture of Telephone Cables. William R. Patterson, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Aug. 24, 1891.

497,649. Magneto-Telephone. James P. Freeman, Washington, D. C., assignor to Marvin C. Stone, same place. Filed May 16, 1892.

MEASURING INSTRUMENTS.

497,448. Galvanometer. Adrian H. Hoyt, Manchester, N. H., assignor to the Whitney Electrical Instrument Company, same place. Filed May 9, 1892.

497,449. Galvanometer. Adrian H. Hoyt, Manchester, N. H.; assignor to the Whitney Electrical Instrument Company, same place. Filed May 9, 1892.

497,521. Electric Measuring-Instrument. Adrian H. Hoyt, Manchester, N. H., assignor to the Whitney Electrical Instrument Company, Saco, Me. Filed Nov. 14 1891.

497,522. Galvanometer. Adrian H. Hoyt, Manchester, N. H., assignor to the Whitney Electrical Instrument Company, Saco, Me Filed Nov. 14, 1891.

497,539. Electrical Measuring-Instrument. Oscar Frolich, Berlin, Germany, assignor to Siemens & Halske, same place. Filed Oct. 25, 1892.

MISCELLANEOUS.

497,310. Automatic Disconnector. William A. Cullen, Paterson, N. J., assignor to the Johnston Safe Automatic Electric Company, Richmond, Va. Filed Jan. 28, 1893.

497,331. Automatic Time-Stamp. Warren B. Martindale, Rochester, Ind. Filed June 30, 1892.

497,336. Insulating-Tape. William R. Patterson, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Aug. 24, 1891.

497,366. Rheostat. Parvin Wright, Denver, Col. Original application filed Jan. 16, 1892. Divided and this application filed Aug. 8, 1892.

497,397. Lightning-Arrester. Alexander Wurts and Chas. F. Scott, Pittsburg, Pa., assignors to the Westinghouse Electric and Manufacturing Company, same place. Filed Oct. 26, 1892.

497,404. Electric Cigar-Lighter. William P. Carstarphen, Jr., Denver, Col., assignor of two-thirds to James E. Gregg, same place, and Richard W. Webb, Santa Fe, N. Mex. Filed Aug. 17, 1892.

497,411. Push-Button Switch. Fred S. McGregory, Revere, assignor to John M. Orford, Boston, Mass. Filed Jan. 21, 1893.

497,430. Circuit-Protector. Harry W. Leland, Jersey City, N. J. Filed Aug. 6, 1892.

497,482 Shunt for Electric Light and Power Stations. Edward Weston, Newark, N. J. Filed Nov. 28, 1892.

497,489. Circuit-Controlling Device. John P. Buchanan, Boston, Mass., assignor to the Hall Signal Company of Maine. Filed Oct. 15, 1891. Renewed Oct. 22, 1892.

497,495. Electric Kink. Midbury V. Hassan, Rochester, N. Y. Filed May 28, 1891.

497,507. Lightning-Arrester. Alexander Wurts, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, same place. Filed Dec. 22 1892.

497,508. Lightning-Arrester. Alexander Wurts, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, same place. Filed Dec. 22, 1892.

497,509. Lightning-Arrester. Alexander Wurts, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, same place Filed Dec. 22, 1892.

497,515. Insulator. Thomas H. Brady, New Britain, Conn. Filed Jan. 16, 1893.

497,535. Process of Manufacturing Electric-Conduit Sections. James F. Cummings, Detroit, Mich. Filed July 12 1892.

497,536. Underground Conduit for Electrical Conductors. James F. Cummings, Detroit, Mich. Filed July 28, 1892.

497,552. System of Conductors for Electric Fire-Engines. Joseph Sachs, New York, N. Y. Filed May 26, 1892.

497,563. Electric Pump-Governor. Charles R. Whittier, New York, N. Y. Filed Aug. 8, 1892.

497,621. Process of Electro-Tin-Plating. Louis Aronson, New York, N. Y., assignor of one-half to James H. Hoffman, same place. Filed Jan 31, 1893.

497,680. Safety Cut-Out Apparatus for Networks of Multiple Electrical Conductors. Paul Nordmann, Berlin, Germany, assignor to Siemens & Halske, same place. Filed Nov. 25, 1892.

497,755. System of Electrical Distribution. Waldemar Meissner, Konigsberg, Germany, assignor to Siemens & Halske, Berlin, Germany. Filed Oct. 23, 1889.

497,756. Circuit Switch. Ernst Woltmann and Harry A. Triggs, Denver, Colo., assignors to the Electrical Specialty Company, same place. Filed Jan. 17, 1893.

ELECTRICITY.

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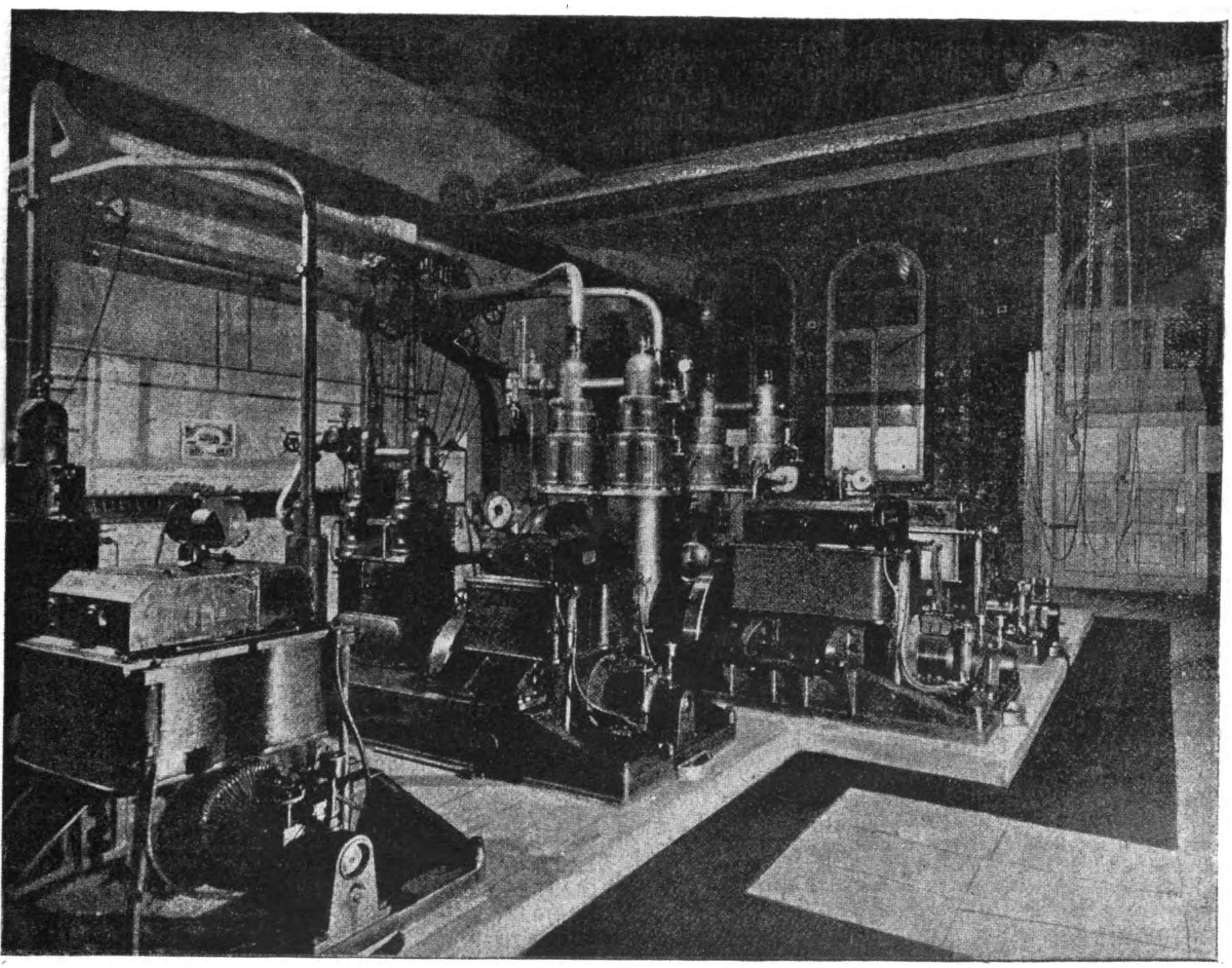

DYNAMO ROOM, HULL CORPORATION SUPPLY. (See Page 271.)

ON LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.

INTRODUCTORY—SOME THOUGHTS ON THE EYE.

BY NIKOLA TESLA.*

When we look at the world around us, on Nature, we are impressed with its beauty and grandeur. Each thing we perceive, though it may be vanishingly small, is in itself a world, that is, like the whole of the visible universe, matter and force governed by law—a world, the contemplation of which fills us with feelings of wonder and irresistibly urges us to ceaseless thought and inquiry. But in all this vast world, of all objects our senses reveal to us, the most marvelous, the most appealing to our imagination, appears no doubt a highly developed organism, a thinking being. If there is anything fitted to make us admire Nature's handiwork, it is certainly this inconceivable structure, which performs its innumerable motions in obedience to external influence. To understand its workings, to get a deeper insight into this Nature's masterpiece, has ever been for thinkers a fascinating aim, and after many centuries of arduous research men have arrived at a fair understanding of the functions of its organs and senses. Again, in all the perfect harmony of its parts, of the parts which constitute the material or tangible of our being, of all its organs and senses, the eye is the most wonderful. It is the most precious, the most indispensable of our receptive or directive organs; it is the great gateway through which all knowledge enters the mind. Of all our organs, it is the one which is in the most intimate relation with that which we call intellect. So intimate is this relation that it is often said that the very soul shows itself in the eye.

It can be taken as a fact, which the theory of the action of the eye implies, that for each external impression, that is, for each image produced upon the retina, the ends of the visual nerves, concerned in the conveyance of the impression to the mind, must be under a peculiar stress or in a vibratory state. It now does not seem improbable that, when by the power of thought an image is evoked, a distinct reflex action, no matter how weak, is exerted upon certain ends of the visual nerves, and therefore upon the retina. Will it ever be within human power to analyze the condition of the retina when disturbed by thought or reflex action, by the help of some optical or other means of such sensitiveness that a clear idea of its state might be gained at any time? If this were possible, then the problem of reading one's thoughts with precision, like the characters of an open book, might be much easier to solve than many problems belonging to the domain of positive physical science, in the solution of which many, if not the majority, of scientific men implicitly believe. Helmholtz has shown that the fundi of the eyes are themselves luminous, and he was able to *see*, in total darkness, the movement of his arm by the light of his own eyes. This is one of the most remarkable experiments recorded in the history of science, and probably only a few men could satisfactorily repeat it, for it is very likely that the luminosity of the eyes is associated with uncommon activity of the brain and great imaginative power. It is fluorescence of brain action, as it were.

Another fact having a bearing on this subject which has probably been noted by many, since it is stated in popular expressions, but which I cannot recollect to have found chronicled as a positive result of observation, is, that at times, when a sudden idea or image presents itself to the intellect, there is a distinct and sometimes painful sensation of luminosity produced in the eye, observable even in broad daylight.

The saying, then, that the soul shows itself in the eye is deeply founded, and we feel that it expresses a great truth. It has a profound meaning even for one who, like a poet or artist, only following his inborn instinct or love for Nature, finds delight in aimless thoughts and in the mere contemplation of natural phenomena, but a still more profound meaning for one who, in the spirit of positive scientific investigation, seeks to ascertain the causes of the effects. It is principally the natural philosopher, the physicist, for whom the eye is the subject of the most intense admiration.

Two facts about the eye must forcibly impress the mind of the physicist, notwithstanding he may think or say that it is an imperfect optical instrument, forgetting that the very conception of that which is perfect, or seems so to him, has been gained through this same instrument. Firstly, the eye is, as far as our positive knowledge goes, the only organ which is *directly* affected by that subtle medium which, as science teaches us, must fill all space; secondly, it is the most sensitive of our organs, incomparably more sensitive to external impressions than any other.

The organ of hearing implies the impact of ponderable bodies, the organ of smell the transference of detached material particles, and the organs of taste and of touch or force the direct contact, or at least some interference of ponderable matter; and this is true even in those instances of animal organisms in which some of these organs are developed to a degree of truly marvelous perfection. This being so, it seems wonderful that the organ of sight solely should be capable of being stirred by that which all our other organs are powerless to detect, which yet plays an essential part in all natural phenomena, which transmits all energy and sustains all motion and, that most intricate of all, life, but which has properties such that even a scientifically trained mind cannot help drawing a distinction between it and all that is called matter. Considering merely this, and the fact that the eye, by its marvelous power, widens our otherwise very narrow range of perception far beyond the limits of the small world which is our own, to embrace myriads of other worlds, suns and stars in the infinite depths of the universe, would make it justifiable to assert that it is an organ of a higher order. Its performances are beyond comprehension. Nature, as far as we know, never produced anything more wonderful. We can get barely a faint idea of its prodigious power by analyzing what it does and by comparing. When ether waves impinge upon the human body, they produce the sensations of warmth or cold, pleasure or pain, or perhaps other sensations of which we are not aware, and any degree or intensity of these sensations, which degrees are infinite in number, hence an infinite number of distinct sensations. But our sense of touch, or our sense of force, cannot reveal to us these differences in degree or intensity unless they are very great. Now we can readily conceive how an organism such as the human, in the eternal process of evolution, or more philosophically speaking adaptation to Nature, being constrained to the use of only the sense of touch or force, for instance, might develop this sense to such a degree of sensitiveness or perfection that it would be capable of distinguishing the minutest differences in the temperature of a body even at some distance, to a hundredth, or thousandth, or millionth part of a degree. Yet, even this apparently impossible performance would not begin to compare with that of the eye, which is capable of distinguishing and conveying to the mind in a single instant innumerable peculiarities of the body, be it in form or color or other respects. This power of the eye rests upon two things, namely, the rectilinear propagation of the disturbance by which it is affected, and upon its sensitiveness. To say that the eye is sensitive is not saying anything. Compared with it all other organs are monstrously crude. The organ of smell which guides a dog on the trail of a deer, the organ of touch or force which guides an insect in its wanderings, the organ of hearing, which is affected by the slightest disturbance of the air, are sensitive organs, to be sure, but what are they compared with the human eye! No doubt it responds to the faintest echoes or reverberations of the medium; no doubt it brings us tidings from other worlds infinitely remote, but in a language we cannot as yet always understand. And why not? Because we live in a medium filled with air and other gases, vapors and a dense mass of solid particles flying about. These play an important part in many phenomena; they fritter away the energy of the vibrations before they can reach the eye; they, too, are the carriers of germs of destruction, they get into our lungs and other organs, clog up the channels and imperceptibly yet inevitably arrest the stream of life. Could we but do away with all ponderable matter in the line of sight of the telescope it would reveal to us undreamt of marvels. Even the unaided eye, I think, would be capable of distinguishing in the pure medium small objects at distances measured probably by hundreds or perhaps thousands of miles.

But there is something else about the eye which impresses us still more than these wonderful features which we observe, viewing it from the standpoint of a physicist, merely as an optical instrument—something which appeals to us more than its marvelous faculty of being directly affected by the vibrations of the medium, without interference of gross matter, and more than its inconceivable sensitiveness and discerning power. It is its significance in the processes of life. No matter what one's views on Nature and life may be, he must stand amazed when, for the first time in his thoughts, he realizes the importance of the eye in the physical processes and mental performances of the human organism. And how could it be otherwise, when he realizes that the eye is the means through which the human race has acquired the entire knowledge it possesses, that it controls all our motions—more still, all our actions.

There is no way of acquiring knowledge except through the eye. What is the foundation of all philosophical systems of ancient and modern times, in fact of all the philosophy of man? *I am, I think; I think, therefore I am.* But how could I think and how would I know that I exist if I had not the eye? For knowledge involves consciousness; consciousness involves ideas, conceptions; conceptions involve pictures or images, and images the sense of vision, and therefore the organ of sight. But how about blind men will be asked? Yes, a blind man may depict in magnificent poems forms and scenes from real life, from a world he physically does not see. A blind man may touch the keys of an instrument with unerring precision, may build the fastest boat, may discover and invent, calculate and construct, may do still greater wonders—but all the blind men who have done such things have descended from those who had seeing eyes. Nature may reach the same result in many ways. Like a wave in the physical world, in the infinite ocean of the medium which pervades all, so in the world of organisms, in life, an impulse started proceeds onward, at times may be with the speed of light, at times again so slowly that for ages and ages it seems to stay, passing through processes of a complexity inconceivable to man, but in all its forms, in all its stages, its energy, ever and ever integrally present. A single ray of light from a distant star falling upon the eye of a tyrant in bygone times may have altered the course of his life, may have changed the destiny of nations, may have transformed the surface of the globe, so intricate, so inconceivably complex are the processes of Nature. In no way can we get such an overwhelming idea of the grandeur of Nature as when we consider that in accordance with the law of the conservation of energy, throughout the infinite, the forces are in a perfect balance, and hence the energy of a single thought may determine the motion of a universe. It is not necessary that every individual, not even that every generation or many generations, should have the physical instrument of sight in order to be able to form images and to think, that is, form ideas or conceptions; but sometime or other, during the process of evolution, the eye certainly must have existed, else thought, as we understand it, would be impossible; else conceptions, like spirit, intellect, mind—call it as you may—could not exist. It is conceivable that in some other world, in some other beings, the eye is replaced by a different organ, equally or more perfect, but these beings cannot be men.

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* A lecture delivered before the Franklin Institute at Philadelphia, Feb. 24, 1893, and before the National Electric Light Association at St. Louis, Mo., March 1, 1893.

Now what prompts us to all voluntary motions and actions of any kind? Again the eye. If I am conscious of the motion, I must have an idea or conception, that is, an image, therefore the eye. If I am not precisely conscious of the motion, it is because the images are vague or indistinct, being blurred by the superimposition of many. But when I perform the motion, does the impulse which prompts me to the action come from within or from without? The greatest physicists have not disdained to endeavor to answer this and similar questions, and have at times abandoned themselves to the delights of pure and unrestrained thought. Such questions are generally considered not to belong to the realm of positive physical science, but will before long be annexed to its domain. Helmholtz has probably thought more on life than any modern scientist. Lord Kelvin expressed his belief that life's process is electrical and that there is a force inherent to the organism and determining its motions. Just as much as I am convinced of any physical truth I am convinced that the motive impulse must come from the outside. For, consider the lowest organism we know—and there are probably many lower ones—an aggregation of a few cells only. If it is capable of voluntary motion it can perform an infinite number of motions, all definite and precise. But now a mechanism consisting of a finite number of parts and few at that, cannot perform an infinite number of definite motions, hence the impulses which govern its movements must come from the environment. So, the atom, the ulterior element of the universe's structure, is tossed about in space eternally, a play to external influences, like a float in a troubled sea. Were it to stop its motion *it would die.* Matter at rest, if such a thing could exist, would be matter dead. Death of matter! Never has a sentence of deeper philosophical meaning been uttered. This is the way in which Prof. Dewar forcibly expresses it in the description of his admirable experiments, in which liquid oxygen is handled as one handles water, and air at ordinary pressure is made to condense and even to solidify by the intense cold—experiments which serve to illustrate, in his language, the last feeble manifestations of life, the last quiverings of matter about to die. But human eye shall not witness such death. There is no death of matter, for throughout the infinite universe all has to move, to vibrate—that is, to live.

I have made the preceding statements at the peril of treading upon metaphysical ground in my desire to introduce the subject of this lecture in a manner not altogether uninteresting, I may hope, to an audience such as I have the honor to address. But now then, returning to the subject, this divine organ of sight, this indispensable instrument for thought and all intellectual enjoyment, which lays open to us the marvels of this universe, through which we have acquired what knowledge we possess, and which prompts us to, and controls, all our physical and mental activity. By what is it affected? By light! What is light?

We have witnessed the great strides which have been made in all departments of science in recent years. So great have been the advances that we cannot refrain from asking ourselves, Is this all true, or is it but a dream? Centuries ago men lived, thought, acted, discovered, invented, and believed that they were soaring, while they were merely proceeding at a snail's pace. So we too may be mistaken. By taking the truth of the observed events as one of the implied facts of science, we must rejoice in the immense progress already made and still more in the anticipation of what must come judging from the possibilities opened up by modern research. There is, however, an advance which we have been witnessing, which must be particularly gratifying to every lover of progress. It is not a discovery, or an invention, or an achievement in any particular direction. It is an advance in all directions of scientific thought and experiment. I mean the generalization of the natural forces and phenomena, the looming up of a certain broad idea on the scientific horizon. It is this idea, which had, however, long ago taken possession of the most advanced minds, to which I desire to call your attention, and which I intend to illustrate, in a general way, in these experiments, as the first step in answering the question "What is light?" and to realize the modern meaning of this word.

(To be continued.)

Hull Corporation Supply.

The Frontispiece which represents the engine and dynamo room of the Hull Corporation Supply, recently described in the *Electrical Review*, London, is 48 feet long and 32 feet wide and contains four combinations of Willans engines and Siemens dynamos. Two of these give 150 volts at 300 amperes each, and the other two 115 volts at 1,000 amperes, and foundations have been laid for the addition of two more installations of the latter units. The entire room is spanned by a traveling crane to facilitate the setting up of the machinery.

The station is supplied with a battery house, situated over the boiler room, with two batteries of 120 31 plate cells. Each battery is capable of discharging 250 amperes in case of emergency, although their best working discharge is about 100 amperes. It is said that during the first three years of working the annual depreciation on this type of accumulators has been found in practice not to exceed two per cent.

The Electric Light at Munich.

The Communal Government of the City of Munich have resolved to introduce the electric light for the principal streets, and for this purpose about 300 arc lamps of various powers are being erected. As well as these there will be the electric lighting of the Town Hall which will take 1,800 glow lamps of 16 C. P. Water power is to be used. This installation is stated to be the first in Germany in which the lighting will not be confined to a few streets, but will extend over a much larger area. It is expected that soon the installation will be extended to double its present dimensions. The work is to be in operation by October. Messrs. Schuckert & Company, the well known firm of Nuremberg, are the contractors.

Electric Heating.

BY CARL K. MAC FADDEN.*

The fact that an electric current when passing through a resisting conductor will generate heat has been known for years. During the past thirty years it has been applied to an ever increasing extent in the manufacture of heating devices used in almost an unlimited number of ways. It remained, however, for the electric street railway to open up the field for heating. The fact that there has been issued during the past two years and a half over eighty per cent. of the total number of patents on heating devices shows conclusively that the influences which have made themselves felt during the past few years in the general development of electrical apparatus has not left heating behind in the list of improvement.

The first patents issued on electric heaters were taken out in the fifties, and a few years later several were taken out on an oil well heater for melting paraffine and other obstructing material from the bore of oil wells. It appears that, after oil has been flowing from a well for some time, a large accumulation forms at the bottom which, unless removed, will lessen or completely cut off the supply. Nitro-glycerine was the agent usually employed to loosen up these deposits, but it would seem that an electric heating device in the form of a pointed elongated cylinder would melt out the obstruction, and that this method was used to some extent in the oil regions of Pennsylvania. Patents taken out between 1860 and 1870 show that the idea of placing an electrical conductor in contact with an insulated heat conductor having a relatively larger radiating surface than the electric conductor had been thought of and applied in a number of ways. In the patent specifications filed between these dates platinum is spoken of as a conductor; it evidently being thought necessary to raise the wire to quite a high temperature, therefore platinum was chosen on account of its high melting point.

There are to-day in the neighborhood of 150 patents on electric heaters, which alone goes to show that considerable attention has been paid them by the inventors. A very large number of these patents apply to the heating of cars. One of the earliest applications for patents on electric heating apparatus, filed in 1869 by Burton, specifies that one of the largest applications of this particular heater for which patent is applied is that of "heating railway carriages by means of heated metallic plates placed under the feet of passengers."

There are a great many inventions, however, that are extremely practical, and as this branch of work progresses will, no doubt, be brought out and become marketable articles.

To one who has not investigated the remarkable differences in the carrying capacity of a wire when provided with various means of radiating its heat, it will appear astonishing to see a wire carrying safely several times the current that would fuse it in open air. The principle of all well known heaters is that of placing a good heat conductor, having a large radiating surface, in intimate contact with the electric heating conductor; and there is little doubt that, inasmuch as nearly all serviceable heaters depend upon this principle, the advantages of one make over another will be more in the line of mechanical details of construction than in efficiency. If the heater is made unusually heavy and contains a large amount of heat-conducting material, it will reach its final maximum temperature much slower than one that is built with its heat conductor or reservoir of lighter and thinner material. It may appear immediately after starting both heaters that the latter is not efficient, but if the amount of energy taken up and the radiating surface is the same in both, it will be found that although the heavier heater heats much more slowly than the lighter one, it will hold its heat and remain in a highly heated condition for a longer time after the current is turned off than the lighter heater.

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* Read before the Chicago Electric Club.

As before mentioned, the electric railway opened up the field for electric heating. The first Sprague road in Richmond, Virginia, was equipped with electric heaters. It has been shown many times that the cost of operating electric heaters on electric roads stands on a par with coal when consideration is made for the value of space that the coal stove generally takes. The electric heaters are generally placed in four or more places in the car where they will be out of the way of passengers when seated, and in such a position that they will at the same time throw their heat into the body of the car. There has been considerable discussion in regard to the amount of current necessary to keep a car warm in cold weather. Reports from roads operating in Northern Michigan and in other portions of the United States and Canada, where the winters are unusually cold, show that from 1,200 to 1,500 watts is sufficient current to keep the average sixteen foot car warm in all kinds of weather. It will be seen that inasmuch as the heaters require no attention whatever, and are practically a fixture of the car, the cost of maintaining and operating on the average electric road will be simply the cost of current. Coal stoves take from twenty to forty cents per day to operate if the least account is taken of time used to keep them in heating condition. The coal stove also takes up room for one or more passengers while it remains in the car, which, on a road doing a good business, is a very important item. Coal stoves, too, on cold days, when being heated unusually warm, become so hot that it is often impossible to stand immediately in front of the stove without burning the clothing of the person standing near.

The electric heaters, being placed under the seats out of the way, and furnishing a lower temperature, cannot be objected to on this score, and being entirely out of the way of passengers, and taking up no space in the car which can be utilized to bring in dividend, often saves in a day more than the entire cost of the current furnished them for the day's run.

There are many times in spring and fall when the mornings and evenings are cool and the middle of the day warm, when a heated car for a few hours each day would add greatly to the comfort of passengers. With coal stoves this is often impossible, unless the car can be taken out of service long enough to have a fire rebuilt in the stove. The many testimonials received from the officials in charge of some of the largest roads cannot leave one in doubt as to the way the public appreciates this method of heating.

If we assume that the only cost of running electric heaters is that of the extra amount of coal burned at the power house, there is no opportunity for argument as to the cheapest method of heating electric railway cars, even when not taking into consideration the convenience and gain in car space by the use of electric heaters.

The total cost of one net horse power at the engine on a plant with an average output of 500 electrical horse power is about six-tenths of a cent per hour. The cost of an electrical horse power hour will be found in this same plant to be about one cent. It will be seen from these figures that the total cost of operating electric heaters will be in the neighborhood of two cents per hour.

I believe that it is just as fair to both sides of the question to assume that the fireman and engineer will not be called on for near as much additional work to furnish current for electric heaters as the street car conductor and other helpers whose time is wholly or partly taken up in attending to coal stoves. In one road which has come under the notice of the writer, a man is paid $1.50 a day to take care of stoves on fourteen cars. This man has no other work to do, with the exception of oiling a few switches near his work. I understand that the man works twelve hours a day, and that the cars run twenty. We may assume that there is at least from 10 to 15 cents a day spent in labor in tending these stoves, the conductor's time not being included. The cost of coal in such a stove will be in the neighborhood of 20 cents when operating twenty hours a day, with coal at $8 per ton. The stove used is open to the same objections that all coal stoves have on electric cars. I assume that electric heaters on these cars could without doubt lower the cost of heating. Under these conditions, as they now stand on this road, the cost of heating during the past winter was far less than in the preceding winter. In many instances coal has to be carried from the power station, or some other point, to the terminus of the line where the cars lay over before starting on their trips. This hauling should be taken in as an item of expense connected with the use of coal stoves.

Street railway companies seldom take account of the cost of operating the two series of incandescent lamps usually found in lighting street railway cars. This lighting takes at least one-third of the energy which might be used for heating.

In a great many estimates which have been made in regard to the cost of coal stoves on electric roads, items have been left out which, when added to the cost of the coal, will bring the actual cost of heating a car on a cold winter day at about the figures to heat the same car by means of electricity. The average life of a street car stove is about three years, and the repairs on even the best make of stoves will be found to amount to a considerable sum before the stove is ready to be abandoned. It also takes time to put these stoves in position and to remove them at the end of the season. It is a well known fact that there are few cars heated by means of stoves that do not have a layer of dust deposited in the car each time the stove is filled or shaken. A deposit of ashes and coal dust five or six times a day on a finely upholstered car soon starts the foundation for an upholsterer's bill, which, of course, on a road equipped with electric heaters, should be a smaller item of expense than on a stove-heated road.

Much has been said in the past in regard to burnouts and other difficulties which occur in the use of electric street car heaters. I believe, however, that with the experience gained in this line by those who have made this branch of work a specialty the failures from such causes as have made trouble in the past will be practically unheard of in the future.

It is by no means an unheard of thing for a coal stove to set barns or cars on fire; a thing which with a properly installed electric heater would be impossible to occur. When properly installed they cannot possibly injure wood-work in the car by excessive heat. There are few street railway companies using stoves for heating that do not find the cost of extra finishing and painting each year, caused by scorched varnish and wood-work around the stovepipe as it leaves the car, to be such as to make quite an additional item to the maintenance of car bodies.

Where power is cheap and coal is dear, which is a condition often met with in mountainous districts supplied with water power, electricity will necessarily play quite a part in heating.

A Pelton water wheel, when running under a large head of water, such as is met with in the Western mountainous districts, can be harnessed to a little mountain stream and develop enough current to heat and furnish power for a small factory with practically no cost except attendance and depreciation.

Under such conditions as these electricity could be used to great advantage for heating purposes even quite a distance from the generating station. There are other places in the West where power is guaranteed the year round at $10 per horse power from turbines. These figures may, of course, be exceptionally low as compared with water power in the Eastern States, and, at the same time, I might say that there are many places in the West where even $10 per horse power would be considered a high figure, power being obtained the year round at $6 to $9 per horse power, delivered at the turbine. Many mines in the West are equipped with large water powers, and could use electric heating to great advantage in keeping certain exposed portions of the power plant at a comfortable temperature. This branch of work has been taken up to some extent already, and, inasmuch as the mine equipped with water power does not depend on coal for its motive power, any coal used for heating would cost even more in the quantities in which it would be purchased than if it was used by the mine for steam generation. In many mines, too, it is out of the question to put in heating apparatus which gives out any gases which might be injurious to the workmen. In the vast majority of cases it is, of course, impossible for this reason to use a coal stove, and entrances to mines and other exposed places in the mines are not heated because it is considered an impossibility.

Since electric heating has been taken up so successfully on electric roads, the fact also presented itself that there would be a large field in cooking devices to be operated by currents of standard voltages to-day used in lighting. A few electric stove companies have at present good lines of cooking utensils which surely fill every want for reliability, cleanliness and good design. There are many cases, especially in the smaller sized cooking utensils, where electricity can compete with coal.

There are, of course, a vast number of plants throughout the country that will not furnish current at a rate which would allow electric cooking apparatus to be used, provided it was simply a question of coal costing so many cents per hour, and electricity a few cents more. There are advantages in the use of electricity for both heating and cooking which must not be ignored. There are a great many places where electric light costs more than gas, and still it is the modern illuminant. It has advantages which gas has not, and the public is not slow to take advantage of them; and for this reason more than any other there are few towns of any size that do not have their electric lighting plant, even though a gas plant has already been installed.

For the heating of chemicals and other applications where an exact amount of heat is needed, electricity possesses more advantages than any other method of heating, and there is no doubt but that in this particular line it will be used to a large extent. For heating water in drug stores, buffets, etc., electricity also should take quite a part. For heating offices and other small rooms in buildings not equipped with steam, electricity, even at current rates for power service, will be found to be far less expensive than one would at first suppose. An office heater capable of warming a fair sized room will be found to be not only an extremely satisfactory way of heating from a sanitary point of view, but will, of course, be entirely free from all gases or odors which are indispensable with the gas or coal stoves.

In conclusion I would say that the field for electric heating seems to be on the eve of development in a sense that will be a surprise to even those laboring in this branch of work. The general public cannot remain long in ignorance of advantages of this method of heating, and although there will be many places where electric heating is an impossibility from a practical standpoint, there will still remain an immense field in which the electric heater will take a firm and permanent hold.

An Automatic Printing Speed-Counter for Dynamo Shafting.

BY GEORGE S. MOLER.*

The automatic printing speed-counter was designed and constructed by the writer, to supply a need felt of having a continuous record of the speed of the shafting which drives the dynamos and other apparatus being used by students in their laboratory experiments.

During part of the year the shafting of the dynamo laboratory at Cornell University is driven by water power, the wheels being situated at the bottom of a deep gorge, and several hundred feet distant. The power is transmitted by means of a wire cable running over large grooved sheaves, and the gate hoisting apparatus is operated by a wire rope passing around drums. No automatic regulator has yet been successfully applied to these wheels, so we have to rely upon hand regulation. On account of this, considerable variations of speed take place, although a tachometer is watched quite closely by the attendant in charge. The variations make it necessary in performing an experiment to continually take account of speed.

The printer (see Fig 1) is essentially a speed-counter which prints the speed at the end of each minute upon a strip of paper, and does this continuously, requiring very little attention. It was built to give the speed of a shaft which runs at about 140 revolutions per minute, but it has a range of from 30 to 185 per minute.

It is connected to the main shaft of the dynamo laboratory by sprocket-wheels and chains, so that the shaft carrying the worm revolves at exactly the same rate as the main shaft. The type wheel is about eight and one-half inches in diameter, and is made by clamping printers' type between a disk and a ring fastened with screws to one side of it. The disk has a series of small holes drilled in it at equal distances apart, and dowel pins passing through holes drilled in the type hold the latter in place. If any of the type become worn, or accidentally bruised, the ring can easily be removed and new ones can be inserted. The type are spaced so as to correspond with the number of teeth of the large gear-wheel which engages with the worm. The printing is done upon a one-half inch tape of district telegraph paper. A typewriter inking ribbon is employed, and as it is fed along it shifts sidewise back and forth so that the whole width of the ribbon is used. It takes several weeks to go once the length of the ribbon.

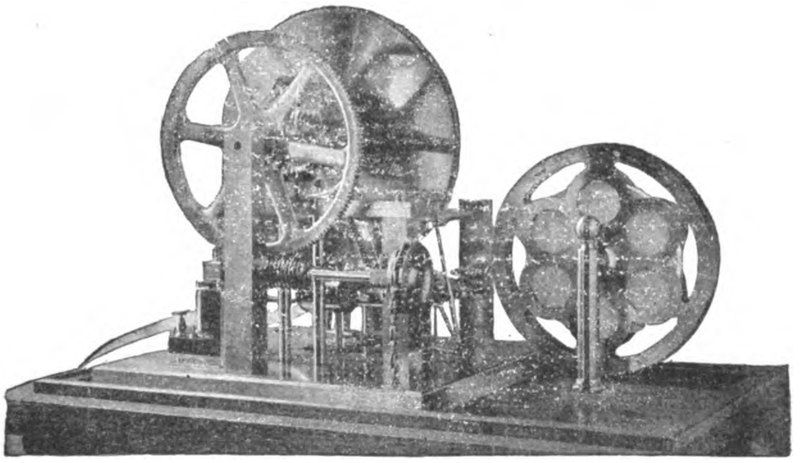

FIG. 1.

The type wheel practically starts from its zero reading at the beginning of each minute. It is necessary to have it do this in order that the number printed at the end of the minute shall be the exact number of revolutions for that minute. When a common speed-counter is used, its index is first set to zero, and it is then applied to the end of the shaft for just one minute, then is withdrawn and read. It is again set to zero, and the operation is repeated, but in doing this a minute or more is lost each time while setting. Now if the speed were not too great, the index wheel might be arranged so that it could be slipped backward or forward the proper amount, after reading, without stopping the counter. In this way a reading made from zero could be taken each minute. A similar method has been adopted in the printer. The type wheel, which is held by friction on the shaft, and is carried with it, is at the beginning of the minute slipped backward or forward until it has the correct relative position, then for the remainder of the minute revolves at the same rate as the large gear wheel on the same shaft. The method of slipping the type wheel around is partly shown in Fig. 2. The toothed wheel *a*, driven by the bevel gear, revolves once for every thirty revolutions of the main shaft. The plate or arm *b* revolves with it when the pawl *c* is allowed to catch in the teeth of the wheel. As the plate *b* goes around with the wheel, the pin *d* overtakes the arm *e*, which is attached to the type wheel, and pushes it along slipping the type wheel on the shaft. When *b* has made one complete revolution, the pin *f* on the pawl *c* comes opposite a notch, not shown in the figure, into which it is pushed by a spring, thus pulling the pawl from the wheel, and also holding *b* stationary. It takes thirty revolutions of the worm to carry the plate *b* around, it coming to rest just at the end of the thirtieth revolution. If at this instant the printing hammer were allowed to act, the number 30 would be printed, but if it does not strike till the end of the minute the type wheel will move with the large gear wheel till that time. The striking of the hammer releases the pin *f*, and the pawl, which has a spring of its own, is again brought in contact with the teeth and so carries the plate *b* around again. If the type wheel should complete its revolution before the pin *d* overtakes the arm *e*, then the arm *e* comes against another pin which stops it, until the pin *d* does overtake it. This is the slipping backward which has been mentioned. If the printer should be driven too fast, so that the type wheel makes a revolution before the minute is up, or if the hammer is not caused to act for several minutes, then it will, the next time it acts, print a zero, which is the type under the hammer while the wheel is held stationary.

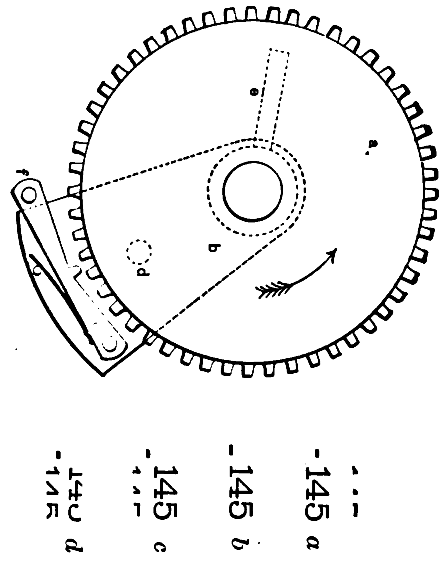

FIG. 2.

The hammer is released at the end of each minute by means of an electro magnet operated by a clock, and when the hammer makes its stroke it opens a switch in the electric circuit while the contact in the clock is still closed, so in this manner the spark on breaking the circuit is made at the switch and not at the clock contact. The hammer is set again by a pin on the side of a wheel coming in contact with a lever, and this closes the switch again before the next contact of the clock. When the machinery is not running, the switch remains open, and so the battery materials are not consumed in useless work.

The numbers move past a stationary point which prints its position upon the paper when the hammer makes its blow. If the number printed is exactly opposite the point, then there has been a whole number of revolutions that minute, but, if the number is above or below it, the fraction indicated by its position can easily be determined. Fig. 3 shows how the fraction of a revolution appears on the record. An exact number, 145 is shown at (*a*), 145.25 at (*b*), 145.5 at (*c*) and 145.75 at (*d*). Usually enough of either the preceding or following number is printed to easily make it out, and to estimate the fraction, which can be read to one-fifth of a revolution. In the original design of this instrument the question of adding a time printing device was considered, for it was thought to be necessary to know just the hour and minute that any part of the record was made. Such an attachment was planned but was not built, for the reason that in nearly all cases the record made will be referred to within the first few minutes after it is printed. If it is desirable to mark a certain point on the record to identify it, the paper can be displaced, and so leave a blank at that point. The paper is fed through at the rate of fifteen and one-fourth inches per hour, and so when necessary this distance can be taken as a unit of length to measure back, and mark off the hours.

One of the ways in which the record obtained is being used is to find the ratio of its reading to that of the speed of the dynamo being experimented upon, then from the record to calculate the speeds for the different parts of the experiment, but this will only answer when the belt is able to drive the machine without slipping.

There is now being built a spindle which is to be tight geared to the main shaft, and which will run ten times faster, or about 1,400 revolutions per minute. This will be for the purpose of testing a student's ability to obtain a correct reading of speed, for the true speed of the spindle will always be ten times the printed speed for that same minute.

The printer which has been described has been running for about three months and has not failed in any respect to do the work that was expected of it.

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*Read at the Tenth General Meeting of the American Institute of Electrical Engineers, New York, May 17, 1893.

Lecture by Prof. Jas. H. Mason.

A lecture to which is given the caption "Electricity, the Monarch of Wonders," will be delivered by Prof. Jas. H. Mason, at Pilgrim Baptist Church, McDonough street and Patchen avenue, Brooklyn, N. Y., on Wednesday evening, May 31, at 8:15 o'clock. Those who have heretofore listened to Prof. Mason's discourses will be glad of another opportunity to hear him, and all who attend will be sure of instructive entertainment in his pleasing elucidation of what is known of the mysterious agent that he has chosen as the subject of his lecture.

A Modified Deprez-D'Arsonval Galvanometer.

BY LIEUT. CHARLES D. PARKHURST.*

So far as the writer has observed, in all forms of this galvanometer in actual use, or as illustrated and described in various articles descriptive of its construction and use, and in catalogues advertising it for sale, it has always been arranged for use with a lamp stand and scale for reading the deflections by the varying position of the spot of light and image of cross hair reflected from a concave mirror; the protective screen to cut off air currents has always been of glass, and even though a plain mirror be substituted for the concave there is nothing to put the mirror in shadow; hence, as the writer knows from experience, no satisfactory results could be obtained with this form used in connection with a reading telescope.

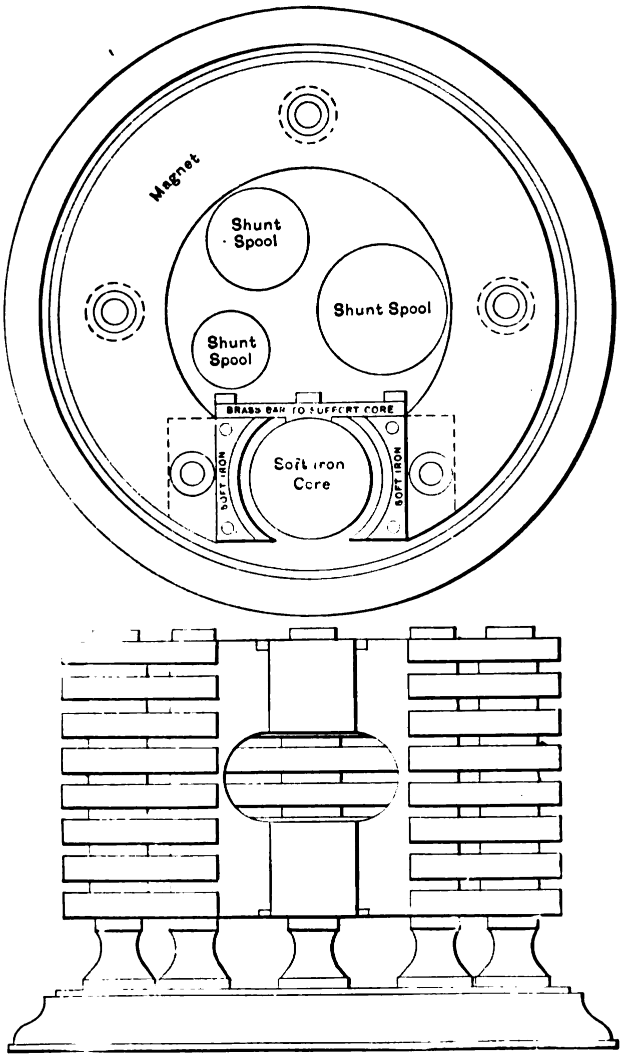

FIG. 2.

Opinions may differ as to the relative merits of the two systems of reading reflecting galvanometer deflections. Certain it is, however, that the lamp stand and scale form a clumsy and bulky outfit. To get a good, sharp and clear image of the spot of light and its cross-hair needs a very strong light or a dark closet in which to use the galvanometer.

In case it is used as a portable instrument, the distance from mirror to scale may not always be kept the same. In this case the constant must be determined for each position of the telescope and scale; but this is very simply done, and need cause no great delay or trouble.

As a specimen of the delicacy of the instrument *as used with a reading telescope*, the writer has frequently seen a deflection, when balancing resistances by the Wheatstone bridge method, *that did not uncover the cross-hair of the eye-piece completely from the zero line of the scale;* the cross-hair is a fine spider web, so fine that it can hardly be seen with the naked eye, and the lines upon the scale are as fine as they can be printed from an engraved plate, vet they did not completely separate from true coincidence; the slight movement of the scale was perceptible, but, of course, could not be measured. This movement indicated that a true balance had not yet been obtained, for finally it would disappear and the mirror hang dead still upon further adjustment of the resistances. This shows how sensitive the instrument is, and *how closely we can see the slightest suspicion of deflection* when using a reading telescope. Resistances adjusted down to absolute zero of the mirror's movement may be taken as pretty closely measured, much closer than is possible with any ordinary galvanometer, and, as the writer believes, much closer than can possibly be done with lamp stand and scale, even with the best of dark closets.

The one great objection to this galvanometer is its want of ready portability; admirably adapted as it is for all kinds of measurements with the utmost delicacy, even in the dynamo room, in proximity to dynamos in action, it yet is not readily transported and set up, owing to the delicacy of the suspension; it will stand a considerable handling without injury, but yet there is much to be desired to render it absolutely portable and free from any liability to injury in transportation, and quickly available, without any tedious adjustment being necessary when set up wherever required.

The Weston voltmeter and ammeter are such an adaptation, these instruments being the simple D'Arsonval galvanometer in another form, and specially constructed and graded for special work; though they are most admirable and accurate, and can be used for all kinds of measurements, they yet leave something to be desired, in that they read by index and not by mirror, and hence extreme refinement of reading becomes impossible. With a view to meet this requirement the following described instrument has been devised and is now in process of construction. (See Figs. 1 to 5, which are drawn to scale, half size.)

The magnet is made circular and compound, with soft iron pole pieces, similar to the arrangement in the Pitkin form of D'Arsonval instrument; but in place of the wire suspension of that instrument, the steel pinion and pivoted centres of the Weston form, with the double hair springs, are adopted.

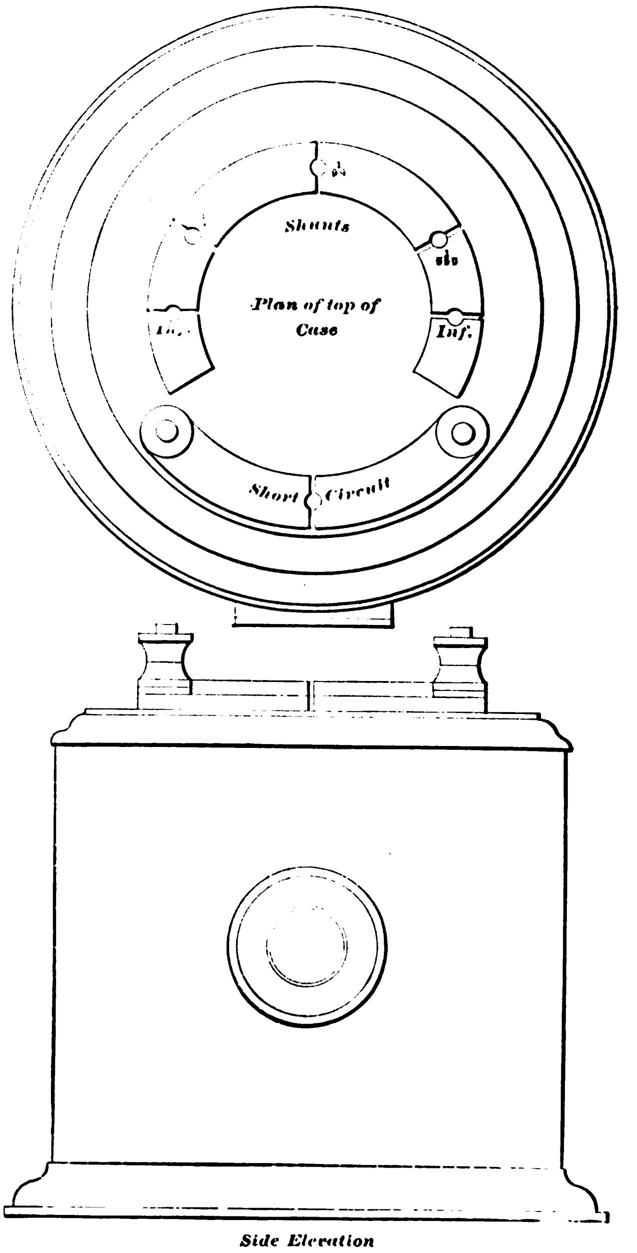

FIG. 1.

The coil may be the flat coil of the Pitkin instrument, or it may be the rectangular coil as generally used. If the flat coil is used the mirror can be attached to the coil; with the rectangular coil the mirror frame is set within the rectangle as shown; in both cases, of course, the mirror turns with the coil. A window, as shown, is provided in the case, to allow the movements of the mirror to be observed. The window can have a brass cap or cover to slip on to protect the glass in transportation.

The bottom and top of the case are of hard rubber; the side of the case is thin brass tubing; in the case, in the space within the bend of the magnet, a set of shunt coils may be inserted, with terminal blocks on the top of the case; the binding posts are upon the top, and a short-circuit may be provided as shown.

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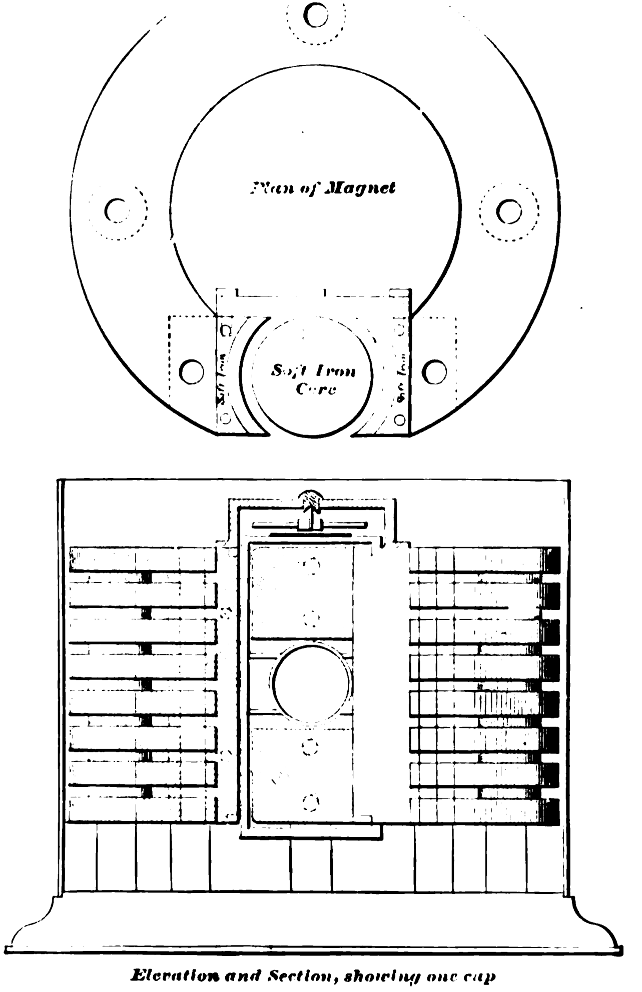
* Abstract of paper read at the Tenth General Meeting of the American Institute of Electrical Engineers, New York, May 17, 1893.

Where the rectangular coil is used, an iron core can be still put in inside the frame of the coil, being cut away as shown to allow the mirror to have room to swing. This really makes this iron core in two pieces, yet it contains a large mass of iron, and helps to strengthen the field of force in which the coil swings; the field of force is kept symmetrical by the shape given to the pole-pieces, so that the lines of force are evenly distributed from front to rear, and the coil remains in practically a constant field during its entire swing. The cutting away of the poles each side of the mirror is to allow the scale to be still reflected from the mirror after large deflection.

We then have a neat, compact and readily portable instrument, whose readings should be as fine and delicate as one may desire. Since the beam of light weighs nothing, and can be made almost as long as one chooses, within reasonable limits, it should be evident how greatly the scale is magnified, and how fine and close the readings may be. The writer may, perhaps, be pardoned if he illustrates this point a little more fully.

Galvanometers with indices must have a very finely graduated scale to read closer than one-fourth of a degree; the average will not read closer than one-half degree; fine readings are, therefore, impossible as a *certainty*, particularly when the tremble and quiver of a finely poised needle and index are considered. The Weston instruments are of this class, and, although they can be closely read *by estimation*, we are *not certain* of the reading, though perhaps we can read close enough for the general work for which they are used.

With a mirror, scale and fine reading telescope we have an index that is imponderable and about as long as we choose within reasonable limits.



Elevation and Section, showing one cap in place, and poles not cut away

FIG. 3.

The scale being graduated to millimetres is easily read at a distance of 3,000 scale divisions, a little over ten feet; the writer has frequently used a telescope at a distance of twelve feet, the distance being only limited by the size of the room, and not by any difficulties in reading the scale.

At this distance, then, a deflection of one millimetre, easily accurately read, means a tangent of $\frac{1}{3000}$ or .000333, corresponding to an angle of about *one minute of arc*, and, as this is the tangent of twice the actual angle of displacement of the mirror, we see that the mirror has actually moved about one-half minute only.

We can read this small angle *positively;* by estimation we can read one-half of a scale division, or our scale can be graduated to half millimetres, and we can read that deflection positively; hence, we see that we can read down much finer, and with more positive exactness, than can be done by any other method, a movement of the mirror being visible in the telescope that could hardly be detected with the unaided eye, and that would be imperceptible if an index had been used.

In conclusion, the writer would say that he hopes the modifications of the instrument as described may be found of value and use. So far as he knows they are original, and are not protected by any patents; any one should be, therefore, free to construct and use such instruments, and if any one so does, and gets as much satisfaction from their use as has been his good fortune, the writer will be fully satisfied.

While upon the subject of measuring instruments, though not exactly pertinent to the instrument described, the writer would beg leave to invite attention to some action being necessary to try and induce instrument makers to be more complete in the data that is furnished with their instruments, which data can only be accurately determined by the maker during process of manufacture, and which, if not then made of permanent record, forever after can only be arrived at approximately by experiment. Such data, carefully and permanently recorded, would oftentimes enhance the value of the instrument more than the extra cost from the extra trouble could possibly amount to.

Reference is here made to the various makers of tangent galvanometers as requiring such attention to the data of their construction, etc., as is shown by the following:

The writer has seen more than one fine standard tangent galvanometer of the Western Union pattern about which there was no information or data to be had as to the *number of turns of wire in each coil* or their mean radii. Similarly, Helmholtz-Gaugain galvanometers have been seen and used by him that were lacking in this same important data. These instruments were all high grade, costing from $125 to $175 each, and yet, for want of data that could have been recorded permanently by the maker at but slight additional expense, they could only be used *positively* and *absolutely* for the *relative* strengths of currents, except by calibrating them absolutely, by reference to some other instrument that had an absolute calibration.

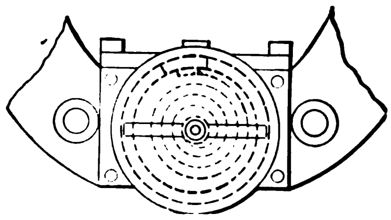


FIG. 4. — PLAN OF CAP CARRYING JEWELED CENTRE.

The formulæ for the use of tangent galvanometers in this manner contain the following quantities as necessary to know:

n = number of turns of wire in coil or coils in use.
r = mean radius in *centimetres* of the coil or coils in use.
d = distance of centre of coil from centre of needle in *centimetres* (for use in sliding coil tangent instruments, such as the Edelman and others).
H = horizontal component of the earth's magnetism at the place of observation (to be determined by experiment and does not necessarily become data for any particular instrument except for a fixed locality).

It will be seen that *the resistance of the coils or of the* instruments is *not* required. Yet we find resistance carefully measured and recorded and much more important data completely omitted.

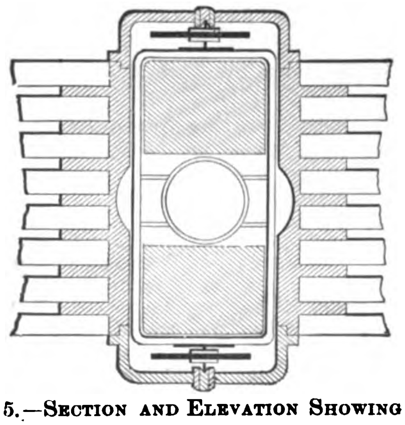


FIG. 5.—SECTION AND ELEVATION SHOWING COIL FRAME, MIRROR AND CAP.

We all know that *if* we know certain quantities, very hard to know or to keep constant, we can find the strength of current giving any deflection by the application of Ohm's law. But, though we may know the exact *external resistance* in circuit by careful measurements, do we know for a dead certainty what the battery or other generator's internal resistance may be from time to time as we use it? Can we be *positively sure* of the E. M. F. of our source of current? Until we can be *certain* of these two changeable and ever changing quantities we cannot be certain of the current strengths as given by Ohm's law, hence the great desirability for use of the general formulæ, into which E. M. F. and battery or other resistance does not enter, and the great need for the furnishing of the proper data by instrument makers to enable us to use these formulæ.

ELECTRICITY.

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Our Platform Is Unchanged. It is proper to recall the announcement made in these columns on August 31, 1892, when the present management secured control of Electricity:

"Electricity, under new ownership, will be conducted as an entirely independent journal, free to give its candid opinion on any and all matters of interest to the electrical fraternity. Our columns will be open at all times to those who have opinions to offer on such matters, whether they agree with us or not.

"We believe that these are the only correct lines upon which a journal, whether electrical or otherwise, can be conducted. We appeal for support to those who believe, as we do, in the fullest possible discussion of all matters of public interest; to those who believe, as we do, that the recent combination of electrical interests is foredoomed to failure in its main objects, and that its success, if possible, would work infinite injury to the development of the electrical industry of America.

"On this platform we stand, with the courage of our convictions, and with no fears as to the result."

There are no amendments, additions or changes in this platform to-day.

We shall continue on these lines until monopoly in the electrical trade has been wiped out never to reappear.

Bluff and bluster will not frighten us nor change our policy. We shall not cease to tell the truth in regard to matters of interest to our readers, and we cannot be intimidated.

As the marble-cutter engraved on the tombstone of the country editor, "We are here to stay."

* * *

Heating by Electricity. The matter of electric heating is at present demanding considerable attention, and was the subject of three papers read before the last meeting of the Chicago Electric Club, one of which we print in abstract in this issue. The problem of electric heating has now been very thoroughly investigated and as far as its practicability is concerned is pretty well established. It can hardly be considered, however, to have been sufficiently developed in point of economy to prove generally useful, although for certain applications it doubtless is now in a position to compete with other methods of heating.

Such cases are of course confined to those in which the heating is required intermittently, and where the consumption of fuel during the periods of disuse is sufficient to more than counterbalance the extra cost of current above fuel.

It is chiefly as a luxury that this method finds its application, and in the line of convenience, electric smoothing irons, cooking utensils, ovens, etc., leaves little to be desired.

It is estimated that electricity at $.015 per horse power per year of 4,000 hours has heating effect equal to coal at $6.00 per ton for house heating, and somewhat less for cooking, which shows that only a small advance in efficiency is necessary to put it in active competition with coal.

* * *

The next dividend on General Electric is due August 1, and nearly $700,000 will be required to pay it.

Have We Libelled General Electric? Most of our readers will have learned, before the current issue of Electricity reaches them, that the publisher of this paper has been indicted for criminal libel on charges preferred by the General Electric Company.

The specific article on which these charges are based is mentioned elsewhere. It is sufficient for the present to state that the article referred to had already appeared in a leading daily paper with over 100,000 circulation a week before we printed it, and that it had not been contradicted by Mr. Coffin or his servants. No changes were made in this office, not even of a punctuation mark.

* * *

No Garbling in This Office. Our friends and constituents may rest assured that Electricity has been guilty of no offence whatever in its treatment of General Electric news. Our "copy" is all preserved carefully, and since the charge of criminal libel was brought against us, we have carefully compared the questions and answers published in our issue of May 17 with the original copy, and we find that our printers and proofreaders have made no error. The matter was copied verbatim from a source which has been recognized as trustworthy.

We are quite ready to believe, in view of Mr. Coffin's present claims, that he never made the statements which we attributed to him. But Electricity has made no mistakes.

* * *

What Are Debentures? We have been frequently asked our opinion of the debenture 5s of the General Electric Company by those who have maintained that the bonds and preferred stock of the company must be worth par whatever the value of the common stock.

From the fact that these debenture 5s have fallen in price from above par to about 84, we suspect that some of the holders have been looking up the exact status of debenture bonds.

Webster defines the word debenture as follows: "A writing acknowledging a debt; a writing or certificate signed by a public officer, as evidence of a debt due to some person; the sum thus due." In other words, debenture bonds are so many notes, and they are not a prior lien on assets.

* * *

A Suggestion. Confidence in the stock and bonds of the General Electric Company may be restored in one way, and in one way only. If the President and Board of Directors are confident that their statements as to the financial soundness of the company are correct, let a committee of the stockholders be appointed, with a reputable chartered accountant as adviser, and make a thorough examination of the company's books, and an appraisement of the various assets. Let them also have free access to the stock-book that they may see what have been the actual transfers of stock since it dropped below 100. It is not many years since this plan was adopted by the Pennsylvania Railroad Company, and with a most wholesome effect. The shares of the company, which had been depressed, were proved conclusively to be worth considerably more than par.

No simpler or more effective plan could be devised.

* * *

Tesla's St. Louis Lecture. We commence in this issue the celebrated lecture delivered before the National Electric Light Association at its St. Louis Convention and a few days before at the Franklin Institute. The present lecture is even more complete than the celebrated London lecture by the same author, and the careful study and wonderful results which have been produced by Mr. Tesla lead to the belief that some practical results will shortly follow in the line of his investigations.

* * *

WE DO not wish to hurt anybody's feelings, but we would like to ask, Why is it that the stock of the United Securities Company was not sold in the present crisis in place of New York and Boston Illuminating Company's stock?. Is it not the only Simon-pure gilt-edged stock in the treasury?

* * *

IF ANY member of the Board of Directors of the General Electric Company can explain why it is that an 8 per cent. common stock is selling at 65, that preferred stock of the same company is below par, and the 7 per cent. bonds are at about 84, we would be pleased to give space to the explanation in our next issue.

* * *

THE General Electric Company have not yet stated whether the stock of the New York Edison Company, recently disposed of, had already been used as collateral for loans. This is an important matter, and the public has a right to know the facts.

* * *

WHATEVER else may be said of Mr. Coffin, no one will deny the accuracy of his knowledge of the affairs of the General Electric Company. It is on account of this accurate knowledge that his appearance on the witness stand, under oath, will be looked forward to with the most intense interest.

* * *

ACCORDING to the *Evening Post*, the cash in the treasury of the General Electric Company was reduced by $1,500,000 in two weeks. Query: If a million and a half will last two weeks, how long will two millions last?

* * *

THE General Electric Company might as well try to dam up the waters of Niagara with stolen blue-prints as to attempt to check, by an action against ELECTRICITY, the anti-trust tide which is sweeping them to destruction.

* * *

IF A man pawns his watch, or his best suit of clothes, the natural inference is that he is in need of funds.

* * *

WHATEVER the weather prophets may say, 'twill be a cold summer for Trusts.

* * *

"There never yet was human power,
That could evade, if unforgiven,
The patient watch and vigil long
Of him who treasures up a wrong."

Criminal Libel Charged.

The General Electric Company Lodges a Complaint Against the Publisher of "Electricity."

The New York Grand Jury, on Thursday last, upon a complaint lodged by C. A. Coffin, President, and S. D. Greene, General Manager, of the General Electric Company, found an indictment for criminal libel against B. E. Greene, publisher of ELECTRICITY. The alleged libellous article was published in our issue of May 17, headed "Mr. Coffin's Admissions."

It is charged that Mr. Coffin's reply to certain questions was not correctly given in ELECTRICITY; that it was maliciously garbled, with intent to injure the General Electric Company.

Our Mr. Greene was in Philadelphia when the indictment was found, and when notified returned at once to the city and surrendered himself, furnishing bail for appearance when the case is called for trial. ELECTRICITY'S case is in the hands of the Hon. Asa W. Tenney, of this city.

Away With All Trusts.

An Anti-Trust Convention to be Held in Chicago.

CHICAGO, May 27.—Gov. Altgeld has received hundreds of responses to his proposal for an anti-trust convention here June 5. The Governors of nearly all the Western States have appointed delegates to be present. The object of this convention is to secure laws to throttle all trusts.

General Electric.

What is Said of It Nowadays.

The General Electric is a striking example. The stock touched 58 in the recent panic, but speedily worked up to 80. The bears sold it all the way up and, although meeting with heavy losses, have so persisted in their attacks that they have been able to recoup. The story is still going the rounds that the dividends will not only have to be reduced, but may be passed altogether, and the company drift into the hands of a receiver. A new story is worked up almost daily, and small holders have become so demoralized that they are influenced by the rumors emanating in the street rather than by the official utterances made concerning the financial status of the company. In view of the fact that the breakdown in General Electric stock and bonds has entailed losses upon holders almost as severe as those caused by the collapse of the National Cordage Company, not a little surprise is manifested at the apparent indifference of those connected with the corporation to the distress occasioned by the shrinkage. Should it transpire, however, that the representations which have been made to various members of the Stock Exchange and to others as to the financial condition of the property for a year past has not been true to the letter there may be a different story to tell. On account of the high standing of these men in the financial community, should any rottenness in the condition of the company be exposed the feeling of indignation would be more intense than on anything that has transpired in Wall Street for the past twenty years. It would probably mark their extinction as factors in the financial world. On this hypothesis alone many holders have kept their shares at an enormous sacrifice, although frequently tempted to sell by the bold assertions of the bears that the concern must end in an administration by a receiver.—*N. Y. World*.

General Electric was the market disturber all day. The unpleasant rumors about the company for several days have made the street very skittish regarding the stock. The sale of valuable treasury stock and the continued talk of a reducton of the dividend were factors against it. In the last hour yesterday, in spite of the better bank statement, the bears made a preconcerted dash against the stock. So successful were they that the price was smashed from 70⅜ to 65, and closed finally at 66⅞. The weakness led to the rumor that the real financial condition of the company had not yet been told, although the management had given the public some very unsavory inside information. When the market closed the general expression was, when, where or how can anybody trust the industrial securities.—*N. Y. Morning Advertiser*.

There is something mysterious in the way this stock has been declining, in the face of the repeated statements that the affairs of the company are in good shape, and that the dividends are not to be cut down. The Board of Directors is composed of some of the largest capitalists in the city, and it might reasonably be supposed that a stock with such strong men behind it would be protected in the market. They seem, however, to be so far behind that they can't catch up to it. To suppose that bear raiding accounts for the decline in the price of the stock from considerably above par to its present price (about 68) is preposterous. There is some good reason for it, and doubtless the reason will become known before a great while.—*N. Y. Times*.

Friends of the company are at a loss to explain this weakness, in view of the assurances of an easy financial condition given by the officers. One explanation was that there was a large loan with a prominent downtown trust company with General Electric as the collateral security. It was the theory that knowledge of this fact having been gained by the bears, a vigorous effort was being made to depress the market value sufficiently to force the closing out of the loan, either voluntarily or from necessity.—*N. Y. Tribune*.

The selling of General Electric was due to the sale of that company's 15,000 shares of Edison Electric Illuminating of New York. Last week the company sold its Edison Illuminating of Boston for $625,000. These sales are to enable the company to meet current liabilities. It is always well to meet current liabilities, but when a company has to sell its assets in order to do it some hypercritical persons are apt to think that it does not speak well for the company's condition. —*Chicago Evening Post*.

The President of the General Electric Company, after a tumble of a dozen points in the stock, was forced to deny a series of rumors designed to produce the impression that his corporation was bankrupt.

Officials of the Whiskey Trust denied that a receivership was imminent.

President Oakes, of the Northern Pacific road, was impelled to deny current rumors that the company would default upon its interest on June 1.—*N. Y. Herald*.

The officers admit that a few weeks ago the company's financial situation was precarious, but affirm that the sale of the Illuminating stock has placed it now beyond the reach of danger. Neither of these assertions will be contested by close observers, and the end of the whole affair is a matter for congratulation. If it should lead to some explanation of what the company really means by "cash" in its published debit and credit statements, shareholders will be still more disposed to stand by their enterprise in the market. —*N. Y. Evening Post*.

There seems to be some return of confidence in General Electric, which has slowly recovered from the panic prices of two weeks ago, and closed yesterday at 79¼. There is still considerable doubt expressed in Wall Street as to the management of this property, and it is still believed that they lack the capital to carry on their business properly. It is largely held by insiders, and this will account for the ease with which it advances.—*N. Y. American*.

For the most part, the property which the holders of the Industrials and other stocks thought they had, has vanished into air. It never existed except in the minds of people. The values were bubbles and the bubbles have been pricked. This is a wiser but a poorer community than it was a few months ago.—*N. Y. Evening Sun*.

Trouble at the General Electric's Lynn Works.

The employees of the General Electric Company are dissatisfied with the 58 hours a week they are now compelled to work, and are agitating for a reduction to 54 hours a week at the old pay. On Saturday the company offered to compromise on 56 hours, but the workmen have yet not taken any decided action as to accepting the proposition.

The Distribution of Power by Alternate-Current Motors—III.

BY ALBION T. SNELL.*

The next point for consideration is the pulsation of the magnetism in the rotary field. This is not a simple matter to represent in a graphic manner, for the magnetic field is not merely the result of the inducing currents in the Drehstrom coils, but it is also largely affected by the frequency and magnitude of the induced currents in the closed coils of the armature, which vary from instant to instant with every fluctuation of load. The frequency of the induced currents will always be less than that of the exciting current—attaining its highest value at full load when the slip of the armature is greatest. It is expressed by $\frac{N - n}{60}$, where N = the number of revolutions of the magnetic field per minute, and n = that of the armature. (If N = 2,400 and n = 1,920, then the frequency will be eight per second.) The average pressure acting in the closed coils will be given by the expression $K\,C\,F\,a\,10^{-8}$,

where K = a constant;
C = the number of turns counted all round the periphery of armature;
F = the average number of lines of force from one pair of poles;
and a = the number of alternations per second of the armature induced currents.

In determining the excitation for multiphase motors and dynamos, it is therefore necessary to make two calculations, one for full and one for light load, just as with direct current machines.

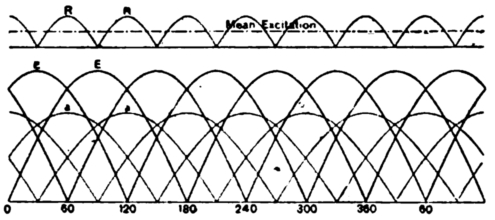


FIG. 10.—Diagram of the Excitation Fluctuations in a Combined Closed Type Drehstrom Circuit.

It is clear that it is not possible to represent the changes of the rotary field magnetism by a general diagram. Fig. 10 shows diagrammatically the relative position of the current and pressure curves in a combined Drehstrom circuit, with the resultant excitation, assuming the armature reactions to have no effect—i. e., the field and armature are supposed to rotate at nearly the same speed. An arbitrary angle of lag of 30 deg. between the pressure and the current in the exciting coils has been assumed, and the curves have been drawn to suit the sine law. The pressure is shown in E_1, E_2, E_3, and the current in a_1, a_2, a_3. The resultant excitation is indicated in curves R, R, R, the limits of which are $2\,a$ and $1.732\,a$, a mean difference of about 7 per cent. If the magnetism varied as the excitation, then the same fluctuation would occur in the rotary field, but owing to hysteresis and eddy currents the mean variation is probably not much more than half as great, say from 4 to 5 per cent.

Now, the torque will vary with the ampere turns, the frequency of the current, and the number of lines of force in the armature; or, the torque $= \frac{C\,i_a\,F\,a}{K_1}$, where i_a = the armature current, and K_1 = a constant, and the other symbols have the same signification as above. The magnetism is determined by the field excitation, and the number of turns of wire is, of course, fixed for a given armature; hence, to increase the torque, it is necessary that the armature rotate more slowly.

The "slip" increases both the frequency and the magnitude of the armature current, thereby weakening the resultant field and lowering the current E. M. F. of the field magnet coils, and allowing more current to flow in the exciting circuit. But since the total magnetism decreases as the armature current increases, there is a point at which the torque is a maximum. This corresponds to a definite current,* which is not at the starting or maximum current, and hence these motors do not exert their greatest effort at starting. In order to avoid large rushes of current when closing the exciting circuit, it is advisable to insert variable resistances in series with the armature windings. This is specially necessary with large machines, and it appears probable from this reason, as well as from other considerations, that large Drehstrom motors will always be designed with stationary armatures and revolving field magnets.

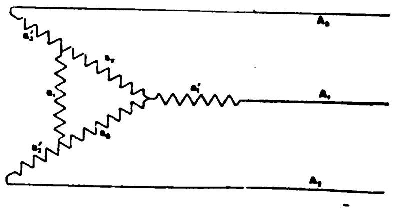
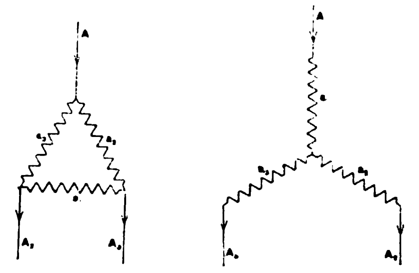


FIG. 11.—Combined Series and Parallel Drehstrom Couplings.

So far, if the difficulty of measuring the power be disregarded, the main point calling for improvement appears to be the magnetic pulsation. The mean variation does not, theoretically, exceed 7 per cent., and, practically, probably not 5 per cent. In order to still further decrease this, Dobrowolski has devised a very pretty combination of the open and closed type windings, which reduces the mean variation of the excitation to 3.5 per cent., when the magnetic field should be practically constant. The winding is shown diagrammatically in Fig. 11, and is known as the double-linked winding. The coils indicated by the symbols $a_1{}^1$, $a_2{}^1$, $a_3{}^1$, are severally wound in two parallel, 15 deg. removed from the closed coils, a_1, a_2, a_3. The complications involved are considerable, and the gain, perhaps, not commensurate with them, yet for large machines the device may prove useful.

There are some important points to be noticed between the series and parallel connections. It has been shown that with the series coupling $e = \frac{E}{1.732}$ (see Fig. 8) and that the currents in the coils and mains are the same, and in the parallel device (see Fig. 5) that each coil carries a current equal to $\frac{A}{1.732}$, and that the pressure at the coil terminals corresponds to the pressure between the mains. These differences are suggested by the term parallel and series, which are in this respect more apt than those of triangle and star.



Practical Application of the Drehstrom

FIG. 12. FIG. 13.

Now, the magnetizing effect exerted by a given number of turns of wire and a definite effective current in the mains will be different with the two kinds of windings.

Consider Figs. 12 and 13, which severally represent the parallel and series couplings, and the direction of current at the instant when the Drehstrom is entering by one main and returning equally by the two others. Let n be the number of turns of wire in one coil. Then the total ampere turns in the parallel device is n A, and in the series arrangement $\frac{3}{2}\,n$ A. Therefore, the magnetizing effect and also the self-induction of the series device is greater than that of the parallel for a given current and a fixed number of turns. Now, the total power absorbed by the two circuits may be made the same by a proper adjustment of pressure and frequency; but since the lag is involved, a complete solution is not very simple. Probably, however, a few experiments made with different sized machines will do more to assist the constructor than pages of mathematical theory.

It must be borne in mind that the triphase system has not been definitely proved to be superior to the diphase, and the leading authorities on the subject differ strongly. Herr Dobrowolski says that "the diphase current now belongs to the past," because in practice machines give curves departing so widely from sine functions. He admits, however, that if the phase difference of current and pressure be the same in each of the two circuits, and follow a sine law, the work is the same in each at the same instant. Messrs. Brown, Kelly, Stanley and Knapp all maintain that there is little to chose between the two systems from this point of view; and Mr. Brown further states that "his extensive experience with multiphase currents shows that two or three phase motors of similar outputs are much the same machines with regard to their respective efficiency, starting torque, weight and apparent watt consumption. This holds good for synchronous as well as non-synchronous machines." It is generally admitted that the Drehstrom presents many difficulties for lighting, and still more for a combination of lighting and power work; but Continental engineers have to a large extent successfully overcome these. Whereas, on the contrary, the diphase system admits of as simple treatment as the single phase one. It appears to be therefore probable that, if multiphase currents come into general use, the diphase may be employed chiefly for combined light and power distribution, and that the Drehstrom may find its field of usefulness in transmission and distribution of power. Experience alone can settle these points.

(To be continued.)

Current Items.

Mr. Swan, the English electrician, declared recently that he had seen electrical blowpipes capable of melting the stoutest iron so rapidly that to melt into a fire and burglar proof safe with this instrument would be the work of only a few minutes, and would be both an easy and noiseless operation. As, however, it would require a forty horse power engine to operate such a scientific tool, banks need be under no apprehension from this mode of attack on their vaults.

Londoners are trying to show that Benjamin Franklin was not the first experimenter in atmospheric electricity, or the inventor of the lightning-rod. It is said that a Catholic priest named Procopius Diwisch as early as June 15, 1754, noticed that lightning was an electric spark and worked out a complete theory of atmospheric electricity. At this time he was living in a small Bohemian village, and he constructed a rod having 324 needle points, connecting the bottom of it to the earth.

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*Paper read before the Institution of Electrical Engineers, London.

*It is clear that the particular current for maximum torque is dependent mainly on the magnitude of the armature reactions; and if the latter were sufficiently small the greatest torque might be obtained at starting, as is the case with a series-wound direct current machine. With commutatorless Drehstrom motors it is probable, in the author's judgment, that the maximum effort will be obtained with a current little greater than that required for the greatest output.

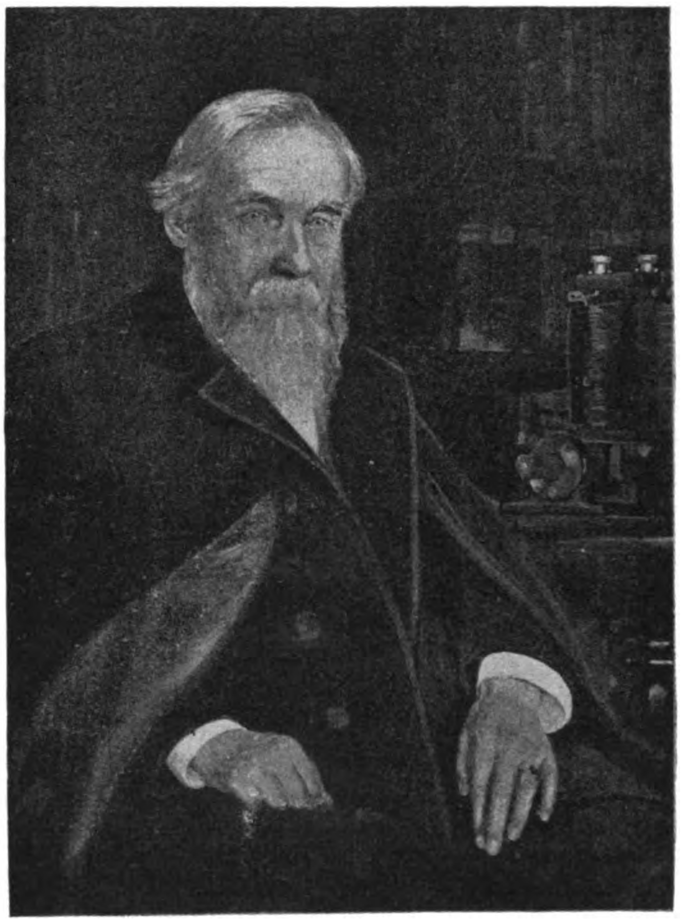
Moses G. Farmer.

Professor Moses G. Farmer died of pneumonia on May 25 at 384 North State street, Chicago. He was seventy-three years old and had been in feeble health for some time.

The body was taken to Boston, where a brief funeral service was held on Monday, the 29th, and the interment was at Eliot, Me., for many years Prof. Farmer's home.

Mr. Farmer was born at Boscawen, N. H., February 9, 1820. His father was a well-to-do farmer and lumber merchant. As soon as the boy was old enough to work he assisted his father in business until the death of the latter in 1836.

Some time after his father's death he went to Andover, Mass., as a student in its well known scholastic institution. This was in the fall of 1837, but he only remained there a short time, entering Dartmouth in 1840, where he made rapid progress. He was unfortunately at this time prostrated with typhoid fever. While at college he was in the habit of giving lessons on the piano and did considerable teaching of music. Singular to state, the typhoid fever left him with but a slight remembrance of one single tune, which marked the end of his musical career.



MOSES G. FARMER.

For a year or so he lived in Portsmouth, N. H., trying to find employment as teacher in a private school. He succeeded, but soon accepted an appointment as teacher in the Academy at Eliot, Me. Just previous to Christmas, 1849, having married, he settled down in Dover, N. H., and continued teaching for a year or two.

Along in 1846, while on his way to Boston, he happened to see a man reading a book entitled "Electro-Magnetic Telegraphy," by Alfred Vail. He was prompted to purchase a copy in Boston, and by the time he reached home he had learned the Morse alphabet. This gave Mr. Farmer a taste for electrical matters, and set him thinking and working on several problems.

Foremost in his mind as he thus plodded on was the subject of utilizing the force he was so fond of experimenting with for propelling vehicles, and so persistently did this idea retain possession of his mind that at last it took actual shape and resulted in the construction of a train of two cars, on one of which was mounted the motor[*] and battery which furnished the current, the other being a passenger car.

Mr. Farmer next identified himself in December of 1847 with Mr. F. O. J. Smith, at South Framingham, Mass., who was then building the telegraph line from New York to Boston. In the following summer he moved to Salem, Mass., and took charge of the line between Boston and Newburyport. Subsequently he undertook to open up offices along the route of this telegraph system and to place the business on a sound working basis.

During his residence in South Framingham he invented an electric striking apparatus for fire-alarm service, two of these machines being built and placed on the Boston Fire Alarm system, one being installed in the Sherman House the other in City Hall. About that time the City of Boston appropriated $10,000 for testing Mr. Farmer's system of fire alarm, which was attracting public attention. Mr. Farmer was requested to make the tests, and soon made several improvements which have been in use ever since. Mr. Farmer was appointed superintendent of the Boston Fire Alarm system, an office he filled until 1853, when he resigned. For a year or two he worked quietly along developing his electrical ideas, but was induced in 1856 to go into partnership with two other gentlemen as electrotypers. Their business prospered until the financial crisis in the following year, when the firm lost most of its capital and gave up. This was a great blow to Mr. Farmer, who, however, kept plodding on until the approach of the war in 1861, when he received an appointment as superintendent of a tobacco-extracting manufactory in Somerville. Here his knowledge of chemistry was found invaluable, and he retained the appointment for quite a long term. In 1872 he was selected to fill the office of electrician at the United States Torpedo Station, Newport, R. I., for six months. So great was the satisfaction his services gave, however, to the Federal Government that the appointment was continued for nine years.

In 1881 his health gave way again, and he became a confirmed invalid. After several years' treatment in New York he moved to Eliot, Me.

In 1852 Mr. Farmer invented, made and used regularly an electric cooking-stove, whereon he broiled his chops and steaks during his residence in Boston, and as early as 1859 he had successfully lighted his house with incandescent lights.

Last year he secured patents for a system of printing telegraphy in England, the United States and other countries.

He was a fellow of the American Academy of Arts and Sciences, fellow of the American Association for the Advancement of Science, member of the Institute of Technology, of the Essex Institute, of the American Society of Mechanical Engineers, of the American Institute of Electrical Engineers and of the English Institute of Electrical Engineers.

Professor Farmer left his New England home last fall, accompanied by his daughter, to spend the winter in Chicago, where it was hoped he might recuperate sufficiently to be able to make a careful study of the electrical exhibits at the Fair. He had arranged for an exhibit of many of his early inventions which will be of great interest.

Mr. Farmer's early work has not been properly estimated. Comparatively few of his inventions and experiments were made public, and the rest were known to a limited circle of friends only. His love for science, as science, was intense, and his work was rarely taken up with a view to pecuniary profit. He led the way by thirty years in many applications of the electric current, and whenever he had arrived at results which settled in his mind the laws of its action, instead of laboring to perfect a marketable invention, would lay aside what he had done and proceed in the search after the unknown.

To those who knew Mr. Farmer best, however the chief interest in his life was not so much because of what he did as of what he was. A more thorough personification of the Christian gentleman could not be found.

Mr. Farmer's wife died some months ago, the only member of his immediate family still living being his daughter, Miss Sarah Jane Farmer, who had been for years his constant companion.

A New Trolley.

A contributor to the Baltimore *American* says: The greatest trouble usually found in the working of the electric trolley on car roads is the wearing out of the bushing in the wheels at such a rate that a rebushing has to be made once a month, and the necessity of excessive daily attention and much oiling is entailed. An attempt has been made to remedy this fault by designing a trolley the bearings of which are made of fiber graphite, and which hence requires no oil whatever. The bearings are fastened on each side of the yoke, and the pin or shaft is fastened to the wheel, both revolving on the bearings in the yoke. This makes the trolley mechanically correct, and avoids all wobbling of the wheel, which is compelled to remain steady and true. Another advantage is that the springs are unable to get out of place, and must constantly keep up the same contact so there is no breaking or arcing of the current, and, moreover, no rattle. Instead of the usual accumulation of oil, grease and dirt on the top of the car, caused by the oil splashing down from the trolley, the car and rope are clean. This trolley wheel is said to have run 900 miles without showing appreciable wear.

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[*] For detailed description see ELECTRICITY, Vol. III, No. 23.

The National Electric Manufacturing Company.

The Plant to be Operated without Interruption.

The following is an official statement in regard to the receivership of the National Electric Manufacturing Company:

The matter had been under consideration for some time. An action had been brought by Jas. T. Barber et al. against the National Electric Manufacturing Company, the complaint in which sets forth that the company was embarrassed by very pressing claims on the part of creditors which it was unable to pay; that the large plant and valuable business of the company could best be preserved in their entirety for the benefit of all concerned by the appointment of a receiver, etc., etc.

Defendant requested the appointment of Ralph E. Rust as receiver, bond being offered in the sum of $50,000 with William A. Rust, John S. Owen, Jas. T. Barber and Fitch Gilbert as sureties. The same being properly filed, Judge Railey made an order appointing Mr. Rust receiver.

Although the company by reason of the general financial stringency has been considerably embarrassed, the conditions are such that under the receiver the business can and will be carried on without any interruption whatever. There will be no stoppage and a reorganization will probably be effected within a very few days.

The company's plant is worth $300,000; there is a large amount of valuable manufacturing products on hand, and there are also large outstanding orders.

The assets foot up between $500,000 and $600,000; the liabilities are about $300,000.

The placing of the plant and affairs of the company in the hands of a receiver is regarded as the very best possible solution of the difficulties which have been encountered.

Private advices from Eau Claire are to the effect that the company's troubles have been internal rather than external, and that a thorough reorganization will place them in a better position than ever. This can readily be believed, as it is known that the company's apparatus was good, and that it has done a large business.

Electric Lighting Station Opened at Leeds.

On the 10th of May was opened at Leeds (Eng.), by the Mayor of that town, in the presence of a number of influential ladies and gentlemen, the central station which had been erected by the Yorkshire House-to-House Company, the company formed to supply Leeds with the electric light. The station buildings were commenced in the middle of August last year, and were proceeded with as rapidly as circumstances would permit, which was not very speedily. The whole of the machinery was ready for testing on the 10th of April this year. The plant erected consists of three Lancashire boilers 30 feet long and 8 feet diameter. The feed-water is drawn from the condenser overflow pipe, and pumped by means of a duplex pump through filters into an overhead tank holding about 10,000 gallons. The water is thence taken to a smaller tank fixed with boiler feed pumps. The engines are of the coupled compound horizontal condensing type; two of them drive alternators of 100 kilowatts, and one drives an alternator of 50 kilowatts. The two large engines have 14 and 25 inch cylinders, with a stroke of 30 inches. Of the alternators two are capable of giving an output of 100 units each, and the other one 50 units, at an electrical pressure of 2,000 volts. The system known as the "Lowrie-Hall" has been adopted, and during the official tests it is said that an efficiency of 90 per cent. was attained. The farthest distance from the works at which current can be supplied is 2½ miles. We understand that the engines and alternators were tested for a twelve hours' run with a full load before the company took them over. Not the slightest hitch occurred in the carrying out of these tests. The company, when their station is in full working order, will have a supply capacity of about 16,000 lamps, and the inhabitants of Leeds have already made application for 11,000 or 12,000 of these. The firm of Messrs. John Fowler & Company of Leeds supplied the engines.

International Electric Congress.

Preliminary Programme.

Opening Session of the General Congress, Monday, August 21, 3 o'clock P. M.

ORDER OF BUSINESS.

1. The Congress will be called to order by the Chairman of the Local Committee, Dr. Elisha Gray, Highland Park, Ill.
2. Election of temporary Chairman and Secretary.
3. Appointment of a committee to nominate permanent officers. The officers will consist of a President, a Vice-President for each nation sending delegates to the Chamber, a Secretary.
4. Report of this committee.
5. Short addresses by the President and by a few of the Vice-Presidents.
6. Announcements and adjournment.

At the close of this meeting the Chamber of Delegates will assemble for preliminary organization, which will proceed as follows:

1. The Chamber will be called to order by one of the delegates representing the United States.
2. Election of a temporary Secretary.
3. Appointment of a Committee of Five on Credentials.
4. Fixing a time for regular sessions. Adjournment.

At the next meeting of the Chamber the Committee on Credentials will report, and a permanent organization will be completed.

DIVISION INTO SECTIONS.

The General Congress will be divided into three sections, as follows:

A—The Section of Pure Theory, including electric waves, theories of electrolysis, electric conduction, magnetism, etc.

B—The Section of Theory and Practice, including studies of dynamos, motors, storage batteries. measuring instruments, materials for standards, etc.

C—The Section of Pure Practice, including telegraphy and telephony, electric signaling, electric traction, transmission of power, systems of illumination, etc.

These sections will meet for organization and work at 10 A. M. August 22.

Their organization will consist of the election of a Chairman, a Vice-Chairman, a Secretary and a Sectional Committee of three in addition to the officers named above. Temporary presiding officers will be as follows:

Section A—Prof. H. A. Rowland.
" B—Prof. Charles R. Cross.
" C—Prof. A. Graham Bell.

Sections will meet at 10 o'clock A. M. on Tuesday, Wednesday, Thursday and Friday, continuing in session at will, except on Friday, when they will finally adjourn as sections not later than 1 o'clock P. M.

Each section will have authority to divide into sub-sections if it is thought to be desirable.

Papers are solicited upon the following subjects, or upon other topics which may be considered suitable in character.

They should be sent to the Chairman of the Programme Committee, not later than August 1, 1893. Such as are accepted by that committee will be put upon the programme of the Congress, to be presented in full or by abstract according to the time available:

Magnetic units and modes of embodying them in concrete standards.

Methods of avoiding electrical interference and risks to person and property.

National and municipal testing laboratories.

Materials for standards of electrical resistance.

Points of difference of the electrical vocabulary used in different countries.

The direct conversion of the energy of fuel into electric energy.

Comparison of the various methods employed for the electric transmission of power.

The cost of insulation in relation to high pressure for the electric transmission of power.

Comparison of the economies of the various systems of electric distribution.

Alternate current motors.

The behavior of transformers when supplying power to alternate current motors.

The construction of condensers for alternate current purposes.

The measurement of power for polyphase currents.

Direct coupled and non-direct coupled dynamos.

The use of equalizing dynamos in a three and a five wire system.

The use of accumulators in central stations.

The proportions between output of dynamos and the weight of copper and iron employed in their construction.

Electric traction.

Application of electric power in mining.

The adoption of a uniform method of distinguishing positive and negative mains.

Electric supply meters, American, British, Continental.

Criterion of sensibility of galvanometers.

Commercial instruments for measurement of electric quantities.

The relation between the voltage of the arc and the quality and composition of the carbons.

The aging of glow lamps.

The electric working of metals.

The use of electric and magnetic tests for ascertaining the mechanical properties of metals and alloys.

The best material and mode of erection of lightning conductors in the light of recent researches in electric discharges.

The prospecting for iron by magnetic surveys.

International telegraphy.

Fast speed and long distance telegraphy.

The use of batteries or other generators for telegraphy.

Telegraphic lines—land and sea.

Harmonic telegraphy.

Writing telegraphs.

Long distance telephony.

The possibility of providing telephonic communication without wires.

Application of electric signaling to the working of railways (alarms, time, etc.,) and to naval and military purposes.

Magnetic separators.

The use of electricity in engraving and in art reproductions.

The time allotted to the discussion of the papers presented will be determined by the several sectional committees. In the discussion of papers the Chairman of the section will name the first speaker.

THE CHAMBER OF DELEGATES.

The following topics will be considered by the Chamber of Delegates:

Adoption of definitions and values of fundamental units of resistance, current and electromotive force.

Adoption of definitions and values of magnetic units.

Adoption of definition and value of the unit of self-induction.

Definitions and values of light, energy and other units.

The standardization of electric lights.

The consideration of an international system of notation and conventional symbols and of a more uniform and accurate use of terms and phrases in electrical literature.

A commercial standard of copper resistance.

Together with such other topics as may properly come before this body.

The hours of meeting for the Chamber of Delegates shall be determined, after the first session, by the Chamber itself; and it shall also decide upon the admission of persons not delegates to its sittings.

It shall finally adjourn not later than 1 o'clock P. M. on Friday, August 25, and at the last meeting of the General Congress the officers of the Chamber shall report to it a summary of its proceedings and the conclusions reached.

Public lectures of a popular character will be delivered by eminent electricians at 8 o'clock P. M. on Tuesday, Thursday and Friday of the Congress week.

The General Congress will assemble to hear reports and for final adjournment at 3 o'clock P. M. Friday, August 25.

Prof. T. C. Mendenhall, Washington, D. C., Chairman.
Carl Hering, Philadelphia, Pa.
Prof. W. A. Anthony, Manchester, Conn.
Prof. H. A. Rowland, Baltimore, Md.
A. E. Kennelly, Orange, N. J.
Prof. F. B. Crocker, New York City.
Prof. E. L. Nichols, Ithaca, N. Y.
Prof. H. S. Carhart, Ann Arbor, Mich.
Committee on Programme.

American Institute of Electrical Engineers.

At the regular monthly meeting of Council, held May 16, the following Associate Members were elected: Fred. Fiske Barbour, 15 First street, San Francisco, Cal.; A. Barth-Bartoshevitch, 160 Arch street, Allegheny City, Pa.; Waldo C. Bryant, Bridgeport, Conn.; James Burke, 24 Front street, Schenectady, N. Y.; John Alfred Cabot, 123 Garfield Place, Cincinnati, Ohio; Adolph Frederick Christmas, Johnstown, Pa.; J. Hally Craig, John Hancock Building, Boston, Mass.; Ignacio Manuel da Cunha, Emprera Industrial Gram-Para, Para, United States of Brazil; Thomas B. Doolittle, 125 Milk street, Boston, Mass.; Henry W. Frye, *Times* Building, New York City; Clarence E. Gifford, 860 Prospect avenue, Buffalo, N. Y.; George Heli Guy, 131 West 34th street, New York City; Charles A. Lieb, 44 Broad street, New York City; James Grieve Lorrain, Norfolk House, Norfolk street, London, W. C., England; Charles P. Matthews, 15 Heustis street, Ithaca, N. Y.; Theodor J. W. Olan, New York City; Walter M. Petty, Rutherford, N. J., and New York City; Fred Sheffler, 74 Cortlandt street, New York City; George C. Sonn, 285 Bellevue avenue, Newark, N.J.; Alfred E. Weiner, 24 Yates street, Schenectady, N. Y.; Peter Wright, Drexel Building, Philadelphia, Pa.; V. H. Yarnall, 29 Broadway, New York City.

Legal Notes.

The Franklin Electric Light Company, of Cape May, has paid its creditors in full, and proceedings in the Court of Chancery asking for a receiver have been discontinued.

A case has been before the courts in San Antonio, Texas, which is the result of a wrangle between the West End Street Railway Company of San Antonio and the Thomson-Houston Electric Company as to the value of a plant erected by the latter company for the former. The defendants claim that the Thomson-Houston Company had agreed to put up a first-class electric street railway plant for them for a stipulated amount of money. The street car company paid $15,000 on the contract. It claims that before the remaining note, amounting with interest to $10,000, fell due serious defects were found in the plant, whereupon the defendants resisted payment of the note.

Judgment has been entered against the Chatham Electric Light Company, of Chatham N. Y., for $11,732 in favor of the General Electric Company for electrical machinery and wares sold in 1890, 1891 and 1892 by the Thomson-Houston Electric Company.

The Covington Electric Light Company field suit in the Circuit Court at Newport, Ky., against the Suburban Electric Illuminating, Heating and Power Company and the City of Newport for $16,562.72, with interest from May 1, 1898, till paid for and its costs. The city of Newport is made a co-defendant in the case for the reason that it is indebted to the Newport Electric Light Company in the sum of about $20,000 for electric light furnished by the latter.

A legal fight between the Winnipeg Street Railway Company and the Electric Railway Company, at Winnipeg, Manitoba, has been going on for some time. The former company, which has been established for the last ten years, claims to have been given the exclusive rights to the streets by the city council. The case first came before the Court of Queen's Bench, whose decision was favorable to the Electric Company. An appeal was taken to the Supreme Court of Manitoba, the judges of which have unanimously ruled that the city council has no power to grant a monopoly of the streets, and that the new company could not be interfered with.

The St. Joseph, Mo., *News* gives the following particulars regarding the sale of the property of the People's Street Railway, Electric Light and Power Company, comprising all the street railways of St. Joseph. It says that M. M. Crandall, master in chancery of the company's property, which was sold at auction recently for $565,000, will "make his report of the sale to Judge Ramey, in Division No. 2 of the Circuit Court, next week, and when the sale is confirmed by the court the property will pass into the hands of the purchaser, James T. Gardiner, chairman of the reorganization committee of the bondholders. The price paid being $235,000 less than the amount of the mortgages held by Harriman & Company, of New York, naturally, while the debt is released, there will be nothing left for the small stockholders. When the settlement by the master in chancery is made the property will pass into the hands of the reorganization of the old company, viz., the St. Joseph Traction and Lighting Company, whose intention is to spend several thousands of dollars in improving and adding to the rolling stock of the various lines and in replacing the old track with new rails."

Boston Notes.

Contracts have been signed for the construction of an electric road at Bath, Me., and work will commence at once. The road is to be in operation by August.

The movement in favor of municipal ownership of electric lighting plants has extended to Cambridge, Mass, and action is being taken thereupon. On Thursday evening a special committee of the City Government held its first meeting to consider the subject. The president of the Cambridge Electric Light Company appeared to show that the city would not save any money. He estimated that his company earned net for the past year about $20,000.

A new submarine cable is to be laid at once between the Isles of Shoals and the New Hampshire mainland. The cable will be $7\frac{3}{4}$ miles long and is to cost $5,000. A shorter cable is to connect Star and Appledore islands. These islands are very popular health resorts.

An interesting evening was spent last Monday by the members of the Eliot Club, Jamaica Plain, a fashionable suburb of Boston, on the occasion of an address entitled "The Invention of the Telephone and the Development of its Use," which was given by Mr. J. H. Farnham, electrician of the New England Telephone and Telegraph Company. During the address many interesting drawings of the earliest forms of telephone instruments were shown and some remarkable experiments to show the wonderful sensitiveness of the telephone were made. There were about 150 ladies and gentlemen present, all of whom were delighted with all they saw and heard. Through the kindness of General Sherwin, president of the Telephone Company, some twenty telephones were placed about the room and connected with the long distance telephone line to Springfield and Chicago. For the entertainment of the audience vocal and instrumental selections were rendered in the operating room at Chicago, every note of which was distinctly heard by all present. A good deal of amusing conversation was also carried on over the line between Chicago, Springfield and the Eliot Hall, Jamaica Plain, where the meeting was held.

A lively meeting took place at Blackstone, Mass., last Monday, on the occasion of a public hearing granted by the Selectmen on a petition presented by the Woonsocket Street Railway Company for leave to erect poles and maintain wires and have an exclusive franchise to Blackstone's streets for twenty-five years. Mr. J. M. Klingelsmith of Chelsea, formerly identified with the General Electric Company, controls the company, and he and those interested with him didn't get any satisfaction from the selectmen. For two hours there was a hot discussion but no definite result was reached. It was contended that hitherto the Woonsocket Company had not lived up to its promises in taking care of the streets, which was part of its original contract. The feeling was against granting a twenty-five year franchise for a trolley road, seeing the possibility of such a system being altogether superseded within the next few years.

In accordance with a decision arrived at a few days previously, 34 out of a possible 40 members of the Massachusetts Senate made a trip to Milford and Hopedale last Tuesday to secure practical experience of the working of storage battery cars before deciding the fate of a bill for granting the Storage Battery Railway Company of Cambridge authority to run its cars over the West End tracks in that city. The visiting Senators rode over the entire system between Milford and Hopedale, witnessed many trying tests, and expressed themselves satisfied when the cars ran over 10 per cent. grades without the slightest difficulty. Senator E. P. Shaw, who is a bitter opponent of the storage battery project, had with him an expert from the General Electric Company to criticise and find fault with everything pertaining to storage battery propulsion, and this he did so persistently that his presence became actually annoying, and he had to be requested to give the Senators a chance of judging for themselves. Some of them admitted their conversion to storage battery propulsion in preference to the overhead trolley. The bill had passed the House almost unanimously, but when brought up in the Senate Wednesday it was thrown out, to the astonishment of everyone but the Senators themselves, by a majority of 30 to 5. This defeat, however, is likely to be only temporary, as the promoters, backed by a growing public opinion, are determined to push their undertaking to a successful issue.

On the Stock Exchange, this city, General Electric Stock went off several points Thursday when the statement got known that the Trust had disposed of $1,500,000 of gilt edge securities for Europe. The selling of its treasury holdings of stock in the Edison Illuminating Company, New York, as above, set the men on the street wondering what would be the next move to raise cash. The transaction had an ominous look to many.

The Long Distance Telephone Company has just declared a quarterly dividend of $1\frac{1}{4}$ per cent. which is equivalent to 5 per cent. per annum. The stock in this company is issued by the Bell Telephone Company.

The new electric railway between Waltham and Watertown, Mass., was opened for traffic last Sunday. The road is a success.

Chicago Notes.

The death of Moses Gerrish Farmer in this city, last week, was sad news to the electrical fraternity at large, and especially to his numerous friends who have made his acquaintance since he has taken up his residence in Chicago. No services were held in this city, but the body was sent directly to Boston last Saturday, where the funeral rites will be held.

The Calumet Electric Railway Company, which operates a number of cross town lines on the south side of the city, has just completed arrangements with a number of railroads entering the city to transfer all their World's Fair passengers from the suburban station at which the road crosses the electric line to the Fair grounds. The roads which have entered this agreement include the following: The Rock Island, Marion, Erie, Baltimore and Ohio, Wabash, Pennsylvania and Lake Shore. A number of new cars will be added to accommodate the increased traffic.

D. E. Robison, of Nashville, Tenn., was a visitor in the city last week, and took time to show his new patent trolley wheel to a number of the railway supply houses. Mr. Robison is one of the few colored gentlemen who have entered the electrical field as a means of earning a livelihood. He has several important inventions upon which patents are pending.

The K. A. P. Electrical Novelty Company have established an office at 440 the Monadnock Building, from where they will handle their patent K. A. P. Lamp Socket and other electrical appliances. Wm. D. Kury is in charge of the Chicago office.

The Knapp Electrical Works has entered suit in the Superior Court of Cook County against the National Electric Company to recover $1,981.33 on an attachment.

General News.

What is Going on in the Electrical World.

Omaha, Neb.—The steam motor line to Manawa is to be changed into an electric line immediately.

Rockport, Tex.—The electric light plant belonging to G. S. Barlow was destroyed by fire on the 12th inst.

Oakland, Cal.—The old Meetz horse-car road between Oakland and Alameda has been superseded by the Alameda, Oakland and Piedmont Electric Railway.

Nutley, N. J.—The town committee have selected locations for 100 electric lights to be paid for by the township.

Macon, Ga.—J. L. Camp, J. King and E. T. McGhee have bought a controlling interest in the Electric Light Company.

Savannah, Ga.—The Electric Railway Company has renewed its lease of the Savannah and Isle of Hope road for three years.

Amsterdam, N. Y.—The Amsterdam Street Railroad Company has been granted a franchise and will extend their road to Fort Johnson.

Pasadena, Cal.—The Consolidated Electric Company of Los Angeles will build an electric road to connect Los Angeles with Pasadena.

Salt Lake, Utah.—An extension of the franchise of the Henderson-Brinker Electric Street Railway has been granted by the city council.

Indianapolis, Ind.—Rumors of negotiations between the two rival street railway companies were in circulation last week, but there is nothing in sight to verify them.

Hamburg, N. Y.—The village board has entered into a contract with the Hamburg Water and Electric Light Company to furnish lights for this place for three years.

Johnstown, Pa.—Ex-Governor Beaver and Gen. Hastings are interesting themselves in the proposed electric road to connect Hastings and Spangler, two new coal towns.

Plainfield, N. J.—An electric trolley road is planned to run from Plainfield to Orange along the Watchung Mountain range. The intention is to develop the mountain top for private homes.

Providence, R. I.—The consolidation of the Pawtucket Valley Electric Street Railway Company and the Electric Light Company, whose plant is located at River Point, has been effected.

Syracuse, N. Y.—At a meeting of the men interested in the proposed Syracuse, Fayetteville and Manlius Electric Railway, recently, it was decided to have the routes suggested surveyed at once.

San Antonio, Tex.—The Citizens' Electric Power and Street Railway Company have been empowered by the Mayor, having paid to the city $5,000, to construct an electric line on certain specified streets in this city.

San Jose, Cal.—The common council has at last decided to report in favor of granting a franchise for an electric road to Alum Rock Park, the franchise to be granted to the highest responsible bidder. Bids will be opened June 26.

Youngstown, Ohio.—The *Vindicator* says that word has come from Canfield to the effect that New York capitalists have offered to take the entire amount of stock needed to complete the proposed electric street car line from Canfield to this city.

Wilmerding, Pa.—The announcement that the Westinghouse Electrical and Manufacturing Company intend moving their entire plant to Wilmerding has given a boom to real estate in the neighborhood, McKeesport being among the places benefited.

Eldora, Iowa.—The boiler in the electric light plant exploded on the night of the 18th, demolishing the building and damaging buildings in the neighborhood. A. E. Gier was instantly killed, and Firemen Templeton badly hurt. The loss was over $20,000.

Middletown, Conn.—It is probable that the street car system in this city will be equipped with electricity in a few weeks and also that the lines will be extended to the asylum and then as far as Pameacha bridge in that direction. The trolley system will be used.

Paterson, N. J.—The Paterson Central Electric Company has 38.40 miles of street railway track; capital stock, $140,750; paid up. $94,000; funded debt, $27,000; other debts, $7,000; cost of road, $1,127,549; expenditures for repairs, etc., $217,000; gross receipts, $23,415.

Fort Lee, N. J.—The Electric Construction Company has begun to build the electric railroad which is to extend from the Fort Lee Ferry to the Institute of the Holy Angels. Work has also been begun on the Palisade Railroad. It is to be completed to Fort Lee by November 1.

Charleston, S. C.—The Electric Light Company have been making great improvements in their plant, and have adopted the meter system in supplying their light to customers. It is reported to be more satisfactory all round than the old system of charging by the month.

Hackensack, N. J.—The Bergen Turnpike Company have decided to carry out the project that it was hinted they had in view when the new directory was organized, of building an electric road from Hackensack to connect with lines in Jersey City and Hoboken. The length of the road at the start will be nine miles and it is probable the line will be eventually extended to Saddle River valley.

Bath, Me.—The Electric Railroad Company will begin work at once on its line. The Worcester Construction Company will construct the road bed, the Pierce Construction Company of Boston the overhead work and the Westinghouse Company the electrical equipment. The road is four miles long and extends a couple of miles into the suburbs.

Eau Claire, Wis.—Ralph E. Rust has been appointed receiver of the National Electric Manufacturing Company. The assets appear to be $500,000, and the indebtedness $350,000. The company is one of the largest electrical manufacturing concerns in the United States. The cause of the appointment is threatened suits arising out of the stringency of the money market.

Gettysburg, Pa.—Judge Advocate General Major George B. Davis, U. S. A., who had been officially instructed to inspect the electric railroad that is now being built over the battlefield, for the purpose of ascertaining whether the line would be injurious to the historical value of the field, will, it is understood, advise the War Department to intervene and take the land and stop the further building of the railroad.

Monrovia, Cal.—Monrovia will soon have an electric light plant and will supply the adjoining towns of Sierra Madre, Duarte, Santa Anita and El Monte with light, and have power enough to run a motor railway between Los Angeles, Pasadena and Monrovia. The plant will be run by water power from the Saw Pet canyon just north of Monrovia. Los Angeles and San Francisco capitalists are the projectors of this enterprise.

Windsor Locks, Conn.—A new industry may be established at this place in the shape of the manufacture of a new electric lamp. The lamp is the invention of a Mr. Greene. Parties were in town a few days ago to look at the building owned by the Electric Light Company. The directors of that company are to make arrangements to have the concern locate here. It is expected that about forty hands would be employed at first.

Baltimore, Md.—The new station of the Suburban Railway Company when finished is expected to be capable of generating sufficient electricity to operate every electric road in the city and suburbs. The machinery employed is to have a capacity of 6,000 or 7,000 horse power. The station at Waverly will be kept intact for emergencies. The new station will be ready for operation as soon as all the lines of the City and Suburban Railway Company are prepared for electricity.

Troy, N. Y.—The Troy City Street Railroad Company have applied to the city council for permission to change the motive power of their White Car line from horses to electricity.—Since the project of constructing an electric road from Albany to Sandlake has been made public, some influential Trojans have been considering the feasibility of running a line from Troy to Sandlake, so as to prevent a diversion of the trade now carried on between these two places to Albany, and efforts will be made to carry out the scheme.

Hartford, Conn.—The Electric Street Railway bill, as amended, has finally passed both Houses. There are seventy applications for charters for electric railways affected by the bill. The original section prohibiting the transportation of freight without permission of the railroad commissioners is reconstructed so that every company may transport persons and property, but in freight transportation shall be subject to regulations prescribed by the Superior Court, on application of the railroad or the local authorities. The order may cover the entire line or a part of it. The matter of paralleling any steam or electric street road is left to the decision of the Superior Court instead of the railroad commissioners. The House provision that any joint stock corporation may build an electric street railroad was erased.

New York.—The Union Electric Railway Company has gained possession of the lines of the Westchester Electric Company, which, when completed, will run from the Hudson River to Long Island Sound, through the northern part of the city. The Union will extend its present system from Fordham, meeting and connecting with the new line at Woodlawn. It is stated that the Union has also acquired title to all of the other lines operated in the lower part of Westchester County.—An electric gig for the new cruiser New York is being constructed by the General Electric Launch Company.—A public exhibition was given at 42 Park Place on the 24th inst. of a telephone that, it is claimed, does not in any way infringe upon the Bell patents. Several tests were made, with satisfactory results. The inventors and promoters claim validity for their patents on the ground that no carbon is used for vibratory purposes, and a general simplicity of construction that will admit of a line five miles in length being constructed at a cost for materials, batteries, transmitters and receivers of only $62.40. This includes the purchases of all rights from the owners of the patents.

Paranite Wire.

The Indiana Rubber and Insulated Wire Company of Jonesboro, Ind., has found it necessary to establish an Eastern sales department at 220 Devonshire street, Boston, where all orders for that part of the country will be promptly taken care of. The high quality of these goods and the excellent reputation they enjoy have been still further enhanced by the following strong letter of commendation and data of tests received a few days ago from the Massachusetts Electrical Engineering Company:

BOSTON, Mass.

We are in receipt of your favor of the 3d inst. referring to your Paranite wire, and herewith enclose, as you request, a set of copies of our tests.

As we stated to you verbally, there is no doubt that the Boston Board of Fire Underwriters will accept this wire for this city on the basis of the tests we have made. Our own opinion is based on this same information, but as the tests speak for themselves we think there is nothing further which we could add that would be of any value to you.

Yours very truly,

STONE & WEBSTER.

The above letter was accompanied with the following data of tests made according to the requirements of the Boston Board of Fire Underwriters:

Report of Insulation Resistance.

Test No. 722.
Marks: Paranite cable No. 2,030, No. 14 wire.
Length, 50 feet. Temperature, 55 degs. Fah.

Resistance of Insulation in Megohms.

Time	500 feet.		Per mile.	
On immersion.	Negative.	Positive.	Negative.	Positive.
After 1 day.	26,000	26,000	2,500	2,500
" 2 days.				
" 3 "				
" 4 "				
" 5 "				
" 6 "				
" 7 "				
" 8 "				
" 9 "				
" 10 "				

Remarks.

Three minute electrification, 550 volts. Qualities for withstanding abrasion, good.

Test No. 728.
Marks: Paranite cable No. 2,030, No. 14 wire.
Length, 500 feet. Temperature, 55 degs. Fah.

Line Test.

Time	500 feet.		Per mile.	
On immersion.	Negative.	Positive.	Negative.	Positive.
After 1 day.	26,000	26,000	2,500	2,500
" 2 days.				
" 3 "				

Remarks.

Three minute electrification, 550 volts.

Test No. 723.
Marks: Paranite cable No. 2,173, No. 14 wire—Taped wire.
Length, 490 feet. Temperature, 55 degs. Fah.

Resistance of Insulation in Megohms.

Time	490 feet.		Per mile.	
On immersion.	Negative.	Positive.	Negative.	Positive.
After 1 day.	30,000	30,000	2,800	2,800
" 2 days.				
" 3 "				
" 4 "				
" 5 "				
" 6 "				
" 7 "				
" 8 "				
" 9 "				
" 10 "				

Remarks.

Three minute electrification, 550 volts.

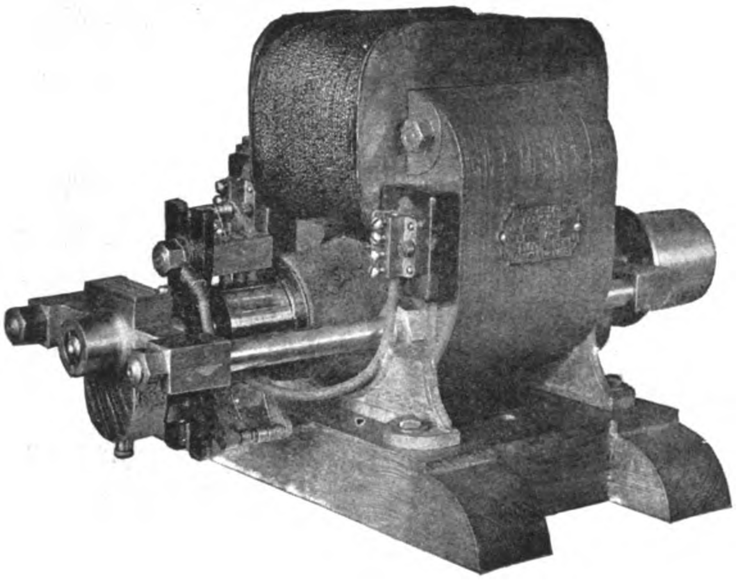
New Perret Motor.

The following illustrations represent a new type of Perret Motor brought out recently by the Elektron Manufacturing Company of Springfield, Mass. As in all motors and dynamos made by this company, the lamination of the field magnet cores is adhered to in these machines. The armature is in all respects the same as that used in the well known Perret machines of the consequent pole type which have gained a wide reputation for efficiency and mechanical excellence in the past four or five years.

The new machines, although much simpler in construction, by reason of having one field coil instead of four, are even more efficient than the consequent pole type. The iron is of the best for the purpose, the magnetic circuit is short, and, by means of a patented method of dovetailing the iron plates, the single joint in the core is most perfectly made.

The bearings are of composition bronze and self-oiling, and for ordinary voltages carbon brushes are used.

This style of machine is made in five sizes, from one-fourth to two horse power, inclusive, and are known as types X and Y. Each motor is accompanied by a neat fire-proof starting box.



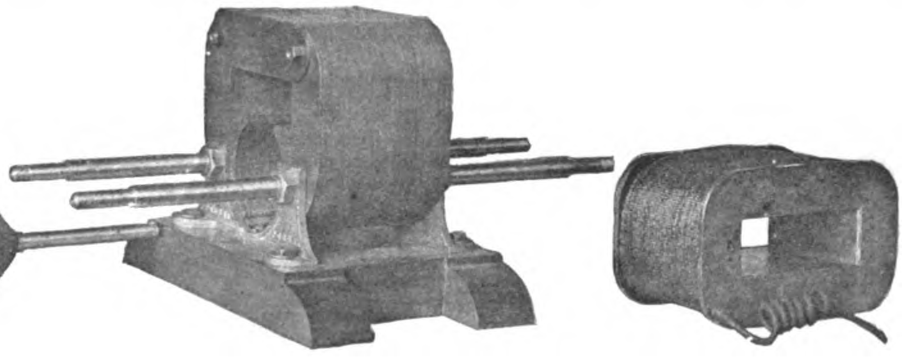
THE PERRET MOTOR.

New La Roche Direct Current Dynamo.

The cut herewith represents the new type of direct current dynamo built by the La Roche Electric Works of Philadelphia. This has been one of the most successful machines that have ever been turned out of their establishment, and for it they have received a number of duplicate orders, giving great satisfaction wherever placed.

The machine, as will be noticed, has a Gramme ring armature of the latest improved construction, thereby reducing the speed very materially. It has all modern improvements, with all parts interchangeable and made to gauge. The machine is compound wound and was designed by Mr. F. A. La Roche. It is so constructed as to stand the most severe abuse that any machine of this kind can be subjected to. It has self-oiling bearings and automatic oil-overflow. The brushholders are of a new design and so made that any degree of tension can be secured, and so arranged that a free movement of the brushes around the commutator is allowed.

The commutator is made of hardened copper well insulated with mica. It will be noticed that the winding of the machine is peculiar, as any of the coils, either series or shunt, can be removed and new ones put in place without interfering with any other part of the machine. An extra heavy steel shaft is used which permits the armature to run very close to the pole pieces, consequently increasing the efficiency of the machine.



THE PERRET MOTOR.

A test of one of these machines showed that there was a variation of only 1 3-10 volts between no load and full load, which is a sufficiently close regulation for any purpose that a machine of this kind may be put to.

Within the last three months this company has installed fifteen of these machines in Philadelphia and vicinity, and they are spoken of in the highest terms.

The La Roche Company are now making arrangements for an increase in their manufacturing facilities.

Pope, Read & Rogers.

In response to the solicitations of many of the clients of the old firm of Pope, Edgecomb & Terry, attorneys and solicitors in electrical patent cases, it gives me pleasure to inform you that I have completed satisfactory arrangements for the resumption of the business so successfully carried on by them for many years, and of which the engagement of its members for a time in special service connected with the organization of the Westinghouse Electric Company, necessitated a discontinuance.

I have now associated with me, Mr. Robert H. Read, formerly Examiner in the Department of Electricity in the United States Patent Office, who for years past has conducted with marked ability and success, the Patent Bureau of the *Electrical Review* of this city. As an expert practitioner in the abstruse and difficult departments of electrical work, especially alternating and multiphase machinery and distribution, Mr. Read has won a deservedly high professional reputation.

Mr. Edward H. Rogers, formerly of counsel for the Westinghouse Electric Company, and favorably known to the profession from his connection with some of the more prominent electrical patent cases which have been before the Federal courts with the past few years, continues his association with us, so that his services may be availed of by our clients in the prosecution or defence of actions for infringement or for advice relating thereto.

The new firm of Pope, Read & Rogers, have fitted up commodious offices at 41 Cortlandt street, New York, and have provided every needful facility for the *prompt dispatch* of all business which may be entrusted to their care.

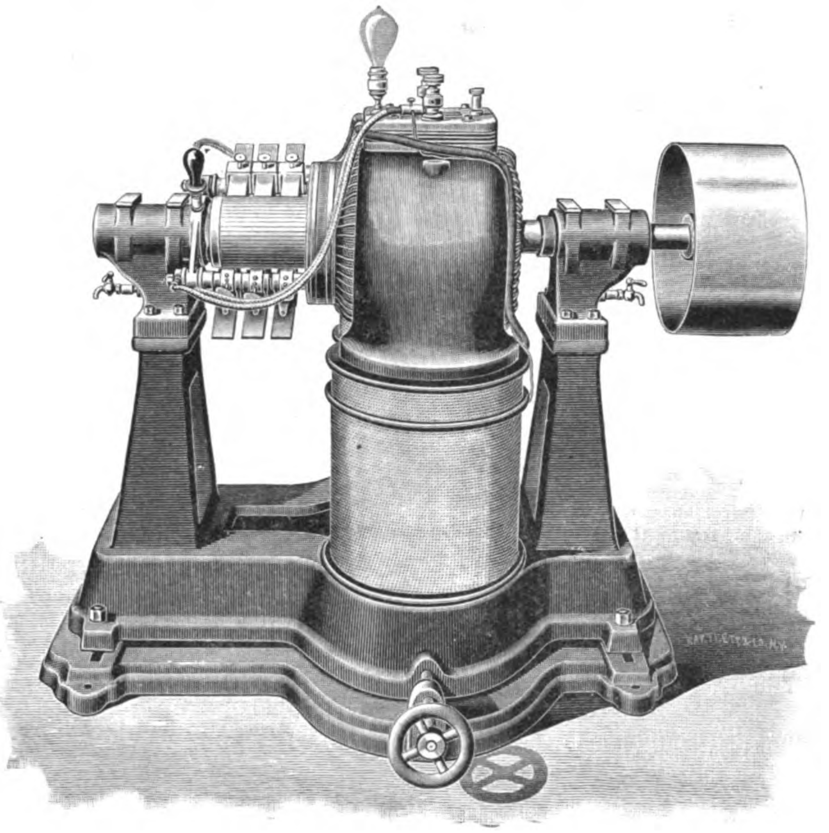
We would especially tender our professional services to parties who desire to obtain adequate and complete patent protection for *complicated, difficult* and *important* inventions, for dealing effectively with which class of cases we feel confident that the long and varied experience of both Mr. Read and myself in all classes of electrical work has given us exceptional qualifications.

Yours very truly,
FRANKLIN L. POPE.

41 Cortlandt street, N. Y., May 25.

Valves and Hydrants at the Exposition.

The Chapman Valve Manufacturing Company have an extensive and attractive exhibit of their goods at the World's Columbian Exposition, including a varied display of Straightway Valves and Hydrants. The location of their exhibit in Machinery Hall is Main 26, K-28. The company has an attentive representative in charge there, and they cordially invite persons intending to visit the Exposition to call and inspect their exhibit. Jackson Park power station of the Western Dummy Electric Railroad is fitted throughout with their valves.



THE LA ROCHE DYNAMO.

A Busy Manufacturing Company.

The Elektron Manufacturing Company of Springfield, Mass., are experiencing a very lively demand for their improved electric elevators; and for the convenience of customers in Boston and that neighborhood they have recently opened an office at 103 Milk street, that city, and have stationed there Mr. E. Marshall as manager of the elevator department, and Mr. F. B. Corey as manager of the electrical department. These two gentlemen are both experts in their particular departments and will handle successfully any business that may come their way. Mr. Marshall has had a long experience in the elevator business in connection with the Otis & Graves hydraulic and power apparatus.

The Boston office of the Elektron Company has recently installed electric elevators for Messrs Curtis & Bolster 2,304 Washington street, and Frank Ferdinand, 2,280 Washington street, Boston.

The main office of the Elektron Company at Springfield has recently sold electric elevators to the new Masonic Hall, Springfield, Mass., the finest building in the city; Brown, Thompson & Co., dry goods store, Hartford; W. H. King & Son, paper dealers, Springfield; the latter order being the second from that well-known firm.

New Use of the Lundell Fan Outfit.

Amusement seekers during the hot summer months will appreciate the liberality of the management of the Fifth Avenue Theatre and actors will bless it when they feel the cooling zephyrs that make this theatre a delightful resort. This invisible, inaudible delight is the result of experiments with a fan motor outfit. The Lundell outfit was chosen, particularly on account of its noiselessness. The boxes will have each an individual outfit and there will be a plentiful distribution of fans throughout the auditorium, stage and dressing rooms. The Interior Conduit and Insulation Company, whose wiring system is installed in the building, furnish the Lundell fan outfits.

The Lundell Fan Motor.

A neat little catalogue, wholly devoted to the Lundell Fan Motors, has just been issued by the Interior Conduit and Insulating Company, who are the manufacturers of the motors. The several illustrations given show the form and construction of the motor and its parts, which are fully described in the letterpress. Among the merits claimed for the Lundell Fan Motors are: Novelty of design, ideal shape, compact and clean appearance, no leakage of magnetic lines of force, highest efficiency attainable, small weight, no sparking at the brushes, steady point of commutation, simplicity and noiselessness. The motors are superbly finished in rich black japanning with neat red and gold striping.

The Premier-DeMott Battery.

BROOKLYN, April 17, 1893.

MR. M. R. RODRIGUES, Brooklyn, N. Y.

Dear Sir: A careful test of a cell of your Premier-DeMott Blue Stone Battery, set up April 5, inst., shows it to be capable of delivering a practically constant current, on short circuit, of 2.89 amperes, electromotive force of 1.079 volts, the internal resistance being less than one-half of an ohm (.45.) Yours, etc.

EDWARD BLAKENEY.

COMMERCIAL PARAGRAPHS.

Mr. Paul Firdler, of the Boston Braid Company, has gone out West on an important business trip, and will be away about a fortnight. He is accompanied by Mrs. Firdler. Before their return they will visit the more important Western cities.

The Consolidated Electric Manufacturing Company is now rushed with orders for their new type arc light machine with Elkins regulator. This dynamo is a radical departure from any other machine on the market and bids fair for becoming a favorite. Its beauty of design and high efficiency in service recommend it every time.

The Whitney Electrical Instrument Company, whose chief office is in Boston, with factories in Penacook, N. H., and Sherbrooke, P. Q., Canada, has just issued a very handsomely illustrated catalogue and price-list of its voltmeters, ammeters, indicators and other instruments for accurate measurement in the electrical business These well known instruments have won a prominent place in popular favor and the demand for them is daily on the increase.

The Campbell Electrical Supply Company, 104 High street, Boston, has been appointed New England agent for the La Roche Motor Company, Philadelphia, and now has on exhibit some of those handsome and efficient motors.

Mr. F. S. Palmer, general manager of the Electric Heat Alarm Company, Boston, has an attractive exhibit at the World's Fair, and in order that visitors shall fully understand and appreciate the value and usefulness of this unique device, he has had circulars and cards printed in three languages, viz., English, French and German.

Those station managers who realize the value of standardized fuse wire may be interested to know that the Wirt fuse wire handled by the Ansonia Electric Company, formerly the Electrical Supply Company, is standardized wire.

The large sales which the Ansonia Electric Company, formerly the Electrical Supply Company, are making of Shield Brand Wire, Stanley Transformers and Helios Lamps would tend to prove that it is a combination which operators of plants think very highly of.

A very neat little pamphlet has recently been issued by the Ansonia Electric Company, descriptive of the W.-W. Lightning Arrester, which ought to be of interest to every station superintendent or manager.

The New Sunbeam Incandescent Lamp which is being manufactured by the Star Electric Lamp Company is proving much superior to the old vacuum lamps. The gas uniting with the carbon when incandescent prevents the drop of candle power which was unavoidable in the old style of lamp, and maintains the lamp at full initial candle power throughout its life. Orders are coming in in increasing quantities, showing that the electrical fraternity appreciate the successful efforts of the Star Electric Lamp Company to supply an entirely new incandescent lamp which shows a great step in advance in the art.

The Railway Equipment Company, Chicago, reports contracts made for type "G" overhead material during the last few weeks with the Tiffin [O.] Electric Railway Company; Belle City Street Railway Company, Racine, Wis.; Norristown [Pa.] Electric Railway Company; South Chicago City Railway Company; Mobile [Ala.] Electric Light and Power Company; Camden and Atlantic Railroad Company, Atlantic City and Camden, N. J.; Calumet Electric Street Railway Company, Chicago; Trenton [N. J.] Iron Company; Columbia [Pa.] and Ironville Street Railway Company; Lehigh Traction Company, Hazleton, Pa.; Wheeling [W. Va.] Railway Company; Wichita [Kan.] Electric Railway Company; Fox River Street Railway Company, Green Bay, Wis.; Pottstown [Pa.] Passenger Railway Company; Wyandotte and Detroit River Railway Company, Ecorces, Mich.; Cumberland [Md.] Electric Railway; Montreal [Can.] Street Railway; Independence [Iowa] and Rush Park Railway; Westminster and Vancouver Tramway Company; Gettysburg [Pa.] Electric Railway; Second Avenue Passenger Railway, Pittsburg; Pittsburg and West End Passenger Railway; Escanaba [Mich.] Electric Street Railway Company; Atlantic Avenue Railroad Company, Brooklyn; Hammond [Ind.] Electric Railway Company.

INCORPORATIONS.

The Pleasure Resort Railway Company, Denver, Col. Capital stock, $100,000. Directors: L. F. Kimball, E. E. Somers, William Thorne, E. C. Skiles and Charles E. Skiles. The proposed line will start at the loop in North Denver and will be an electric line. It will extend to Rocky Mountain Lake.

The Rhinebeck Electric Light and Power Company of Rhinebeck, N. Y. Capital stock, $5,000. Directors: Thomas J. Swift and James L. Williams, of Poughkeepsie, and Allen H. Hoffman, of Rhinebeck.

The Kankakee Power Company, at Kankakee, Ill.—for the development of water and electric power. Capital stock, $100,000. Incorporators: William C. Thompson, John C. Smith and Antoine J. Bedard.

The Milford Electric Light and Power Transmission Company, Milford, Ill. Capital stock, $15,000. Incorporators: Henry V. Brown, Eugene W. Whipple and William H. Megg.

The Rochester and Irondequoit Railway Company—to build and operate an electric railway in North St. Paul street, Rochester, N. Y., to extend to Windsor Beach. Capital stock, $1,000,000. Directors: J. N. Beckley, Frederick Cook, W. S. Kimball, W. C. Barry, W. D. Ellwanger, Max Brickner, Jacob Gerling, Henry C. Brewster, Frank S. Upton, Louis Greishhimer, George W. Archer, Bernard Dunn, Fred W. Smith, of Rochester; Benjamin Graham, of New York, and M. A. Verner, of Pittsburg.

The Tiffin [Ohio] and Fostoria Railway Company has organized and elected officers as follows: Directors, Hon. George E. Seney, Milton Sayler, R. W. Brown, Hon. John McCauley, H. J. Weller, J. H. Platt and R. J. Beatty, of Tiffin, and Alonzo Emerine and Jeremiah Kestlerode, of Fostoria: president and treasurer, R. W. Brown: vice-president, Alonzo Emerine; secretary, Milton Sayler.

Centralia Light and Power Company, Centralia, Ill. Capital stock, $31,000. Incorporators; Seymour Andrews, F. Kohl and George L. Grittinger.

The Norwich Light and Power Company, formed to operate the gas and electric plant at Norwich, Chenango County, N. Y., recently owned by the Norwich Electric Illuminating Company, has been organized and the following directors elected: Edward F. Murray, of Troy; Senator Louis W. Emerson, of Warrensburgh; Senator Harvey J. Donaldson, County Treasurer Stephen C. Medbery and Herbert C. Westcot, of Ballston. The directors are the sole owners of the plant.

The Electrical Supply and Construction Company of Kansas City, Kan. Capital stock, $10,000. Directors: W. S. Nelson and B. F. Moots, of Kansas City, Mo.; W. H. Campbell, J. F. Frankey and H. A. Young, of Kansas City, Kan.

Consolidation papers of the Cooperstown Gas Company with the Cooperstown Electric Company have been filed with the Secretary of State at Albany, N. Y. The new company, which is to be known as the Cooperstown Gas and Electric Company, is to have a capital of $25,000. The following are the directors for the first year: Charles B. Staats, of Albany; Lee B. Cruttendon, Oliver R. Butler, James Bunyan and Paul T. Brady, of Cooperstown.

The Wagner Electro-Medical Company, at Chicago. Capital stock, $50,000. Incorporators: C. B. Gregg, W. D. Hawk and John S. Goodwin.

The Iowa Electric and Construction Company—to manufacture and sell all kinds of electrical apparatus and have its general office in Des Moines. Capital stock, $100,000. Incorporators: A. T. Hess, J. A. James, J. Steadman, E. C. Spinney, E. C. Pratt and Wm. Bowen. Officers: President, E. C. Spinney; vice-president, E. G. Pratt; secretary, J. A. Innessded; treasurer, Wm. Bowen. It is a reorganization and enlargement of the Hess Electrical Company.

The Wadestown Telephone Company, Wadestown, W. Va.—to construct and operate telephone lines from Wadestown to Burton, Blackstown, Morgantown, Fairmont, Mannington and intermediate points. The principal office will be at Wadestown. The incorporators are T. W. Barr, C. C. Hartner, C. L. Eakin, Asa Henderson and N. G. Garrison, all of Wadestown.

The Muncie Electric Company, Muncie, Ind. Capital stock, $200,000. Incorporators: Aretus W. Hatch, Willard C. Nichols, Edward McDevitt, James C. Devor and Andrew T. Hart. The articles secure the right to run a railway into adjoining counties.

The Mt. Pleasant and Hammondville Electric Street Railway Company, at Harrisburg, Pa. Capital stock, $18,000. Directors: D. P. Lowe, I. J. McWilliams, Monroe Morrison F. H. Sheppard, V. B. Hubbs, H. C. Morrison, of Mt. Pleasant. The road will be three miles long and will run through the borough of Hammondville, Pa.

The following charters were issued last week at Harrisburg, Pa.: The Allegheny Valley Heat, Light and Power Company, New Kensington, Westmoreland County; capital stock, $15,000. Tioga Point Electric Light and Power Company, Athens, Bradford County; capital stock, $8,000. The Electric Light and Power Company, Sayre; capital stock, $3,000. The Towanda Traction Company, Towanda; capital stock, $42,000.

ELECTRICAL PATENT RECORD.

Letters Patent Issued May 23, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

498,046. Electric-Railway Trolley. Edward H. Allen, Cramer Hill, N. J., assignor of two-thirds to William A. Barrett, Jr., Philadelphia, Pa. Filed Nov. 16, 1892.

498,135. Conduit Electric Railway. George F. Moffett, Portland, Ore. Filed Oct. 7, 1892.

498,169. Electric-Railway Conduit. Arthur H. Hieatzman, Baltimore, Md., assignor of one-half to Harry D. Hieatzman, same place. Filed July 28, 1891.

498,189. Electric-Railway Conduit. Joseph L. Reynolds, Winterset, Iowa. Filed July 23, 1892.

ELECTRIC LIGHTS AND APPLIANCES.

497,849. Wall Socket for Incandescent Lamps. Herbert C. Wirt, Boston, Mass., assignor to the General Electric Company, same place. Filed March 7, 1892.

497,898. Electrode-Shield for Arc Lamps. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Nov. 3, 1890.

497,955. Temporary Circuit-Connector for Incandescent Electric Lamps. Gustav A. Frei, Springfield, Mass. Filed Dec. 19, 1892.

497,956. Incandescent Lamp. Gustav A. Frei, Springfield, Mass. Filed Dec. 19, 1892.

497,957. Incandescent Electric Lamp. Gustav A. Frei, Springfield, Mass. Filed Feb. 7, 1893.

498,141. Electrode for Arc Lamp. Albert C. Seibold, Mount Vernon, N. Y. Filed Feb. 28, 1893.

DYNAMOS AND MOTORS.

497,887. Armature for Electric Motors or Generators. James F. McLaughlin, Philadelphia, Pa. Filed Dec. 17, 1891.

497,888. Electric Motor or Generator. James F. McLaughlin, Philadelphia, Pa. Filed July 27, 1892.

TELEPHONE AND TELEGRAPH APPARATUS.

497,907. Coin-Controlled Lock for Telephones. Pitt Cooke, Washington, D. C. Filed Dec. 24, 1892.

497 942. District-Telegraph Return-Signal Key. John M. Bell, Tacoma, Wash. Filed Oct. 24, 1892.

MEASURING INSTRUMENTS.

498,021. Electric Current Time-Meter. Henry H. Pattee, Monmouth, Ill. Filed Sept. 6, 1890.

498,022. Electric Current Time-Meter. Henry H. Pattee, Monmouth, Ill. Filed Sept. 6, 1890.

ELECTRIC HEATERS AND DOMESTIC APPLIANCES.

497,771. Electric Heater. Samuel M. Cook, Boston, Mass., assignor to the American Electric Heating Company, same place. Filed Jan. 17, 1893.

497,790. Electric Boiler. Samuel B. Jenkins, Boston, Mass., assignor to the American Electric Heating Company, same place. Filed Oct. 14, 1892.

497,791. Electric Radiator. Samuel B. Jenkins, Boston, Mass., assignor to the American Electric Heating Company, same place. Filed Nov. 25, 1892.

497,792. Electric Flat-Iron Heater. Samuel B. Jenkins, Boston, Mass., assignor to the American Electric Heating Company, same place. Filed Dec. 5, 1892.

497,793. Electric Soldering-Iron. Samuel B Jenkins, Boston, Mass., assignor to the American Electric Heating Company, same place. Filed Dec. 5, 1892.

497,794. Electric Heater for Flat-Irons or other Articles. Samuel B. Jenkins, Boston, Mass., assignor to the American Electric Heating Company, same place. Filed Dec. 5, 1892.

497,795. Electric Heater. Samuel B. Jenkins, Boston, Mass., assignor to the American Electric Heating Company, same place. Filed Dec. 8, 1892.

498,078. Method of Manufacturing Electric Heaters. Henry G. O'Neill, Boston, Mass., assignor to the Standard Electric Heat, Light and Power Company of Maine. Filed Aug. 20, 1892.

MISCELLANEOUS.

497,822. Electro-Therapeutic Appliance. Henry C. Royer, Los Angeles, Cal., assignor of one-half to John E. Reed, same place. Filed Oct. 3, 1892.

497,832. Electric Mining-Machine. Elmer A. Sperry, Chicago, Ill., assignor, by mesne assignments, to the Thomson-Houston Electric Company of Connecticut. Filed Oct. 8, 1888.

497,836. Safety Block System for Railway Signaling. William R. Sykes, Jr., and John P. O'Donnell, London, England. Filed Oct. 1, 1892.

497,838. Safety Appliance for Systems of Electric Distribution. Elihu Thomson, Lynn, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Jan. 29, 1890.

497,844. Electrical Fuse-Link. Marion C. Walls, Plymouth, Ind. Filed March 2, 1893.

497,852. Insulation for Underground Wires. Parvin Wright, Denver, Col. Filed Jan. 27, 1890. Renewed Aug. 18, 1892.

497,869. Electric Accumulator. Paul J. R. Dujardin, Paris, France. Filed March 15, 1892.

497,963. Combined Nut-Lock and Electrical Connection for Railroad-Rails. Albert L. Johnson, Cleveland, Ohio. Filed April 27, 1892.

498,153. Thermal Circuit-Closer and Indicator. Jay L. Bradly, St. Louis, Mo. Filed Dec. 5, 1892.

498,160. Electric Steering-Gear. Frank L. Dyer and Leonard H. Dyer, Washington, D. C., assignors of one-third to Alexander McDougall, Duluth, Minn. Filed April 18, 1891.

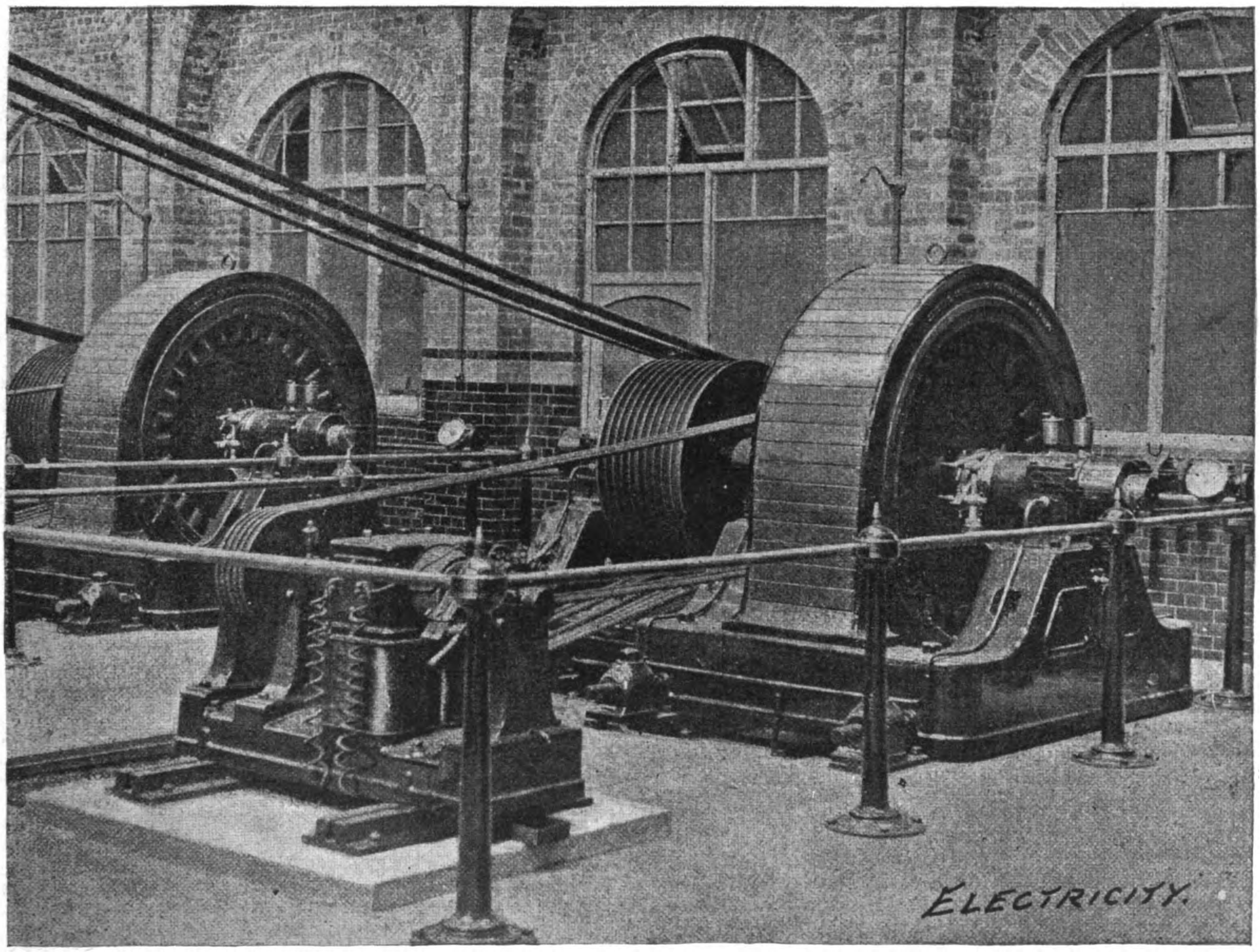
498,183. Torpedo. Samuel E. Mower and George E. Haight, New Haven, Conn., assignors to Henry G. Thompson & Son, same place. Filed July 5, 1892.

RE-ISSUE.

11,341. Incandescent-Electric-Lamp Socket. Isaac Goldkind, New York, N. Y., assignor to Louis Stirn and Julius Somborn, same place. Filed Nov. 22, 1892. Original No. 479,859, dated July 19, 1892.

ELECTRICITY.

VOL. IV. NEW YORK. JUNE 7, 1893. CHICAGO. No. 21



DYNAMO ROOM, LEEDS CENTRAL STATION. (SEE PAGE 286.)

The Leeds Central Station.

The inauguration of the Leeds (England) Central Station took place on May 10, and was marked by extensive ceremonies, including a banquet.

The system is a high-pressure alternating-current transformer supply at constant pressure to transformers fixed at first in suitable positions on consumers' premises; but when a sufficient number of services has been secured the distribution will be carried out by means of low-pressure distributing mains fed from converting stations. The distributing mains consist of insulated cables laid in cast-iron conduits underground where possible.

The engine room, shown in Fig. 1, is a large, commodious room 68 feet × 63 feet, which is spanned by a traveling crane of ten tons capacity.

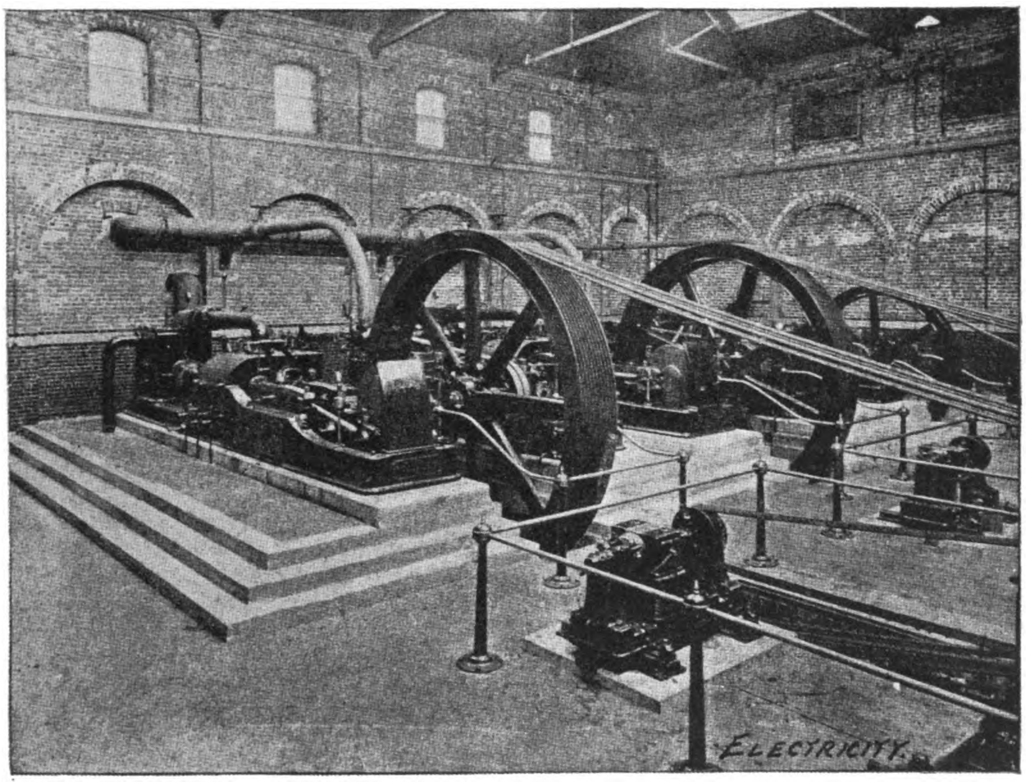


FIG. 1.

The engine room is equipped with two 200 I. H. P. engines driving two 100-kilowatt alternators, and one 100 I. H. P. engine driving a 50 kilowatt alternator. The plant is capable of supplying 7,500 35-watt lamps. The engines are of the horizontal coupled compound condensing type, the size of the larger ones being considered by the engineers to be the most suitable unit to work in sections, having regard to the requirements of the business. The speed of the larger engines is 90 revolutions, the ordinary working pressure is 125 lbs. per square inch, but they will work without difficulty up to 140 lbs., and give each 250 I. H. P. as a maximum load. This provides for a good margin sufficient to meet all possible contingencies. The dimensions of the parts are: high pressure cylinder 14 inches diameter, low pressure 25 inches diameter, and stroke 30 inches. The slide bars do not consist of a cylindrical casting, but are made separate in two pairs to each cylinder in such a way that easy adjustment is possible. The bed plate of the engine is of the most massive construction. A noticeable feature is the strength of the crankshaft and the length and surface of the bearings.

Injection condensers are employed in conjunction with these engines, the air pumps, condenser and hot well being formed in one casting, and fixed to the bed plate at the back of the low pressure cylinder, the air pump being coupled direct to the low pressure piston rod working through the back of the cylinder cover. The engines are so arranged that they can be worked non-condensing in case of any failure of condensing water. They are also fitted with automatic expansion gear, controlled by powerful governors acting on the cut off valves of both cylinders. The fly-wheels of the large engines are 14 feet in diameter.

The alternators, shown in the Frontispiece, are the Lowrie-Parker multipolar type. They are self-regulating to about 16 per cent., this advantage being secured by a simple alteration in the design of the magnetic field. The working pressure is 2,000 volts, and, as in the case of the engines, allows a good working margin. The insulation resistance between the coils and the frame is about 15 megohms. The armatures and field magnet conductors do not carry more than 2,000 amperes per square inch of section. The cables are led away from the switchboard terminals in suitable trenches which are rendered accessible by wooden traps let in the floor.

The exciters for the alternators are driven by ropes from a grooved pulley on the alternator shaft, and are each of ample size to generate a current sufficient for exciting the fields of the corresponding alternator without overheating. The exciting current is about 30 amperes, at a pressure of 120 volts for the 100 kilowatt machines, and 30 amperes at 60 volts for the 50-kilowatt machines.

The Electrical Experiments on the Erie Canal.

Superintendent Hannan has received several applications for permission to use the Erie Canal for experiments in electric propulsion for canal boats. There are 3,500 canal boats, and the electric motors to propel them would probably cost $250 each. The great manufacturers will no doubt enter into the competition announced by Superintendent Hannan. John Alden, of Rochester, one of the applicants, will use the power of the Westinghouse Electric Light Company at Rochester. Another inventor desires to have a trial at Schenectady, the headquarters of the General Electric Company.

Superintendent Hannan says he will employ the $10,000 appropriation partly in paying the salary of some competent electrical engineer who will make a report to him as to the success of the various systems of electrical propulsion proposed.

ON LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.

BY NIKOLA TESLA.* (*Continued.*)

It is beyond the scope of my lecture to dwell upon the subject of light in general, my object being merely to bring presently to your notice a certain class of light effects and a number of phenomena observed in pursuing the study of these effects. But to be consistent in my remarks it is necessary to state that according to that idea, now accepted by the majority of scientific men as a positive result of theoretical and experimental investigation, the various forms or manifestations of energy which were generally designated as "electric," or more precisely "electromagnetic," are energy manifestations of the same nature as those of radiant heat and light. Therefore the phenomena of light and heat, and others besides these, may be called electrical phenomena. Thus electrical science has become the mother science of all, and its study has become all important. The day when we shall know exactly what "electricity" is will chronicle an event probably greater, more important, than any other recorded in the history of the human race. The time will come when the comfort, the very existence perhaps, of man will depend upon that wonderful agent. For our existence and comfort we require heat, light and mechanical power. How do we now get all these? We get them from fuel; we get them by consuming material. What will man do when the forests disappear, when the coal fields are exhausted? Only one thing, according to our present knowledge will remain; that is, to transmit power at great distances. Men will go to the waterfalls, to the tides, which are the stores of an infinitesimal part of Nature's immeasurable energy. There will they harness the energy and transmit the same to their settlements, to warm their homes by, to give them light, and to keep their obedient slaves, the machines, toiling. But how will they transmit this energy if not by electricity? Judge then, if the comfort, nay the very existence, of man will not depend on electricity. I am aware that this view is not that of a practical engineer, but neither is it that of an illusionist, for it is certain that power transmission, which at present is merely a stimulus to enterprise, will some day be a dire necessity.

It is more important for the student who takes up the study of light phenomena to make himself thoroughly acquainted with certain modern views than to peruse entire books on the subject of light itself as disconnected from these views. Were I therefore to make these demonstrations before students seeking information—and for the sake of the few of those who may be present, give me leave to so assume—it would be my principal endeavor to impress these views upon their minds in this series of experiments.

It might be sufficient for this purpose to perform a simple and well-known experiment. I might take a familiar appliance, a Leyden jar, charge it from a frictional machine, and then discharge it. In explaining to you its permanent state when charged, and its transitory condition when discharging, calling your attention to the forces which enter into play and to the various phenomena they produce, and pointing out the relation of the forces and phenomena, I might fully succeed in illustrating that modern idea. No doubt, to the thinker, this simple experiment would appeal as much as the most magnificent display. But this is to be an experimental demonstration, and one which should possess, besides instructive, also entertaining features, and as such a simple experiment, such as the one cited, would not go very far towards the attainment of the lecturer's aim. I must therefore choose another way of illustrating, more spectacular certainly, but perhaps also more instructive. Instead of the frictional machine and Leyden jar, I shall avail myself in these experiments of an induction coil of peculiar properties, which was described in detail by me in a lecture before the London Institution of Electrical Engineers in February, 1892, This induction coil is capable of yielding currents of enormous potential differences, alternating with extreme rapidity. With this apparatus I shall endeavor to show you three distinct classes of effects, or phenomena, and it is my desire that each experiment, while serving for the purposes of illustration, should at the same time teach us some novel truth, or show us some novel aspect of this fascinating science. But before doing this it seems proper and useful to dwell upon the apparatus employed, and method of obtaining the high potentials and high-frequency currents which are made use of in these experiments.

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* A lecture delivered before the Franklin Institute at Philadelphia, Feb. 24, 1893, and before the National Electric Light Association at St. Louis, Mo., March 1, 1893.

ON THE APPARATUS AND METHOD OF CONVERSION.

These high-frequency currents are obtained in a peculiar manner. The method employed was advanced by me about two years ago in an experimental lecture before the American Institute of Electrical Engineers. A number of ways, as practised in the laboratory, of obtaining these currents either from continuous or low-frequency alternating currents is diagrammatically indicated in Fig. 1, which will be later described in detail. The general plan is to charge condensers from a direct or alternate current source, preferably of high tension, and to discharge them disruptively while observing well-known conditions necessary to maintain the oscillations of the current. In view of the general interest taken in high-frequency currents and effects producible by them, it seems to me advisable to dwell at some length upon this method of conversion. In order to give you a clear idea of the action, I will suppose that a continuous-current generator is employed, which is often very convenient. It is desirable that the generator should possess such high tension as to be able to break through a small air space. If this is not the case, then auxiliary means have to be resorted to, some of which will be indicated subsequently. When the condensers are charged to a certain potential, the air or insulating space gives way and a disruptive discharge occurs. There is then a sudden rush of current and generally a large portion of the accumulated electrical energy spends itself. The condensers are thereupon quickly charged, and the same process is repeated in more or less rapid succession. To produce such sudden rushes of current it is necessary to observe certain conditions. If the rate at which the condensers are discharged is the same as that at which they are charged, then, clearly, in the assumed case the condensers do not come into play. If the rate of discharge be smaller than the rate of charging, then again the condensers cannot play an important part. But if, on the contrary, the rate of discharging is greater than that of charging, then a succession of rushes of current is obtained. It is evident that if the rate at which the energy is being dissipated by the discharge is very much greater than the rate of supply to the condensers, the sudden rushes will be comparatively few, with long time intervals between. This always occurs when a condenser of considerable capacity is charged by means of a comparatively small machine. If the rates of supply and dissipation are not widely different, then the rushes of current will be in quicker succession, and this the more the more nearly equal both the rates are, until natural limitations incident to each case and depending upon a number of causes are reached. Thus we are able to obtain from a continuous-current generator as rapid a succession of discharges as we like. Of course, the higher the tension of the generator the smaller need be the capacity of the condensers, and for this reason, principally, it is of advantage to employ a generator of very high tension. Besides, such a generator permits the attaining of greater rates of vibration.

The rushes of current may be of the same direction under the conditions before assumed, but most generally there is an oscillation superimposed upon the fundamental vibration of the current. When the conditions are so determined that there are no oscillations, the current impulses are undirectional, and thus a means is provided of transforming a continuous current of high tension into a direct current of lower tension, which I think may find employment in the arts.

This method of conversion is exceedingly interesting and I was much impressed by its beauty when I first conceived it. It is ideal in certain respects. It involves the employment of no mechanical devices of any kind, and it allows of obtaining currents of any desired frequency from an ordinary circuit, direct or alternating. The frequency of the fundamental discharges depending on the relative rates of supply and dissipation can be readily varied within wide limits by simple adjustments of these quantities, and the frequency of the superimposed vibration by the determination of the capacity, self-induction and resistance of the circuit. The potential of the currents, again, may be raised as high as any insulation is capable of withstanding safely, by combining capacity and self-induction or by induction in a secondary, which need have but comparatively few turns.

As the conditions are often such that the intermittence or oscillation does not readily establish itself, especially when a direct current source is employed, it is of advantage to associate an interrupter with the arc, and I, some time ago, indicated the use of an air-blast or magnet, or other such device readily at hand. The magnet is employed with special advantage in the conversion of direct currents, as it is then very effective. If the primary source is an alternate current generator, it is desirable, as I have stated on another occasion, that the frequency should be low, and that the currents forming the arc be large, in order to render the magnet more effective.

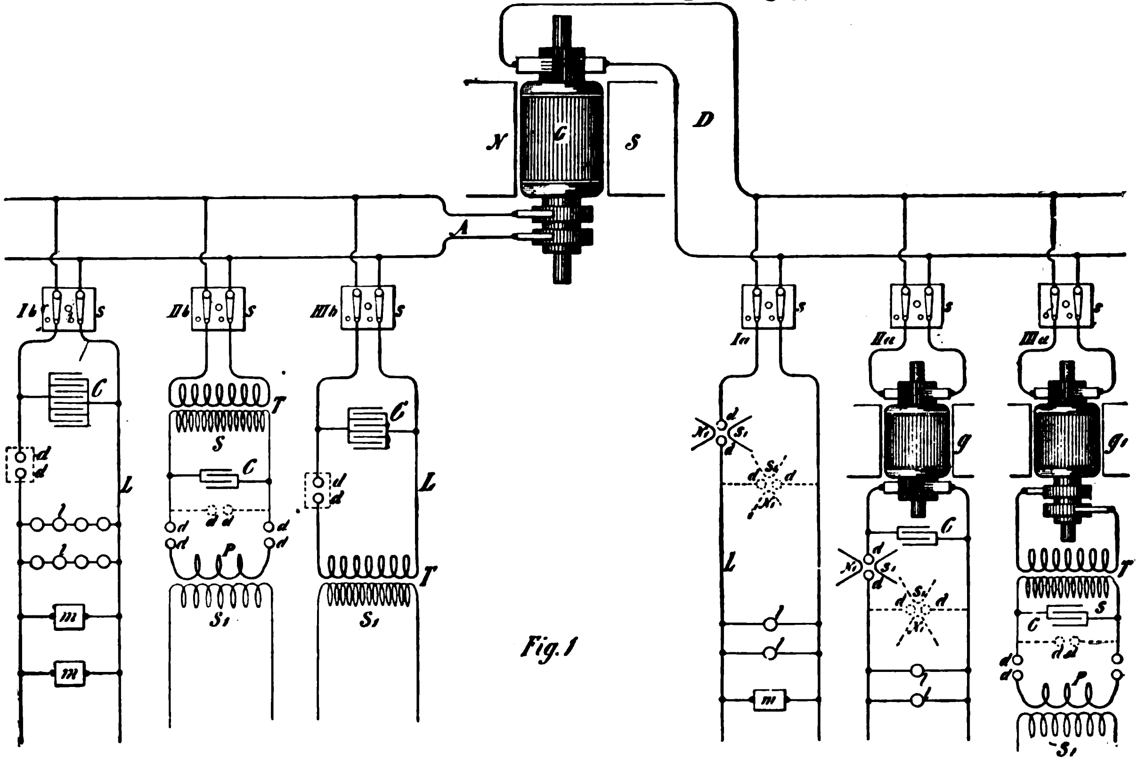

Fig. 1

A form of such discharger with a magnet which has been found convenient, and adopted after some trials, in the conversion of direct currents particularly, is illustrated in Fig. 2. N S are the pole pieces of a very strong magnet which is excited by a coil C. The pole pieces are slotted for adjustment and can be fastened in any position by screws s_1 s_1. The discharge rods d d_1, thinned down on the ends in order to allow a closer approach of the magnetic pole pieces, pass through the columns of brass b b_1 and are fastened in position by screws s_2 s_2. Springs r r_1 and collars c c_1 are slipped on the rods, the latter serving to set the points of the rods at a certain suitable distance by means of screws s_3 s_3, and the former to draw the points apart. When it is desired to start the arc, one of the hard rubber handles h h_1 is tapped quickly with the hand, whereby the points of the rods are brought in contact, but are instantly separated by the springs r r_1. Such an arrangement has been found to be often necessary, namely, in cases when the E. M. F. was not large enough to cause the discharge to break through the gap, and also when it was desirable to avoid short circuiting of the generator by the metallic contacts of the rods. The rapidity of the interruptions of the current with a magnet depends on the intensity of the magnetic field and on the potential difference at the ends of the arc. The interruptions are generally in such quick succession as to produce a musical sound. Years ago it was observed that when a powerful induction coil is discharged between the poles of a strong magnet the discharge produces a loud noise not unlike a small pistol shot. It was vaguely stated that the spark was intensified by the presence of the magnetic field. It is now clear that the discharge current, flowing for some time, was interrupted a great number of times by the magnet, thus producing the sound. The phenomenon is especially marked when the field circuit of a large magnet or dynamo is broken in a powerful magnetic field.

When the current through the gap is comparatively large, it is of advantage to slip on the points of the discharge rods pieces of very hard carbon and let the arc play between the carbon pieces. This preserves the rods and besides has the advantage of keeping the air space hotter, as the heat is not conducted away as quickly through the carbons, and the result is that a smaller E. M. F. in the arc gap is required to maintain a succession of discharges.

Another form of discharger which may be employed with advantage in some cases is illustrated in Fig. 3. In this form the discharge rods d d_1 pass through perforations in a wooden box

B, which is thickly coated with mica on the inside, as indicated by the heavy lines. The perforations are provided with mica tubes $m\ m_1$ of some thickness, which are preferably not in contact with the rods $d\ d_1$. The box has a cover c which is a little larger and descends on the outside of the box. The spark gap is warmed by a small lamp l contained in the box. A plate p above the lamp allows the draught to pass only through the chimney c of the lamp, the air entering through holes $o\ o$ in or near the bottom of the box and following the path indicated by the arrows. When the discharger is in operation the door of the box is closed so that the light of the arc is not visible outside. It is desirable to exclude the light as perfectly as possible, as it interferes with some experiments. This form of discharger is simple and very effective when properly manipulated. The air being warmed to a certain temperature has its insulating power impaired, it becomes dielectrically weak, as it were, and the consequence is that the arc can be established at much greater distance. The air should, of course, be sufficiently insulating to allow the discharge to pass through the gap *disruptively*. The arc formed under such conditions, when long, may be made extremely sensitive, and the weak draught through the lamp chimney c is quite sufficient to produce rapid interruptions. The adjustment is made by regulating the temperature and velocity of the draught. Instead of using a lamp it answers the purpose to provide for a draught of warm air in other ways. A very simple way which has been practised is to inclose the arc in a long vertical tube with plates on the top and bottom for regulating the temperature and velocity of the air current. Some provision had to be made for deadening the sound.

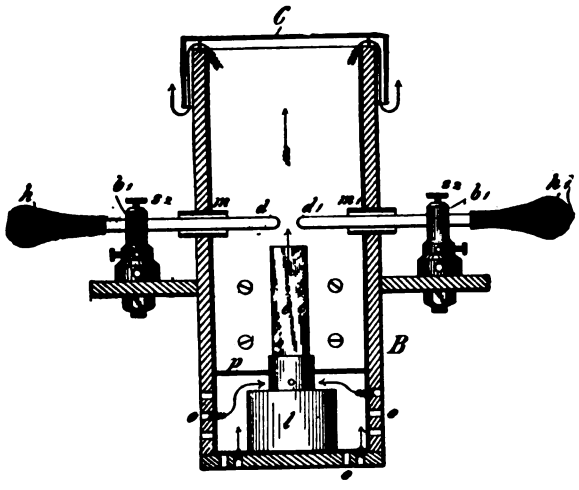

Fig. 3

The air may be rendered dielectrically weak also by rarefaction. Dischargers of this kind have likewise been used by me in connection with the magnet. A large tube is for this purpose provided with heavy electrodes of carbon or metal, between which the discharge is made to pass, the tube being placed in a powerful magnetic field. The exhaustion of the tube is carried to a point at which the discharge breaks through easily, but the pressure should be more than 75 millimeters, at which the ordinary thread discharge occurs. In another form of discharger, combining the features before mentioned, the discharge was made to pass between two adjustable magnetic pole pieces, the space between them being kept at an elevated temperature.

It should be remarked here that when such, or interrupting devices of any kind, are used, and the currents are passed through the primary of a disruptive discharge coil, it is not, as a rule, of advantage to produce a number of interruptions of the current per second greater than the natural frequency of vibrations of the dynamo supply circuit, which is ordinarily small. It should also be pointed out here that while the devices mentioned in connection with the disruptive discharge are advantageous under certain conditions they may be sometimes a source of trouble, as they produce intermittences and other irregularities in the vibration which would be very desirable to overcome.

This is, I regret to say, in this beautiful method of conversion a defect, which fortunately is not vital, and which I have been gradually overcoming. I will best call attention to this defect and indicate a fruitful line of work by comparing the electrical process with its mechanical analogue. The process may be illustrated in this manner: Imagine a tank with a wide opening at the bottom which is kept closed by spring pressure, but so that it snaps off *suddenly* when the liquid in the tank has reached a certain height. Let the fluid be supplied to the tank by means of a pipe feeding at a certain rate. When the critical height of the liquid is reached, the spring gives way and the bottom of the tank drops out. Instantly the liquid falls through the wide opening, and the spring, reasserting itself, closes the bottom again. The tank is now filled and after a certain time interval the same process is repeated. It is clear that if the pipe feeds the fluid quicker than the bottom outlet is capable of letting it pass through, the bottom will remain off and the tank will still overflow. If the rates of supply are exactly equal, then the bottom lid will remain partially open and no vibration of the same and of the liquid column will generally occur, though it might, if started by some means. But if the inlet pipe does not feed the fluid fast enough for the outlet, then there will be always vibration. Again, in such case, each time the bottom flaps up or down, the spring and the liquid column, if the pliability of the spring and the inertia of the moving parts are properly chosen, will perform independent vibrations. In this analogue the fluid may be likened to electricity or electrical energy, the tank to the condenser, the spring to the dielectric and the pipe to the conductor through which electricity is supplied to the condenser. To make this analogy quite complete it is necessary to make the assumption that the bottom, each time it gives way, is knocked violently against a non-elastic stop, this impact involving some loss of energy, and that, besides some dissipation of energy results, due to frictional losses. In the preceding analogue the liquid is supposed to be under a steady pressure. If the pressure of the fluid be assumed to vary rhythmically, this may be taken as corresponding to the case of an alternating current. The process is, then, not quite as simple to consider, but the action is the same in principle.

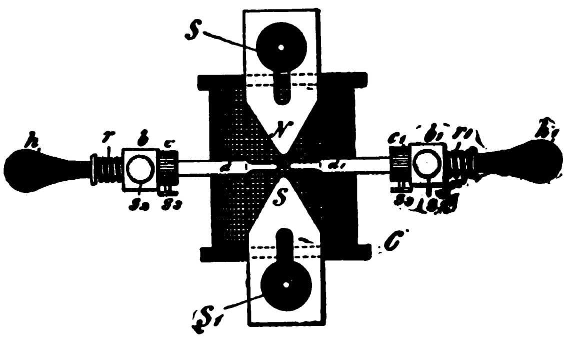

Fig. 2

(To be continued.)

The new telegraph and telephone lines for the New York police, fire and hospital services are now nearly completed, and will soon be in operation.

Revolution in Electric Heating.†

The State Department has just received from United States Consul General Frank M. Mason, at Frankfort, an interesting report concerning a discovery recently announced from Brussels and tested at Berlin, so original and so wide in its practical application that it is believed that it will open a new and important chapter in the use of electricity for heating purposes.

The invention is the joint achievement of two Belgian scientists, Messrs. Lagrange and Hoho, who a few days ago applied to the Imperial German Patent Office for patents on a new method of heating, melting and refining metals by means of electrical heat. The means, as designated in their claim, were so simple and the results as therein described so incredible that the patent examiners demanded that before issuing the patent a practical demonstration of the process should be made in their presence. The matter was referred to an eminent and disinterested electrical expert at Berlin, who made the first essays in his private laboratory and was so delighted with the result that he asked by telegraph permission of the inventors to repeat the demonstration before the Electro-Technical Society at the German capital. Permission was readily granted, and the experiments were performed before the group of expert electricians with brilliant success. From the account given by one of the experts who were present at these demonstrations and from various other sources the following report of the new process has been derived:

The apparatus consists of a glass or porcelain vase, which may be of any size conveniently adapted to the purpose, provided with a lining of lead connected with a strong conductor of positive electricity. The vase is filled to three-fourths its capacity with acidified water. A pair of iron tongs with insulated handles is attached by a flexible conductor to the negative pole of an electrical current generated by an ordinary dynamo. With this simple and inexpensive equipment the following phenomenon is produced.

The electrical current having been switched on, a bar of wrought iron or other metal is taken up with the tongs and plunged into the water within the vase. Immediately the water begins to boil at the point of contact; the immersed portion of the iron rises quickly to a red, then to a white, heat, and emits a stream of brilliant white light. In a few moments the heat becomes so intense that the iron melts and falls off in bubbles and sparks, leaving a clear, glowing surface in perfect condition for welding. The heating process has been so rapid that neither the water nor the end of the bar held within the tongs has been more than slightly warmed, and the current being switched off, the bar, with its submerged and glowing ends, may be readily held in the naked hand. If, instead of a bar of metal, a stick of carbon is used, the heat in a few minutes produces detached fragments of amorphous carbon, which proves scientifically that a temperature of 4,000 degrees Celsius has been developed. The rapidity of the heating and the limit of temperature to be reached are easily and accurately governed by the strength of the current employed, so that the whole process is under the absolute control of the operator. During the recent experiments at Berlin the measuring instruments registered a tension of 120 volts and an energy of 220 amperes. It was estimated that fully 50 per cent. of the current was directly utilized as heat, and at a still stronger current a temperature of 8,000 degrees Celsius has been developed. The importance of this fact will be apparent when it is remembered that this is a degree of heat nearly three times greater than that required to extract iron from the ores, the most refractory of which fuse at about 2,700 degrees.

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†From advance sheets of U.S. Consular Reports for June.

Divested of all technical phraseology the process under consideration may be explained as follows: One of the well-known effects of electricity is to separate compound fluid bodies through which it passes into their primitive elements. The current, passing through the tongs and metallic bar into the water, decomposes the latter into its two gaseous elements—oxygen and hydrogen. The oxygen is attached and gathered on the relatively large surface of the lead lining, and produces no noticeable effect. The hydrogen, on the other hand, gathers around the immersed portion of the bar; and as this has a comparatively limited surface area, it is immediately surrounded with a close envelope or jacket of hydrogen, which, being a bad conductor of electricity, creates a powerful resistance to the passage of the current and thus develops the heat which causes the bar to glow and melt. It is merely an application of the well known law that friction or resistance to the passage of an electrical current causes heat.

It is as yet too early to form any definite estimate of the practical range of this discovery or its commercial value. Thus far it has been applied experimentally only to the welding of various metals, but with such success that it promises, in that special field, to inaugurate a complete revolution.

All these former difficulties in electric heating are apparently completely mastered by the newly discovered process above described. For welding purposes it is pronounced perfect. The clean envelope of hydrogen which surrounds the heated metal prevents oxidation, and the welding surface is left free from the effects of sulphur and other impurities which are always present when iron is heated by a coal fire in an ordinary forge. The quality which entails the largest possibilities, and which has been as yet only superficially investigated, is the capacity of this process to heat quickly and to any desired temperature the end or submerged surface of a mass of iron while the remainder of the mass is left cool and comparatively unaffected by the heat. It is believed that this may lead to important results in the hardening and tempering of armor plates and other objects in iron and soft steel in which great resistance to penetration or abrasion by friction is requisite while preserving the interior tough and fibrous to resist concussion or strain, as in many parts of machinery. At Essen, Messrs. Krupp & Co. are experimenting with it in the hardening of steel cannon; and it is believed that in chemistry this method of producing an intense and easily regulated temperature may lead to the successful manufacture of diamonds, rubies and sapphires through the production of the larger forms of crystallized carbon.

The Hawaiian Cable Survey.

The results of the survey made by the Albatross party to determine the practicability of laying a cable between California and the Hawaiian Islands have been printed in the form of an elaborate report, illustrated with numerous drawings showing the routes surveyed and matters incidental to the soundings.

According to the report submitted to the Hydrographic Office, the most feasible route is a lane about 300 miles wide between Monterey Bay and Honolulu. Soundings were taken in general at alternate intervals of ten and two miles between Salinas Landing in Monterey Bay and Honolulu and between Point Conception and Hilo Bay, and along a rhomb line between Salinas Landing and Honolulu. Specimens of the bottom of the sea were obtained at each sounding, and the temperature of the air and the surface of the ocean were observed. The density of the sea water was frequently taken by observations at the surface and at depths ranging from 25 to 1,000 fathoms. Whenever, by reason of a notable change in the depth or in the character of the bottom soil, there were reasons to suspect any important irregularity in the bed of the ocean, numerous soundings were taken to provide for an examination of the locality in detail.

The total length of the lines sounded was 4,511 miles; the mean intervals between the soundings were 8.1 miles; total distance steamed in connection with the survey, 8,735 miles; number of soundings made with wire, 502; number made with hand line, 54.

In the shallow waters of the Hawaiian Islands the temperature was found to be about 77 degs. in winter, and, as a gutta percha core may sustain deformations sufficient to bring about a weakening of the insulation on this account, the experts on the Albatross recommend the employment of another insulation material at that end of the line.

World's Fair Notes.

The Electricity Building at the World's Fair has at last been formally opened to the public. The event took place Thursday evening of last week, and although the weather was threatening, a large crowd was attracted by the electrical display promised. The Edison tower, located in the center of the building, proved to be the leading feature of the exhibits. In time with the music from a band of fifty pieces, stationed in the balcony, the light was made to chase up and down and zigzag across the column and at the same time change to several colors. As it is necessary to have an attendant present to operate the lights, the display was shown at intervals of fifteen minutes. It was admitted by all present that the display was one of the most brilliant ever seen in the electrical line.

Last Saturday evening was the opening night for the battle-ship. The public was invited to inspect the model warship, and among other things to see the various applications of electricity to modern warfare. Among the applications illustrated on the ship were the searchlights, the training of guns, the telephone and the illumination of the decks and cabins by both arc and incandescent lights.

On account of several of the dynamos not being ready for use, a number of the circuits intended for illuminating the various buildings have to be cut out during certain portions of the evenings on which the Fair is opened. A large number of the exhibitors have entered complaints about the lights being suddenly turned out in the parts of the building where their exhibits are located, but as there is no remedy until the machines are in shape to generate current their complaints are without avail.

There is one exhibit in the Electricity Building which can be certainly depended upon to always draw a crowd—that is, if the ordinary street hand-organ can be taken as a criterion. It is located in the northeast balcony, and is composed of a number of pianos and automatic organs. The latter instruments can be distinctly heard in any part of the building when the crank is turned by a sturdy employé.

The Western Electric Company will soon have their large multipolar generator, the base of which was accidentally broken when it was being installed, in operation in the generating station of Machinery Hall.

For the convenience of spectators desiring to visit the Ansonia Electric Company's booth, they have erected an elevator operated by an electric motor at the north end of the Electricity Building.

Among the exhibits which were operated for the visitors last week was that of the K. A. P. Electric Novelty Company. It consisted of a number of incandescent lamps mounted on an endless belt, which runs over two pulleys located at some distance from each other. The effect of the revolving colored lights forms a very pleasing subject for the eye.

Electrical Railway in Paris.

It is now some five years since the project of uniting the Bois de Boulogne and the Bois de Vincennes by means of an electric underground railway was first mooted in the French capital. Last year the Municipal Council accorded the concession as a work of public utility, and nothing but administrative formalities require to be complied with in order to place the project upon a sound working basis. It may be interesting to our readers to briefly describe what our neighbors on the other side of the Channel are doing with regard to this particular system of intercommunication. Owing to the nature of soil, and the numerous disturbances, amounting in many instances to absolute excavations, to which the upper stratum in Paris has been so frequently subjected, it is considered as highly dangerous to construct the subway or tunnel in masonry of even the best description. Another reason for abandoning the time-honored method is that it would be impossible to employ it without breaking up the surface of the roads and thoroughfares overhead, which the exigencies of a large and incessant metropolitan traffic do not permit of. In deference to these objections, cast-iron has been selected for the gigantic tube which will constitute the subway, and the circular form has been adopted for its section. The diameter of the tunnel will be twenty feet, which will ensure ample ventilation and passenger accommodation. A double line will run through the subway, and each train will be composed of four carriages or coaches succeeding one another at intervals of two minutes. Seventeen stations upon a total length of seven miles will occasion a large number of stoppages; but the time from one terminus to the other is calculated to be effected in three-quarters of an hour. This velocity is about the same as that at which our own electric line runs. A uniform fare of 20 centimes, equivalent to about two pence [four cents], will be charged, irrespective of the distance traversed. The motive force necessary for the adequate working of the line will be heavy. Steam-power of 4,000 horses will be required to generate electricity for the tractive power, as well as for the lighting of the subway. The generating station will be close to the site of the old Bastile. For the people, especially the working population, the new railway will be of the greatest advantage.—*Electricity* (London).

Current Items.

The Automatic Telephone and Electric Company of Canada intend, it is said, to lay a line of copper wires on the metallic-circuit plan from Halifax, N. S., to Vancouver. This is a distance of 3,500 miles. The circuit will be in sections, and be available for communication to many intermediate points.

A dispatch from Helena, Mont., states that Supt. Sommers, of the Rocky Mountain Bell Telephone Company, is building a telephone line between Livingston and Missoula. It will be a metallic or two-wire circuit and furnished with the latest improvements in long-distance transmitters, etc., and will be one of the best constructed long-distance lines in the Northwest.

A new invention is reported having for its aim the saving of waste in woollen and worsted mills. The device as described consists of a square wooden tank, about 6x6. Suspended in the upper part of this tank is a receiving box. Into this box is put the waste generally found in the mill, such as floor sweepings, waste from beneath the dusters, etc. The bottom of the receiving box is made of netting, and it is swung to and fro mechanically, the dust, etc., falling through. This leaves the waste, pieces of sticks, straw, etc., in the top. Now the action of the electrical current, which is obtained by a series of wires just above the receiving box, causes the wool fibres to separate from the refuse matter, and raise sufficiently to meet a current of air produced by a fan, by which they are carried off and saved.

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Facts.

It is just about nine months since ELECTRICITY, under new ownership, adopted a vigorous policy in regard to the Electric Trust and its proposed monopoly in the business. How effective this policy has been in preventing the accomplishment of the Trust's objects we leave to our readers to determine in the light of recent events.

Our contention was as follows:

That the Trust was organized on the theory that the entire electrical industry of the country could be monopolized and a majority of smaller concerns either frozen out or compelled to pay tribute. We held that the success of this campaign of extinction meant untold and unjustifiable injury to the smaller concerns, and a practical cessation of development in the art.

And further, that the Trust was ridiculously over-capitalized; that it had neither the manufacturing plants nor earning capacity to justify a capitalization of $50,000,000; that the collapse of the stock in the market was inevitable, and that when it came great and widespread injury to the trade at large would ensue, as capital would be timid about electrical investments generally.

We see no reason to-day to change our opinions on any of these points.

The only possible way for the Trust to earn dividends was to establish a monopoly. This it has not been able to do, and monopoly is as dead as a salted codfish hung up on a nail.

The theory was, of course, that by coming together the T.-H. and Edison companies would do as much or a little more business than formerly, and at a greater margin of profit. This theory has been proved fallacious. The margin of profit is no greater, and the volume of business is below that of the underlying companies last year.

ELECTRICITY is informed upon unquestioned authority that the Trust's business for the year falls a little short of $15,000,000. We believe that this business has been done at an actual loss. But allowing that they have made a legitimate manufacturer's profit of 15 per cent. net, we have, on the basis of $15,000,000 total business, net earnings of only $2,250,000, or $980,735 less than dividend charges for the year. No manufacturer in the trade will dispute that 15 per cent. is above the average net profit, and it is a well-known fact that no concern in the trade is so extravagantly managed as the General Electric Company; to none is the cost of doing business so great in proportion to business done.

In view of all the facts, we stand to our original assertion that the collapse of the Trust is sure to come and is only a question of time. The cash on hand to-day, whether it be $1,000,000 or $10,000,000, will not affect the inevitable result.

The Trust scheme will fail because it is founded on monopoly and extortion and a theory of finance which is fundamentally wrong and unsound.

When the reorganization comes, the water squeezed out, and Mr. Coffin's successor appointed, we shall look for better things.

Until then ELECTRICITY will make no change whatever in its policy or conduct, and we will welcome the opportunity to prove the correctness of our views, the accuracy of our aim.

A Conundrum.

Nothing affords us greater pleasure than to answer the varied questions asked by our constituents from time to time—to supply the information sought by inquiring minds. Now and then we receive one which is a poser, and which cannot be answered off hand. But ELECTRICITY has an editor who is employed for this single purpose, and it is nothing unusual for him to spend a week digging in the Astor or the Lenox Library in order that we may furnish a single subscriber in Arkansaw or Texas, who has not the advantages of these vast repositories of knowledge, with the information which he is seeking.

Among the many inquiries recently received was the following:

> *To the Editor of* ELECTRICITY:
>
> We note that Mr. S. D. Greene appears as one of the complainants against you in an action for libel instigated by the General Electric Company. We also noted some time ago that Mr. Greene assumed to announce the policy of that company. Can you tell us what Mr. Greene knows of the policy of the General Electric Company, of its present condition, or of its business? CURIOUS.

Here indeed was a poser, or rather three posers all in one. There was absolutely no information in this office on these points. Naturally, we were inclined to look to Mr. S. D. Greene himself. But upon looking over some public documents we found what seemed to us conclusive proof that Mr. S. D. Greene knows nothing whatever about the policy, the business, or the present condition of the General Electric Company. Then we turned to the gentleman's friends and business associates. But after a week of diligent inquiry we have failed to learn anything. We are therefore compelled for once to announce that we cannot answer our constituent's questions.

Can any one tell us what Mr. S. D. Greene knows of the policy, the business, or the present condition of the General Electric Company?

* * *

We Will Notify Our Friends.

Since the publisher of ELECTRICITY was arrested on the charge of libelling the General Electric Company the mail received at this office has been not only voluminous but highly interesting. Comments on the situation are as varied as the localities from which they come, but perfect unanimity is expressed by our correspondents on one point: they all want to know when the trial is to be, and to hear what Mr. Coffin will have to say in regard to the affairs of the General Electric Company. There is a general expectation that the information elicited from Mr. Coffin by a rigorous examination will be of universal interest, and worth a trip from Chicago to hear.

* * *

CAPT. EUGENE GRIFFIN has denied in the *Evening Post* the statement which we attributed to that paper last week, that "the officers admit that a few weeks ago the company's financial situation was precarious," and that the cash on hand was reduced by $1,500,000 in two weeks.

* * *

WE HAVE little doubt that the General Electric Company will pay its July dividend promptly. But, in view of recent events, we urge Mr. Coffin to state plainly to his stockholders and to the public whether that dividend is paid out of earnings this year, or whether it is paid from the proceeds of sales of treasury assets.

Electricity for Canals. The use of electric propulsion for boats on canals has been often suggested, and has come to be regarded as a perfectly simple suggestion, all that is necessary, according to many of the promoters of the scheme, being to establish a trolley line for the boats and fit them up with propellers or paddle wheels. The New York Legislature, we believe, has passed a law permitting inventors to make trials of their inventions in this line on the canals under proper supervision, apparently ignoring or forgetting the trouble which similar attempts with steam propulsion brought about some years ago.

It is scarcely possible that any scheme involving the use of propellers will be found practicable, as the wash of the water has sooner or later broken down the banks of the canals in all the experiments which have been tried.

If any plan of electric propulsion is to be a success, the propelling power must be placed outside the water, or at least so applied that any damaging wash may be avoided.

* * *

High Speed Electric Railways. Considerable is being written at present concerning high-speed electric traction, and the possibility of running trains at a rate of 150 or 200 miles an hour. The subject has been considered heretofore from an engineering standpoint, but it presents another phase which is of equal importance, that has certainly not received the consideration which it merits. We allude to the practical utility of such a road, and the demand for this sort of service. In considering the subject from this point of view it seems as though there are but few locations where such a speed would be demanded, and as the expense of travelling at such a rate must be far more than by the moderate speed steam roads, there is a probability that a great majority of passengers would content themselves with the latter. The question therefore arises whether such speeds can be attained with financial success, and by this alone will the success of high-speed roads be determined.

The engineering problems, though by no means solved as yet, are not so great as to be considered at all impossible, but the expense of constructing a roadbed to meet the requirements is an unknown quantity, and can be determined only by trial. The power necessary to propel a train at 200 miles an hour is also a quantity to be determined, but both of these are known to be greatly in excess of anything known in present practice. The resistance of the air is another factor which has yet to be determined.

As the demand for roads of this character is at best but small, the most prudent policy would seem to be to attain these speeds by means of gradual advances in railway improvement, rather than project at once a questionable enterprise which is more than likely to result in financial disaster.

* * *

IT WOULD be well for the officers of the Electric Trust to remember that no newspaper can do serious injury when it is in the wrong; that the only powerful journal is the one conducted with fairness, and whose policy is solidly grounded on TRUTH. No respectable business concern will support a journal which is in the wrong; and if ELECTRICITY had not been in the right it would have been dead long ago.

* * *

IT IS pertinent to remind Mr. Coffin and our other regular readers that the editorials on the Electric Trust which have appeared in these columns from time to time were not evolved from the inner consciousness of the editor of ELECTRICITY alone. They are founded on facts—facts supplied by scores of the best men in the trade, who stand ready to come to the front when called on. ELECTRICITY has made no mistakes.

* * *

A LARGE number of the leading men in the electrical trade have already volunteered their services as witnesses, to tell what they know about the Electric Trust and its methods. It appears to be recognized that the attack of the Trust is not aimed at ELECTRICITY alone, but that it is only another move in the general plan which has for its object the crushing out of all competition and of all criticism.

* * *

"Mr. Coffin has recently advised the agents of his company to be on the outlook for desirable opportunities for investment in the electrical line, as his syndicate has $25,000,000 ready to invest in good properties."—ELECTRICITY, Oct. 5, 1892.

What has become of this $25,000,000? Has it all been invested? Or was this announcement only a bluff?

* * *

THE humorous side of that action for libel cannot have escaped the notice of Mr. Coffin and the other close readers of ELECTRICITY. The Boston *Herald*, the leading paper in Boston and New England, published Mr. Coffin's letter on May 11, making a perfectly excusable error therein. This publication escaped the notice of Mr. Coffin and his friends. Even the financial editor of the *Herald* did not know of the error until his attention was called to it by us three weeks later. But when the matter appeared in ELECTRICITY Mr. Coffin and his fellow directors all read it, and re-read it, and began an action for libel. The whole incident is conclusive proof that we have not exaggerated—*that* ELECTRICITY *is the best read paper in the field!*

How It Happened.

(From the Boston Herald, June 2.)

Attention has been called to a fact, which until now has escaped notice, that there was a fatal omission of the word "fifth" in Mr. C. A. Coffin's reply to a series of categorical questions sent to him by a director of the General Electric Company, as published in the evening edition of this paper on May 11. Mr. Coffin was made to say:

"I can answer categorically to each one of the questions 'no,' except to the first part of your inquiry, and to that I answer 'yes.'"

Now, this should have read "except to the first part of your fifth inquiry," etc., and it did so read in the morning edition of May 12, for which edition proof was read from the original copy, which was reprint.

This matter is revived now to correct any misapprehension which may have arisen from the compositor's blunder, and because a technical paper in New York, or its owner, has been indicted for libel in part at least for republishing on May 17 the correspondence between Mr. Coffin and a fellow-director as it appeared in this paper on the evening of May 11. The *Herald* regrets that a typographical error, for which human frailty was alone responsible, should have temporarily perverted fact and led to unpleasant consequences to any of its readers.

Legal Notes.

Another Lamp Suit.

Suit was begun on Monday in the United States Circuit Court by the Edison Electric Light Company and the Edison Electric Illuminating Company of New York against the proprietors of the Imperial Hotel, the proprietors of the Holland House and others, to restrain them from using in their buildings any other than the Edison incandescent lamp, and also to compel them to pay damages to the Edison Company for the use of tho Westinghouse plant.

Judge Dennis, in the Circuit Court at Baltimore, rendered a decision a few days ago which determines Mr. Bowie's right to provide all necessary appliances to run his electric road on the main business thoroughfare of Baltimore. The decision was in the case of the Baltimore City Passenger Railway Company, which applied for an injunction to restrain the city authorities from interfering with the erection of the trolley poles. The bill was demurred to by the city, and the only question remaining was the construction of the two acts of the Legislature which related to the matter. This Judge Dennis has settled in favor of the railway company.

In the case of Townsend & Brown against the Cloverdale Electric Railway Company, Judge Arrington, in the City Court, in Equity, at Montgomery, Ala., has rendered a decision in favor of the complainants. The court decrees that the Cloverdale Company is indebted to Townsend & Brown in the amount of $138,050, the amount of a judgment recovered by them against the company in December last, with interest on the same from that time, less $50,000, the proceeds of the sale of certain bonds held by Townsend & Brown as collateral security, which sale was made in February last. A sale is ordered by the court within the time allowed by law, of the property of the Cloverdale Company. It consists in real estate in the southern part of Montgomery and the electric street railway and appurtenances.

Referring to the suit brought in the Supreme Court, New York, against Hugh R. Garden and Henry C. Davis, to compel them to account for $250,000 worth of stock of the Consolidated Electric Light Company, which Mr. Treadwell alleges was wrongfully obtained by the defendants, Mr. Garden says: "Mr. Treadwell only holds fifty shares out of 25,000 of the Consolidated Company. He was one of the first stockholders and has been cognizant of all the affairs of the company. When the company was on the verge of bankruptcy and the stock was not worth 50 cents a share, Mr. Davis and I, at the directors' request, made arrangements which placed the company on its feet. Our charges were passed upon by the Board of Directors and I received a letter from the president, Edwin S. Thayer, in which he said my charges were moderate and thanked me for the interest I had shown. Regarding the consolidation with the Westinghouse Company, the transaction was legal and was ratified by the directors and a majority of the stockholders. I can show by the records that Mr. Davis and I saved the company from ruin. The charges are absurd."

The Distribution of Power by Alternate-Current Motors—III.

BY ALBION T. SNELL.*

6. PRACTICAL APPLICATION OF THE DREHSTROM.

With a view of adding to the somewhat scanty practical information on the subject of multiphase working, the author proposes to lay before the Institution a few tests of two Drehstrom machines, designed and built by himself some eighteen months ago. These machines were adapted from material at hand, and were built under restrictions as to cost and time, and thus can only be regarded as rough experimental designs. The dynamo was a Gramme wound 10 unit two-pole shunt machine, designed to give 160 volts and 60 amperes, at a speed of about 1,000 revolutions per minute. Three insulated copper rings, with suitable brushes, were fitted around the commutator and connected to the windings of the armature at points 120 deg. apart. The ordinary commutator and brushes were left intact, so that both direct and triphase currents could be taken from the armature; and the field was separately excited. At a speed of 720 revolutions per minute the frequency was 12 ~ per second. This was afterwards increased to 30 ~ by raising the speed of the armature.

The motor was specially built, and had a laminated ring magnet, with Gramme windings, and a closed circuit armature. It was estimated to give 3 B. H. P. at about 1,200 revolutions per minute, and the gross weight was approximately 300 pounds. The armature plates had holes drilled parallel to the shaft and as near to the periphery as possible without breaking through. In these were placed lengths of No. 4 S. G. W. copper wire, insulated from the plates and soldered at either end to massive copper rings. The field winding consisted of six coils, each containing 68 turns of No. 6 S. W. G. copper wire, and having a resistance of 0.055 of an ohm. Opposite coils were joined in series with each other, so as to make three separate circuits, each of 136 turns and 0.11 of an ohm resistance, which could be connected in star or triangle fashion, as desired. This motor proved to be a very effective machine, having considerable torque at starting, and a speed regulation quite as good as a direct current machine of similar output. The only instrument available for taking electrical measurements were a Cardew voltmeter and a Siemens dynamometer; hence it was not possible to measure the angle of lag, or estimate the true watts. The experiments made with the dynamo and motor are shown in the following curves and tables, which at this stage may be instructive, since they show the order and direction of the difficulties met with in Drehstrom working.

(*a*) *Preliminary Experiments with the Dynamo.*

The three copper rings were connected to points in the winding at 120 deg. apart, the Gramme winding being otherwise untouched. The arrangement is diagrammatically represented by Fig. 14. The field was separately excited by 3.05 amperes, and the speed was kept at 710 revolutions per minute. The load was absorbed by iron spiral resistances with small self-induction. Readings were taken of the direct pressure; the alternating pressure at the ends of the three coils, a_1, a_2, a_3; and the current in each of the three mains, A_1, A_2, A_3 (see Fig. 15, curves 2 and 3). It was found that with the armature unloaded the pressure developed by each coil was practically the same; this was also the case when they were equally loaded (see Fig. 16). But it fell rapidly as the current increased, and so a considerable difference could be made between the pressure of the three circuits by simply giving different loads to each of them. The magnetic induction of the armature core, curve 1, Fig. 15, was calculated from the usual formula, $E_a = \frac{N A n}{10^8}$, where E_a equals the total number of volts in the armature, A the number of turns counted all round the armature, N the total flux, and n the number of revolutions per second. It will be seen that the values of the induction measured were all small. The frequency was 12 per second. These conditions were not the most favorable, it is true, but they showed the detrimental effects of internal resistance and self-induction in not only restricting the output but also in affecting the regulation of the pressure of distribution. It will also be seen that the direct pressure is higher than that of the alternating in the proportion of 158 to 94 on open circuit, and with 20 amperes in each branch (or a total of 1.732 × 20 = 34.64 from the combined circuit) in the proportion of 124 to 70. This difference is to be expected, since the alternating pressure is the average value of 120 deg. of the differential curve of potential; and, further, when the armature is loaded, the self-induction probably increases the difference between the two values. The apparent output, curve 4, Fig. 15, estimated by the product of effective amperes and volts, is found to be a maximum with about 22.5 amperes in each circuit, or 39 in all. The current was next increased in each circuit, so as to find the slope of the external characteristic curve. It was found to steadily fall at about the same slope until 37.5 amperes were reached, corresponding to a torque due to 65 amperes, this current being rather more than that designed for the armature. At this point the belt began to slip, and the experiment was stopped. It is clear that this class of dynamo can be safely overloaded for short periods.

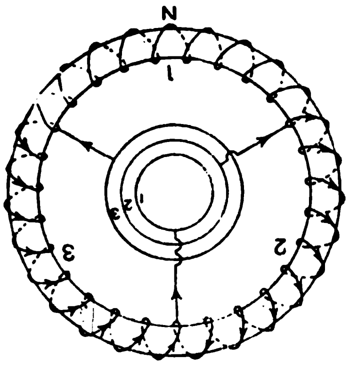

FIG. 14.—Connections of Drehstrom Dynamo, Coils in Series.

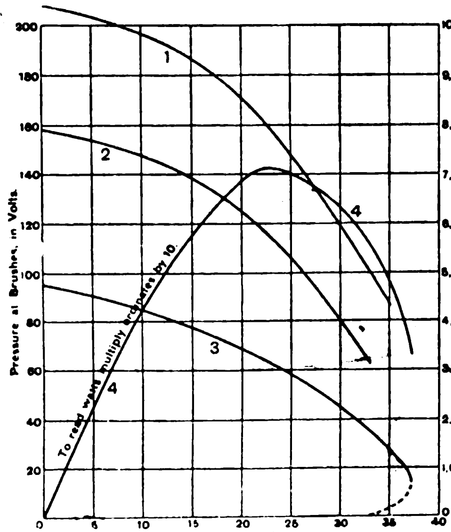

FIG. 15.—Curve 1. Induction in Armature Core. Curve 2. Direct Pressure. Curve 3. Alternating Pressure. Curve 4. Apparent Watts in each Circuit.

The winding of the armature was next divided into six equal parts and opposite sections were joined in parallel (see Fig. 17). The copper rings were then connected as before to points at 120 deg. from each other. Each of the three circuits had now only half as many turns as with the coupling shown in Fig. 14, and one-fourth the resistance. The effect of this alteration was to lower the internal resistance of the armature, and also, presumably, to reduce the self-induction. The excitation was maintained as before at 3.05 amperes, and the speed also at 710 revolutions. The results obtained from the two couplings are shown in Figs. 16 and 18 respectively. It is noticeable that the parallel winding has not materially affected the apparent output of the dynamo. The effective number of turns in each coil is only one-half that with the series winding; and, therefore, for the same heating effect the number of amperes is twice as great. To compare two outputs, then, it is necessary with the series arrangement to take only half as many amperes as with the parallel one. Referring to Figs. 16 and 18, it is found that the apparent watts at 710 revolutions per minute are severally 69 × 20 and 34 × 40, or approximately the same. There was probably a smaller lag of current with the parallel than with the series connections. The smaller pressure and larger current were most suitable for testing the motor, and so the parallel connections of the dynamo armature were used during the whole of the following experiments.

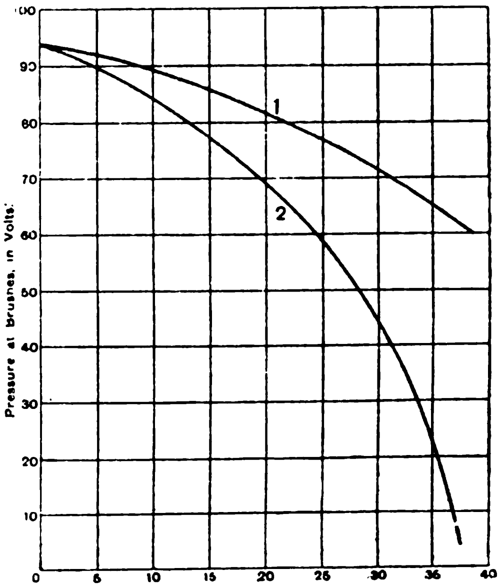

FIG. 16.—Fall of Pressure at Terminals of Drehstrom Dynamo with Armature Coils Coupled as in Fig. 14. Curve 1. Only One Circuit Loaded. Curve 2. All Three Circuits Equally Loaded.

(*b*) *Experiments with the Drehstrom Motor.*

(1) Star or open coil coupling. The motor was coupled to a dynamo by belting and then supplied with current at frequencies ranging between 12 and 33.3 ~ per second. With the lowest frequency the motor ran light at about 700 revolutions per minute, being nearly synchronous with the dynamo. As the load was applied the speed

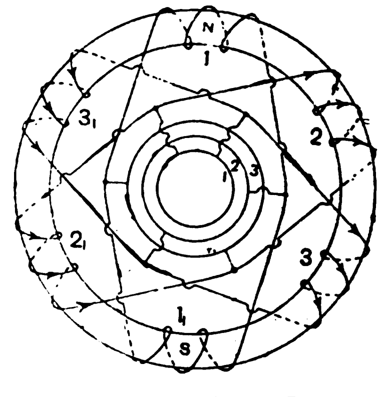

FIG. 17.—Connections of Drehstrom Dynamo, Opposite Coils in Parallel.

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*Paper read before the Institution of Electrical Engineers, London.

decreased, and since the output was inconveniently small the dynamo speed was raised to about 900 revolutions per minute, when the following readings were taken :

Groups A and B.

No. of test.		Speed of motor.		Pressure on mains.		Amperes in each circuit.		Exciting current in dynamo field circuit.
1	......	848	......	58	......	21	......	2.5
2	......	746	......	55	......	21	......	2.8
3	......	880	......	77	......	38	......	4.5
4	......	800	......	77	......	27	......	Not taken.
1	......	888	......	80	......	28.7	......	4.3
2	......	866	......	80	......	27.6	......	4.3
3	......	824	......	75	......	27.6	......	4.3
4	......	890	......	77	......	28	......	3.9
5	......	790	......	70	......	27.6	......	3.9
6	......	866	......	75	......	27.6	......	3.9
7		Armature held stationary		70	......	34.7	......	3.9

The frequency was about 15 in the above experiments; but the dynamo speed varied from 932 to 833 revolutions per minute, owing to the engine governing badly.

The load on the engine was next adjusted so as give a steady dynamo speed of 960 revolutions, and the tests included in Groups C, D, and E were made.

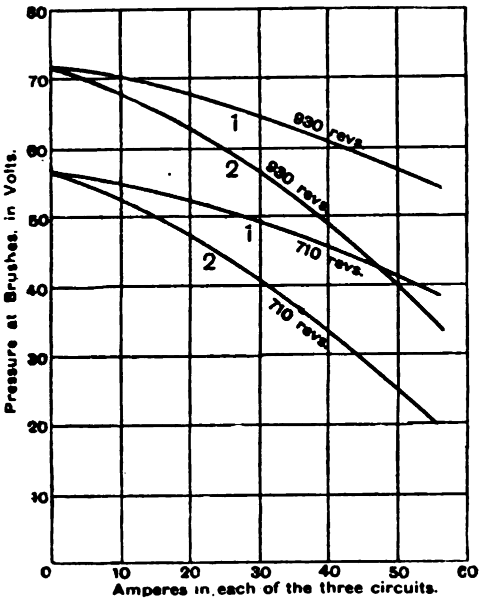


FIG. 18.—Fall of Pressure at Terminals of Drehstrom Dynamo with Armature Coils Coupled as in Fig. 17. Curves 1. Only One Circuit Loaded. Curves 2. All Three Circuits Equally Loaded.

In C a Prony brake was applied to the pulley of the motor, and in D and E a dynamo was driven, as in the tests of Groups A and B, this being found to be more convenient.

Group C.

No. of test.		Motor speed.		Pressure on mains.		Amperes in each circuit.		Weight on end of 24 in. brake arm.
1	......	736	......	84	......	31	......	2 lb.
2	......	624	......	82	......	32	......	3 lb.
3	......	500	......	83	......	32.9	......	4 lb.
4	......	500	......	81	......	33	......	4 lb.
5	......	340	......	84	......	34.7	......	5 lb.

The frequency was 16.

Groups D and E.

No. of test.		Motor speed.		Pressure on mains.		Amperes in each circuit.		Dynamo speed.
1	......	0	......	79	......	37.8	......	960
2	......	340	......	79	......	34.8	......	960
3	......	512	......	78	......	32.5	......	960
4	......	740	......	77.5	......	30.6	......	960
5	......	820	......	77.5	......	28.15	......	960
6	......	864	......	76	......	28.1	......	960
1	......	922	......	91	......	31	......	952
2	......	914	......	90	......	32.9	......	956
3	......	0	......	85	......	39.8	......	970

In both D and E the frequency was approximately 16.

Next, the dynamo speed was increased to 1,960 revolutions in Group F, and to 2,000 revolutions in Group G; and the motor connections were altered to the triangle or closed type. This required 1.732 times the current and 1 / 1.732 times the pressure for the same output with the star or open type connections (see the latter part of 5). The Prony brake was used in Group F.

Group F.

No. of tests.		Motor speed.		Pressure on mains.		Amperes in each circuit.		Weight on 24 in. brake arm.		B. H. P. of motor.
1	...	1,820	...	41.5	...	26.5	...	1	...	0.68
2	...	1,480	...	41	...	29.8	...	3	...	1.67
3	...	1,200	...	40.5	...	31	...	4	...	1.8

The frequency was 32.6.

Group G.

No. of test.		Motor speed.		Pressure on mains.		Amperes in each circuit.
1	....	0	....	36.5	....	39.4
2	....	732	....	37	....	35
3	....	1,000	....	37.75	....	35
4	.. ..	1,276	....	38.75	....	30.5
5	....	1,702	....	41.5	....	27
6	....	1,750	....	42.5		27 Motor running free.

The frequency was 33.3.

Groups A and B were made to see how far the excitation of the dynamo affected the experiments. The pressure on the main varies, of course, with the excitation, but the speed of the motor, as far as can be seen from these rough measurements, is nearly independent of the pressure, and seems rather to vary with the frequency and perhaps the lag. The law connecting speed and current variation for constant frequency and pressure of supply is not very obvious, and evidently requires the lag to be taken into account. For example, see Group B : In test 6 the motor loaded with 27.6 amperes in each circuit and 75 volts makes 866 revolutions; and test 7 shows zero speed for 75 volts and 34.7 amperes. Evidently the lag in 7 is far greater than that in 6. This is confirmed by test 1 in Group D, by test 3 in Group E, and test 1 in Group G. It is curious to notice how small are the variations of current between running light and full load, or even when the armature is held stationary. This large waste or idle current is most prejudicial, and if it cannot be lessened by some practical means (by condensers or otherwise) will militate seriously against multiphase motors without commutators. If the revolving part of the motor be supplied with the triphase current, these troubles will be much less, because the moving parts will contain less iron, and hence the hysteresis and eddy current losses, and the induction disturbances will be of less importance. The frequency in the induced circuit is then so small as to give little trouble.

In Group C a Prony brake with a lever 2 feet long was fitted around a 16 inch pulley, and the motor was supplied with current of 16 ∼ per second. The pressure and current variations are seen to be insignificant, though the speed varies some 50 per cent. This low frequency (16) was found unsuitable for the design of the motor, since it gave too low a speed; but the tests in Groups D and E were taken so as to show the capabilities of the motor under these conditions. The power of the motor was utilized to drive a direct current dynamo, the two machines being coupled by a belt. The figures in Group D again show large variations of speed for nearly constant pressure and small changes of current. In Group E the pressure was increased, but only a few readings were taken, as the increase in speed was insufficient to give results widely different from those obtained in the preceding tests.

In the next experiments the connections of the motor were altered to the triangle or closed arrangement, the end in view being the increase of motor speed and consequent output.

The tests in Group F are some of the most important in the series, for the output measured by the Prony brake was sufficiently large to give practical data. It will be seen that the frequency was 32.6 per second and the pressure about 41 volts. The speed again shows large variations. When running light the speed of synchronism, 1,960 revolutions, was nearly attained.

In Group G the motor was coupled to a small dynamo by a belt, and the frequency was raised to 33.3 per second. In test 6 the motor was running free, but the speed was 250 revolutions below that of synchronism. The best results seem to have been obtained with a frequency of about 32 (test 3, Group F), and it appears probable that if the arrangements had been such as to admit of a larger current at this frequency, at least 3 B. H. P. might have been taken from the motor.

These rough experiments show the importance of reducing the magnetizing current to a minimum. It can be accomplished by careful attention to the design and by making the air-gap as small as possible. The Drehstrom motor may be regarded as an open magnetic circuit transformer, and the only way to lessen the waste current is to make the magnetic resistance as low as possible. Mr. C. E. Brown has already suggested bedding the field as well as the armature turns in iron, and the same end may be attained by perhaps a better way, i. e., by winding the field coils in drum fashion.

7. DREHSTROM MOTORS WITH STATIONARY ARMATURES.

Triphase motors are sometimes made with the rotary magnetic field in the revolving part of the machine. This necessitates brushes and rings, it is true, and consequently simplicity of design is departed from, but it must be recollected that there can be no sparking under ordinary conditions. The brushes would probably be made of flexible strands of copper, such as are commonly used for alternators. The chief point gained is that the most marked effects of hysteresis, eddy currents, and self-induction are limited to the relatively small moving part of the machine, whilst the massive stationary portions, which then form the armature, are magnetized by currents of frequency equal only to the difference between the speed of the armature and that of the rotary field. It is clear that the speed of the revolving part can never equal that of the rotary field; but at normal loads the period of the armature current will be small, and therefore the heating from hysteresis, etc., will be comparable with that of a direct-current machine, the period probably being of the order of from eight to ten per second. Herr Dobrowolski's 2 H. P. motor is of this type, and a brief comparison with the small motor built by the author may be interesting, because it will show the order of the results obtained from the two types of machines. Herr Dobrowolski's motor weighed approximately 365 lbs. and the maximum output deemed advisable was 4 B. H. P. at about 1,700 revolutions per minute. On open circuit it made 2,100 revolutions, and at 2 B. H. P., the rated output, about 1,950. The frequency was 35, the supply pressure 70 volts, and the torque at starting considerable. The lag was stated to be 72 deg. when the motor was running light, 28 deg. at 2 H. P. and 22 deg. at 3 H. P. The efficiency at 1 H. P. was 75 per cent., at 2 H. P., the rated output, it had reached to about 80 per cent., and at 2.3 H. P. it attained its maximum of 81.4 per cent. The author's motor weighed about 300 lbs., and at 1,200 revolutions gave 1.8 H. P. on the brake, and it was evident from the slight heating that this output could have been safely doubled if the speed had been raised to about 1,800 revolutions, but it had a larger lag than the other machine, the waste currents at small loads were much greater, and the all-round efficiency was certainly less.

8. COMBINED ROTARY AND SYNCHRONOUS MOTORS.

A multiphase dynamo requires the revolving field magnets to be separately excited by a direct current. It is reversible, and will run as a motor if supplied with a multiphase current, but is not necessarily self-starting, and probably will not start against a large torque. If, however, the magnets be rotated so as to synchronize with the rotary magnetic field, the motor will work as satisfactorily as a single-phase machine.

Attempts have been made to combine the advantages of a self-exciting rotary field and a synchronous motor. The plan proposed is some modification of the following idea: The moving part, usually the armature, is wound with two circuits, the one closed on itself acting precisely as the closed circuits of the multiphase armature, the second supplied with a direct current and therefore having fixed poles. When the field is excited by a rotary current the induced currents in the closed circuits will start the armature (if the torque be not too great) and the permanent poles due to the direct current will have but little influence. But as the speed of synchronism is approached the induced currents in the armature will decrease, and the fixed poles will have more effect, until finally the armature rotation will be entirely due to them.

Such a motor has many disadvantages, besides requiring an independent direct current. It necessarily has a low efficiency at starting and at all speeds below that of synchronism; but within wide limits of load when once started it will run at a constant speed with a high efficiency.

The initial torque cannot be so great as that of a simple diphase or Drehstrom winding, since the closed circuits on which the starting depends are relatively smaller.

Mr. Schuckert has built a self-exciting diphase rotary-field synchronous motor on the above principles. But the method does not appear to offer any special advantages, and it is not likely that such motors will supersede ordinary single-phase alternators.

9. SINGLE-PHASE NON-SYNCHRONOUS MOTORS—SELF-EXCITING AND SELF-STARTING.

Messrs. Hutin and Leblanc, C. E. L. Brown, and others have devised modified forms of Prof. Elihu Thomson's motor, all of which will run with single-phase currents, non-synchronously and with good efficiency.

The principle seems to depend on the induction of currents in short-circuited coils, in unsymmetrical positions with reference to the main field, but this end is not necessarily attained by brushes and rings, as in Thomson's motor, but by the rotation of the armature itself. In its simplest form this type of motor has no commutator, and is self-exciting, but will not start. If, however, the armature be spun in either direction, it will rapidly acquire the speed corresponding to the torque, and will then revolve at a uniform rate.

By the combination of an additional rotary magnetic field, the armature can be made to start against a considerable torque, and the auxiliary field can be stopped after the proper speed is attained. Various devices to secure such a field are suggested by Mr. C. E. L. Brown, the most feasible being two parallel windings on the field magnets, one with small self-induction (or even capacity), and the other with larger self-induction. These two circuits when supplied with a ngle-phase current will produce a rotary field, and so cause the armature to revolve. (Other forms of this ingenious motor have been suggested by Mr. Brown, for which reference should be made to the technical journals of March of this year. Most of the arrangements, however, necessitate rings and brushes, and the motor is therefore only preferable to a synchronous reversed dynamo inasmuch as it is self-exciting and self-starting. These two points are of great importance with small motors, and probably the invention will be of utility in many ways.)

The general details of construction are, broadly, similar to those of a multiphase motor, but the number of poles in the field magnets and armature must not have a common factor, and the windings of both armature and field magnets are preferably laid in grooves or holes in the iron, an arrangement which permits the magnetic resistance to be reduced to a minimum and decreases losses from Foucault currents, while the weight output is increased. This is perhaps the best type of single-phase motor up to date, but it is undoubtedly susceptible of considerable improvement, and the problem of alternate-current motors suitable for running or ordinary supply circuits cannot yet be said to be satisfactorily solved.

(Concluded.)

At a meeting of the laryngological section of the Academy of Medicine, recently, Dr. Wendell Phillips exhibited what he called an electric head illuminator. A small boy was taken from the audience, and a powerful electric lamp was inserted in his mouth, which was then closed on the handle which held the lamp. The lights of the hall were turned down, and the storage battery turned on. The light in the boy's mouth shone out through his cheeks, detailing every vein, line or imperfection in the skin and gums in the mouth.

Boston Notes.

By September 1 the cities of Lowell, Lawrence and Haverhill, three of the most prosperous cities in Massachusetts, will be connected one with the other by an electric railway under a single management. This fact is expected to give the above cities a tremendous boom, and far-seeing citizens are making predictions on the future development of the three cities.

The trouble at the Lynn factories of the General Electric Company is practically over. Last Saturday the company made a proposition to the men conceding 56 hours work and 58 hours pay per week, which has been practically accepted.

The eyes of the entire country are being turned towards Boston these days, where changes, developments and improvements are being introduced by the electrical workers, and it is no exaggeration to state that within the next two or three weeks several new devices of an electrical character will be presented for popular favor and acceptance by Boston electricians that will mark entirely new departures in this great field of commercial industry.

The Union Railroad Company, Providence, R. I., has secured from the Legislature power to absorb every electric and horse railway in the State. This is the only instance that we know of where a single corporation enjoys such power and authority for an entire State.

The State of Maine is as enterprising as any State in the Union in the matter of electric lights and electric railways. Several light and power stations are at present underway, and it looks as if Bangor and Oldtown would soon be connected by electric railway.

So great is becoming the demand on the Edison Electric Illuminating Company of Boston that they find it necessary to extend their underground wires right along. No sooner is one section of the city equipped than the demand for more light and power comes from another, so that a very large staff of men is constantly employed on underground work solely.

The entire fleet of Nantasket Beach steamers are now equipped with electricity. The United States system has been installed, the New England Weston Company having been the contractors, and the work throughout, including the handsome fixtures, has been done in first class shape.

The Rapid Transit question for Boston drags its slow length along before the Legislature still. There does not appear much prospect of the problem being tackled without gloves for some time to come, and so the patient and long-suffering public has to wait until the State Solons can decide just what the solution of the problem is to be. Some very hard things, approaching nearly to "cuss words," have been bandied about in the legislative halls and corridors lately, but the arriving at a useful decision seems remote yet.

Chicago Notes.

Mr. Thos. L. Townsend, representing Partrick & Carter, of Philadelphia, was a Chicago visitor last week. He took in the Fair, and made the acquaintance of a number of the exhibitors.

H. L. Blizzard, manager of the Franklin Electric Company of New York, put in the greater part of last week in Chicago and at the World's Fair.

C. A. Daigh, until recently the Chicago representative of the National Electric Company, and formerly the manager of the same company, has accepted the position of selling agent for the Siemens & Halske Electric Company.

The friends of Wm. F. Taylor, of the firm of Taylor, Goodhue & Ames, are sympathizing with him in the loss of his daughter, her death occurring last week after a short illness.

The Chicago Athenæum has made arrangements to give a series of lectures twice a week in one of the halls of the building on the "Science of Electricity" as illustrated in the Electricity Building at the World's Fair. Following each lecture the members attending will be conducted through the building, and exhibits explained by one of the lecturers.

General News.

What is Going on in the Electrical World.

Jersey City, N J.—The annual meeting of the Cataract Construction Company (Niagara Falls), will take place here on June 8.

St. Augustine, Fla.—The Ponce de Leon Hotel is being rewired for a change in its electric lighting which it is said will cost $60,000.

Pittsburg, Pa.—C. I. McDonald & Company have been awarded the contract for building the Pittsburg, Neville Island and Coraopolis electric road.

Frederick, Md.—The Frederick and Middletown Valley Railroad has been granted a franchise for an electric railway in specified streets in Frederick.

Harrisburg, Pa.—The session of the Legislature ended on the 1st inst. The bill giving increased powers to electric railway companies failed to pass.

Glens Falls, N. Y.—The stockholders of the Glens Falls Electric Street Railway intend to increase the capital stock of the company from $30,000 to $120,000.

Chattanooga, Tenn.—The Alton Park Land Company is going to build an electric railroad from this city to Alton Park. Engineers are at work on the survey.

Newport, R. I.—H. N. Hassard has received permission from the committee on street lights to place a number of electric lights along Eastin's Beach, beginning at the Cliff walk.

Tiffin, Ohio.—Work has begun on the Tiffin and Fostoria Electric Railway, and a large force of hands will be kept on it until it is completed. The road will be fourteen miles long.

Huntington, L. I.—The town board has granted a franchise to the Huntington Electric Light, Heat and Power Company for lighting election districts 1, 2 and 3 of the town.

Maumee, Ohio.—A franchise has been granted to Albion E. Lang, representing the Toledo Consolidated Street Railway Company, to build an electric railway from Toledo to Maumee.

Sedalia, Mo.—It is learned that the Missouri, Kansas and Texas Railroad Company will at an early date commence the construction of a telephone line from St. Louis to Parsons, Kans., a distance of 348 miles.

Hamilton, Can.—The Hamilton Radial Electric Railway Company will in October supply all the power required in Hamilton for every purpose, bringing it from Niagara Falls at an estimated cost of $200,000.

Manchester, N. H.—The new contract between the city and the Electric Light Company for lighting the city streets is for ten years and will result in a saving of $60,000 as compared with the former contract price.

Detroit, Mich.—A franchise has been granted to Parke, Davis & Company to do commercial electric lighting in the district adjacent to their factory, on the condition that they pay an annual tax amounting to $31 per mile of wire laid.

Digby, N. S.—Bear River is to have electric light, the generating power to be supplied by the falls on the west branch of the river.—The Annapolis Valley Telephone Company have put in a branch from Granville Ferry to Belleisle.

Syracuse, N. Y.—The Syracuse Telephone Company has applied to the council for a franchise to do a telephone business, offering much lower rates than the present. Wm. Cowie is the promoter of the company, which is not yet incorporated.

Peekskill, N. Y.—The Peekskill Electric Surface Railway Company have decided to build the road themselves, considering bids offered for the construction work to be too high. Work will be pushed so as to complete the road as soon as possible.

Salt Lake, Utah.—The mayor's veto of the twenty-five year franchise recently granted by a vote of council to the Salt Lake and Ogden Gas and Electric Light Company although at first sustained was on reconsideration of the vote by council not agreed to and the franchise stands.

London, Can.—The Canadian General Electric Company have bought out Hunt Bros.' electric lighting and power business, and will make it the nucleus of their new plant and business in this city. They have appointed Charles B. Hunt local manager, and he will take full charge.

Elizabeth, N. J.—A charter for a new electric railway is being prepared. The road is to run up Morris avenue through Springfield and thence probably to Summit. The name of the road will be the Ursino Park and Springfield Electric Railway, and Silas D. Drake is its chief promoter.

Pittsfield, Mass.—A controlling interest in the Pittsfield Electric Railway has been bought by Dolan Bros., of New Britain, Conn. The new owners are said to be desirous of extending the railway to Dalton this year, and will do so if such action meets the approval of the Pittsfield directors.

Trenton, N. J.—It is understood that a syndicate has under consideration plans for an electric belt line for this city. The talked-of line takes in the Interstate Fair, Battle Monument, Cadwalader Park, Riverview Cemetery, Broad Street Park, Greenwood Cemetery, and back to the fair grounds, circling the entire city.

Bucyrus, Ohio.—The right of way has been obtained for an electric railway from Galion to Bucyrus. It will be twelve miles long and go through a country thickly settled with prosperous farmers. There is also under contemplation the building of a line eighteen miles long from New Washington, through Sulphur Springs, to Bucyrus.

Battle Creek, Mich.—The electric street car line in this city has changed management, W. J. Willson, the former superintendent and general manager, having been superseded by A. K. McRae, of Chicago, who purchased his stock and assumed his place. Ex-Governor John L. Beveridge, of Illinois, is the principal stockholder in the company.

Montgomery, Ala.—The sale of the Cloverdale electric railway by order of the court may lead to a consolidation of the Cloverdale line and the Montgomery Terminal Street Railway, a scheme which is now under consideration. If the consolidation takes place electricity will be extended over both lines. The new organization will have a capital stock of $350,000.

Peoria, Ill.—The Fort Clark Electric Railway has changed hands, the General Electric Company having gained possession of it. The new directors are F. O. Cunningham, W. T. Whiting, of Peoria; G. H. Atkins, J. S. Cummins, F. W. Horne and Theodore P. Baily, all of Chicago. B. K. Otis, of Peoria, was chosen secretary and treasurer to succeed Willis Hall.

Bangor, Me.—An electric railway to connect Bangor with Hampden, Winterport, Frankfort, Prospect and Stockton Springs has been planned, and will probably be built Among those interested in the scheme are Gen. H. L. Mitchell and E. C. Nichols, of Bangor; H. W. Mayo, of Hampden; Fred Atwood, of Winterport; J. Manchester Haynes and George E. Macomber, of Augusta, and H. L. Shepherd, of Rockport.

Cleveland, Ohio. — The Cleveland General Electric Company, lately formed by a combination of the Cleveland Electric Light Company and the Brush Electric Light and Power Cempany, intends to erect a power station in the downtown district and equip it with the latest and most improved machinery, with cables running all through the city to furnish light, heat and power. The estimated cost is about $600,000.

Newark, N. J.—The Central Power Company, which secured possession of valuable city franchises for the distribution of power by purchase of the Schuyler Company's interest, has determined to increase its capital stock from $50,000 to $100,000, and will proceed at once to develop the business of supplying electric power throughout the city. Among the men interested in the company are A. Q. Keasley and W. H. Lemassena.

Middletown, Ohio.—C. F. Gunckle, a prominent banker here, has purchased G. N. Clapp's controlling interest in the Electric Light and Gas Company. The electric light plant will be enlarged and power furnished for street car and other purposes.—There is a movement on foot by prominent capitalists of Middletown to put electric boats on the Miami and Erie Canal, which connects Toledo and Cincinnati.

West Buxton, Me.—Mr. R. S. Brown, of the Westinghouse Electric and Manufacturing Company, has been in consultation lately with a number of our citizens who are anxious to have an electric railway from Bar Mills to Bonney Eagle by the way of West Buxton. There is a magnificent water power at Bonney Eagle that might be utilized in the generation of power. The road will probably be built.

Niagara Falls, N. Y.—At a meeting of the stockholders of the Niagara Power Company held here on the 1st inst. the following directors were elected: C. B. Gaskell, Benjamin Flagler, W. C. Ely, Peter A. Porter, De Lancey Rankine, A. J. Porter, L. W. Pettibone, F. A. Dudley, of Niagara Falls, and Dr. Coleman Sellers, of Philadelphia. The board elected the following officers: President and chief engineer, Dr. Coleman Sellers (who will move here from Philadelphia); vice-president, Benjamin Flagler; treasurer, De Lancey Rankine; secretary, James S. Milner.

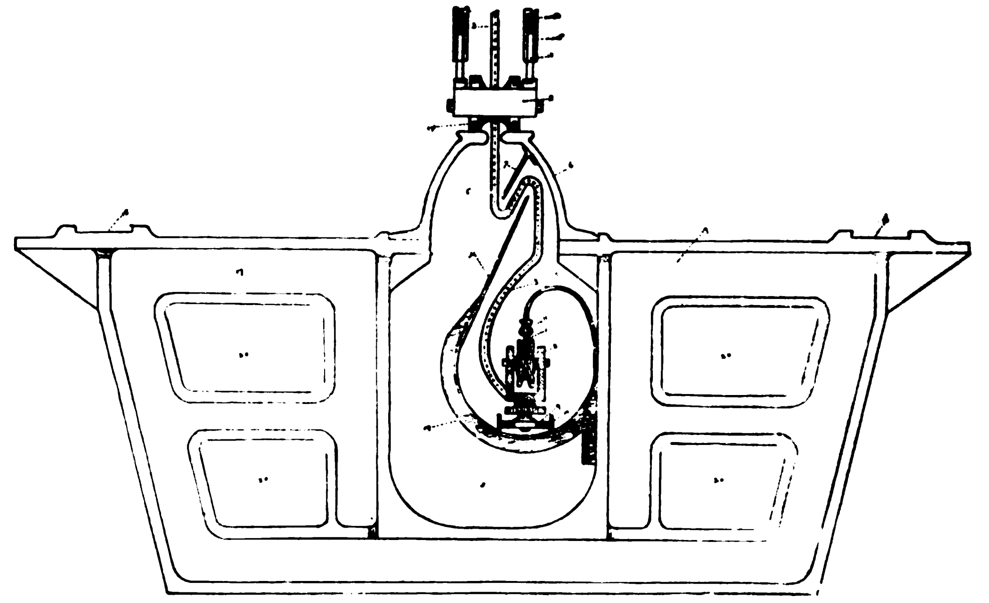
Hartford, Conn.—The special committee on street railroad improvements recommend a trial of the storage battery system on the Hartford and Wethersfield road, and this failing, the trolley system is their next choice. The Milford storage battery system is favored in the committee's report, but Dr. Robb, of Trinity College, Hartford, while calling attention to the suit of the Brush Electric Company against the Milford Company for infringement of their battery patents, considers the Milford system inapplicable to the Hartford line on account of the heavier grades that would be encountered as compared with those on the Milford and Hopedale road.

Noblesville, Ind. — The city council has granted a thirty years franchise to the Chicago Electric Street Railroad Company to put down tracks in this city. It is thought that Noblesville will be made the focal point of a network of railways extending over the entire Indiana gas belt, and connecting with Indianapolis.--A dispatch from Noblesville, received at Indianapolis June 2, says: "Last night an organization known as the 'Central Indiana Electric Railway Company' was perfected with a capital stock of $4,500,000. It is composed of moneyed and influential men from Dayton, St. Louis, Chicago, Philadelphia and London, England. The purpose of the new organization is to connect Indianapolis, Noblesville, Anderson, Muncie, Elwood, Tipton, Kokomo, Frankfort, Peru, Logansport, Lafayette, Marion and Fort Wayne by electric street car lines."

Washington, D. C.—Engineers have lately been engaged in marking the proposed route of the Washington and Great Falls Electric Railroad. It is the intention to run a double track line as far as Cabin John Bridge at first, and if the business demands it the tracks will be laid to Great Falls. The road will begin at the north end of the Aqueduct Bridge and be elevated twenty feet on steel pillars. The elevated track will be twenty-four feet wide, covering the entire canal road. It has not been definitely settled as yet whether a trolley or motor system will be used, but in all probability the latter system will be adopted. The power at first will probably be supplied by the Potomac Electric Light Company, the works of which are at the Virginia end of the Chain Bridge. The present officers of the company are: President, J. H. Rotherbut; vice-president, George S. Chase; treasurer, John G. Slater; secretary, Col. Tyree; board of directors, Smith Pettit, John G. Slater, J. R. Robbins, C. A. Maxwell, J. H. Rotherbut, George Chase and W. C. Codd.

Conduit Railway System.

Although some of the matter written on the "deadly trolley" is exaggerated, still electrical railroad men, as a rule, look to the future with the hope of seeing brought out a more perfected electrical railway system that shall do away with the many objections and dangers incidental to overhead trolley for street use. As to the outcome of just what line of improvement the ideal system of the future will be, it is at the present time impossible to say.



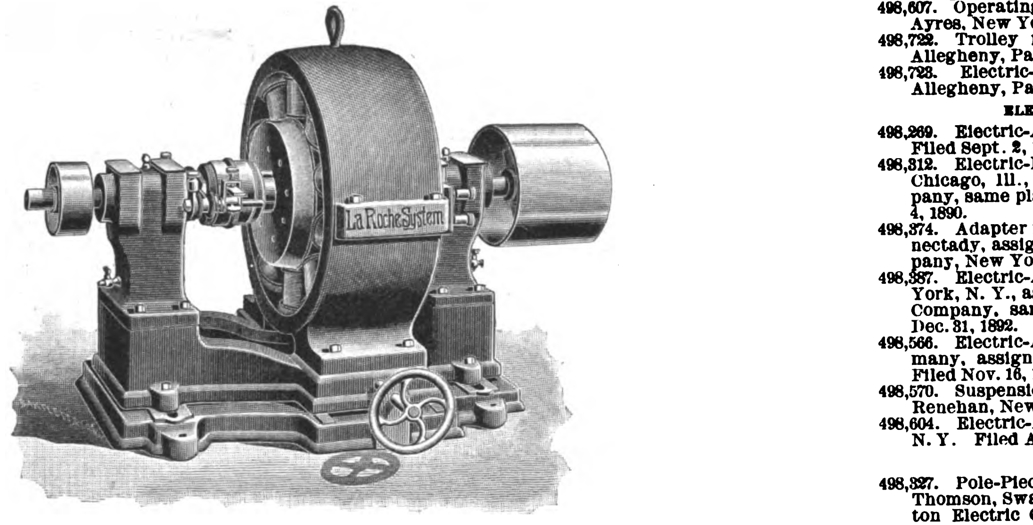
CONDUIT RAILWAY SYSTEM.

Conduit and storage battery systems both seem to be in the line of progress, with, perhaps, the advantage at present with the former. If we only had perfectly clean streets, no floods, snows, and obliging and progressive municipal governments, the conduit system would become very popular at once. While it is true that these conditions are not with us to any great extent, it is also true that by the ingenuity of inventors conduit systems are being brought forth which are surmounting the many obstacles in the path and making the conduit system a reliable and efficient one.

Our illustration shows a recently invented conduit system which has many points of merit and overcomes many of the objections hitherto brought forward. Some electrical conduit systems have been practically inoperative on account of the arcing of the current from the electrical conductor to surrounding parts, caused by the insulation used not being adequate to prevent it; and also on account of the drip from the slot rail opening and consequent flooding of the conduit, while in many others the numerous mechanical parts often get out of order. In the accompanying illustration of the system is shown a cross-section with yoke (17), as in cable road construction, which supports the conduit (5) and slot-rails (6). The chamber in which the conductor (No. 1) is placed is, by the overlapping cover (No. 7) protected from floods until the water rises to within six inches of the street level. By the form of the trolley arm it becomes impossible for rain to drip into the conductor tube. Dirt or water falling through the street slot is prevented by the cover (No. 7) from entering the tube which contains the electrical conductor, etc., and is gathered at the bottom of the large chamber. Ample air insulation is given by the conductor being placed centrally in the trolley chamber. The lateral and perpendicular motions of the trolley arm are provided for by the guide carriage and the point of contact of the trolley wheel on the trolley may be at the top or bottom of it. This promising system is brought out by the Electrical Conduit Traction Equipment Company, 94 Wall street, New York City.

La Roche New Alternating Dynamo.

The cut herewith represents one of the types of alternating machines built by the well-known La Roche Electric Works of Philadelphia. The above company was one of the first in America making a specialty of alternating apparatus. The demand for their alternating machines has been so great that they were compelled to make up a full line of small alternators, and now build same with a frequency of 16,000 revolutions, and from 25 to 3,000 lights. The La Roche machines are well known throughout the United States and Europe. The company has been very successful with these machines which are made in two classes—self-exciting and non-exciting.



La Roche New Alternating Dynamo.

The machines from 25 lights up to 500 lights are arranged with ten poles, running at 1,600 revolutions, thereby giving a frequency of 16,000 per minute. The larger machines, of course, have more poles and give the same frequency, but at a lower speed. The alternators have all modern improvements, with all parts interchangeable and made to gauge; they have been designed by Mr. F. A. La Roche. They have self-oiling bearings and an automatic oil overflow. The brushholders are of a new design and so made that any degree of tension can be secured. The machine, of course, has no commutator, but has two collector rings which are made of specially hardened copper well insulated with mica. The fields in even the smaller machines are made separable so that any repair work can be done without interfering with balance of the machine.

The field bobbins are separately wound and slipped over the core, and any of them can be replaced, in case of necessity, in a very few minutes.

The armature is built up of the best laminated, pure charcoal iron, well magnetically insulated. The core is mounted on two of the La Roche latest bronze spiders well secured to polished steel shaft. The shaft is turned down to standard size where entering bearings. The armature coils are separately wound, and any intelligent person can replace any or all in a very few minutes as this company has a new method of securing the coils to the core. They also have a new and improved method of connecting and winding the armature whereby the difference of potential between coils never exceeds 200 volts, while in machines of other systems now in use the difference of potential between coils is from 500 to 1,000 volts. By the La Roche system it is almost an impossibility to have a burnout or short-circuit from lightning. The coils are insulated from the core of the armature by the best grade of mica that can be procured. It will be noticed that the above cut is not of the self-exciting type, neither is the exciter attached to this illustration.

At a test of some of these machines it was found that there was a variation of only 2 3-10 volts between no load and full load, which is a sufficiently close regulation for any alternating machine.

This company has placed alternators with such well-known concerns as the University of Wisconsin; Messrs. Queen & Co., Philadelphia; Helios Electric Company, Philadelphia, etc., and they can show flattering testimonials from all parties using their system.

All the machines have a cast-iron sub-base well secured and mounted so that no foundation is required, as the sub-base answers that purpose.

COMMERCIAL PARAGRAPHS.

Some good contracts have recently been secured by Boston electrical supply houses. Among these may be mentioned the Brown Electric Company, which has closed contract for the equipment of the South Jersey Traction Company's road, which will be thirty-six miles in length, connecting a number of small towns in central New Jersey.

The firm of Cummer, Craig & Company, Boston, has the contract for equipping the new building of the Boston Plate and Window Glass Company with a 600-light plant. A Crocker-Wheeler dynamo will be installed. This electrical firm now represents the Crocker-Wheeler, Bishop Gutta Percha, Waddell-Entz, General Incandescent Arc Light, Star Electric Lamp and Interior Telephone Companies.

The Hawks Electric Company, Summer Street, Boston, reports a constant increase in its business, having many nice contracts in hand and several additional ones coming along. Altogether the outlook for the electrical business is very promising, notwithstanding this is the time of the year when a big rush is not looked for.

No better evidence of the standing and sterling features of the Ansonia Electric Company's specialties could be had than from the number of propositions that are being made them by foreign companies through their representatives who are visiting the Fair, they appreciating in particular the value of the Wirt Indicators, Wirt Brushes and W.-W. Lightning Arresters, of which the Ansonia Electric Company are sole manufacturers.

Very large sales of Habirshaw wire during the past week have been reported to us as having been made by the Ansonia Electric Company, formerly the Electrical Supply Company.

The good work done by the Wirt Brush in saving commutators seems to be appreciated by the customers of the Ansonia Electric Company (formerly the Electrical Supply Company), judging from the growth of the sale of the brush.

INCORPORATIONS.

The Poudre Valley Telephone Company, Greeley, Col. Capital stock, $5,000. Directors: H. C. Watson, A. S. Eaton, Harrison Teller, Willus H. Eaton and James S. Newell. The company will operate lines from Greeley to Eaton and from Greeley to New Windsor, Fort Collins and North Poudre canon. The object of the company is to assist the irrigating system of Poudre Valley and not for personal profit.

The Fort Smith and Van Buren Electric Light and Power Company, Fort Smith, Ark. Capital stock, $100,000. Incorporators: W. C. Lemert, Jas. B. Gounly, Miles N. Beaty, A. F. Howard, Wm. Blair, F. T. McClure and R. C. McClure. The company propose to conduct, maintain and operate an electric street railway from Fort Smith to Van Buren, and to purchase or consolidate with other street railway companies in either or both of said cities, and to maintain and operate the same; and also the production, generation and furnishing of light, heat and power.

The College Hill Electric Railway Company of Cincinnati. Capital stock, $10,000. Incorporators: Peter G. Thompson, Lowe Emerson, Adam G. Gray, Newbold I. Pierson and Samuel A. Ramp.

United States Automatic Telephone Register Company, Chicago. Capital stock, $100,000. Incorporators: Sylvanus Hemans, William B. Thompson, Frank P. Blair.

The Mason Electric Company of New York City—to manufacture and deal in electrical goods in New York City and Brooklyn. Capital $25,000. Directors: Albert Van Derwerken, James H. Mason, Albert Van Derwerken, Jr., and Frank B. Johnson, of Brooklyn.

The Garton-Daniels Electric Company, Keokuk, Iowa—to manufacture the Garton lightning arrester and other electrical machinery and appliances. Capital stock, $20,000. Incorporators: W. R. Garton and J. C. Daniels.

Bar Harbor Electric Light Company, Portland, Me.—to supply light, heat and power by gas or electricity. Capital stock, $75,000. President, Geo. F. West, of Portland; treasurer, Luther A. Leach.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED MAY 30, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

498,403. Electric-Railway Trolley. Patrick F. O'Shaughnessy, New York, N. Y., assignor to the Sprague Electric Railway and Motor Company, same place. Filed Sept. 27, 1888.

498,435. Electric-Railway Trolley. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company of Connecticut. Original application filed June 7, 1888. Divided and application filed Nov. 8, 1888. Again divided and this application filed March 4, 1892.

498,577. Electric Locomotive. Albert Schmid, Allegheny, assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Filed Nov. 16, 1891.

498,603. System of Supplying Currents to Electric Railways. Charles Zipernowsky, Buda-Pesth, Austria-Hungary. Filed March 7, 1891.

498,607. Operating Street or Station Indicators. Ruben B. Ayres, New York, N. Y. Filed Dec. 22, 1891.

498,722. Trolley for Electric Cars. Robert D. Nuttall, Allegheny, Pa. Filed July 14, 1891.

498,723. Electric-Railway Trolley. Robert D. Nuttall, Allegheny, Pa. Filed May 10, 1892.

ELECTRIC LIGHTS AND APPLIANCES.

498,269. Electric-Arc Lamp. Louis Hills, New York, N. Y. Filed Sept. 2, 1891.

498,312. Electric-Lighting System. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed June 1, 1889. Renewed Nov. 4, 1890.

498,374. Adapter for Lamp-Sockets. Henry P. Ball, Schenectady, assignor to the Edison General Electric Company, New York, N. Y. Filed July 6, 1892.

498,387. Electric-Arc Lamp. Frederick D'A. Goold, New York, N. Y., assignor to the Edison General Electric Company, same place. Filed Nov. 7, 1891. Renewed Dec. 31, 1892.

498,566. Electric-Arc Lamp. Paul Nordmann, Berlin, Germany, assignor to Siemens & Halske, same place. Filed Nov. 16, 1892.

498,570. Suspension Device for Electric Lamps. James J. Renehan, New Britain, Conn. Filed Sept. 29, 1892.

498,604. Electric-Arc Lamp. Hugh Alexander, Brooklyn, N. Y. Filed April 19, 1890. Renewed Nov. 4, 1892.

DYNAMOS AND MOTORS.

498,327. Pole-Piece for Dynamo-Electric Machines. Elihu Thomson, Swampscott, assignor to the Thomson-Houston Electric Company, Boston, Mass. Filed Aug. 26, 1892.

498,462. Electric Rotary Fan. Julian F. Denison, New Haven, Conn., assignor to the Backus Water Motor Company, Newark, N. J. Filed March 15, 1892.

498,537. Dynamo-Electric Machine. Charles E. Dressler, New York, N. Y. Filed Oct. 6, 1891.

498,538. Electric Generator or Motor. Charles E. Dressler, New York, N. Y. Filed Sept. 15, 1892.

498,585. Electrical Rotary Motor. William J. Still, Toronto, Canada. Filed Dec. 28, 1891.

BATTERIES.

498,422. Galvanic Battery. William Burnley, North East, Pa. Filed June 15, 1892.

498,743. Galvanic Battery and Electrical Toy Instrument. William A. Connelly, Boston, Mass., assignor to the Electro-Novelty Company, Portland, Me. Filed Sept. 1, 1892.

TELEPHONE AND TELEGRAPH APPARATUS.

498,236. Telephone System. Emery A. Clark, Sioux City, Iowa, assignor, by direct and mesne assignments, to the Clark Automatic Telephone Equipment Company, same place. Filed April 5, 1892.

498,243. Telephone-Switch. Augustus G. Davis, Baltimore, Md. Filed Nov. 25, 1892.

498,291. Automatic Telephone-Exchange System. Alfred S. McCaskey, Chicago, Ill. Filed Aug. 25, 1892.

498,309. Telephone Transmitter. Charles F. Scattergood, Albany, N. Y. Filed Dec. 14, 1892.

498,503. Index for Telephones. Frank S. Blanchard, Worcester, Mass. Filed Oct. 10, 1892.

498,529. Printing-Telegraph. Edward V. Baillard, New Utrecht, N. Y. Filed Feb. 4, 1893.

498,674. Printing-Telegraph. Donald Murray, Sydney, New South Wales. Filed Nov. 2, 1892.

MISCELLANEOUS.

498,289. Electrical Signaling System. Alfred S. McCaskey, Chicago, Ill. Filed July 29, 1892.

498,290. Railway Block-Signaling System. Alfred S. McCaskey, Chicago, Ill. Filed July 29, 1892.

498,372. Electric Registering Device. Barton B. Ward, New York, N. Y. Filed May 28, 1890.

498,407. Insulated Binding-Post. Richard H. Rich, Beverly, Mass. Filed July 15, 1892.

498,448. Fire-Alarm System. Joseph Sachs, New York, N. Y. Filed June 24, 1892.

498,468. Electric Alarm-Clock. William M. Fowler, Milford, Conn. Filed May 6, 1892.

498,492. Gas Lighting or Extinguishing Apparatus. James Sangster, Buffalo, N. Y. Filed Dec. 27, 1892.

498,519. Electric Perforating-Pen. Aaron D. Lewis, Canton, Mo., and Silas Witherell, Fort Madison, Iowa; said Witherell assignor to said Lewis. Filed April 23, 1892.

498,560. Electric Cut-Out. William P. Mashinter, Montreal, Canada, assignor of two-thirds to Herbert Montague Linnell and Charles Morton, same place. Filed July 5, 1892.

498,624. Electric Car-Brake. Nicholas J. Clute, Schenectady, N. Y. Filed Oct. 24, 1892.

498,707. Copper-Coating the Hulls of Vessels. Thomas S. Crane, East Orange, N. J. Filed Oct. 12, 1892.

498,710. Electric Time-Alarm. Charles S. Gibson, South New Berlin, N. Y. Filed Oct. 12, 1892.

498,735. Electric Welding Apparatus. John H. Bassler, Myerstown, Pa. Filed Aug. 23, 1892.

ELECTRICITY.

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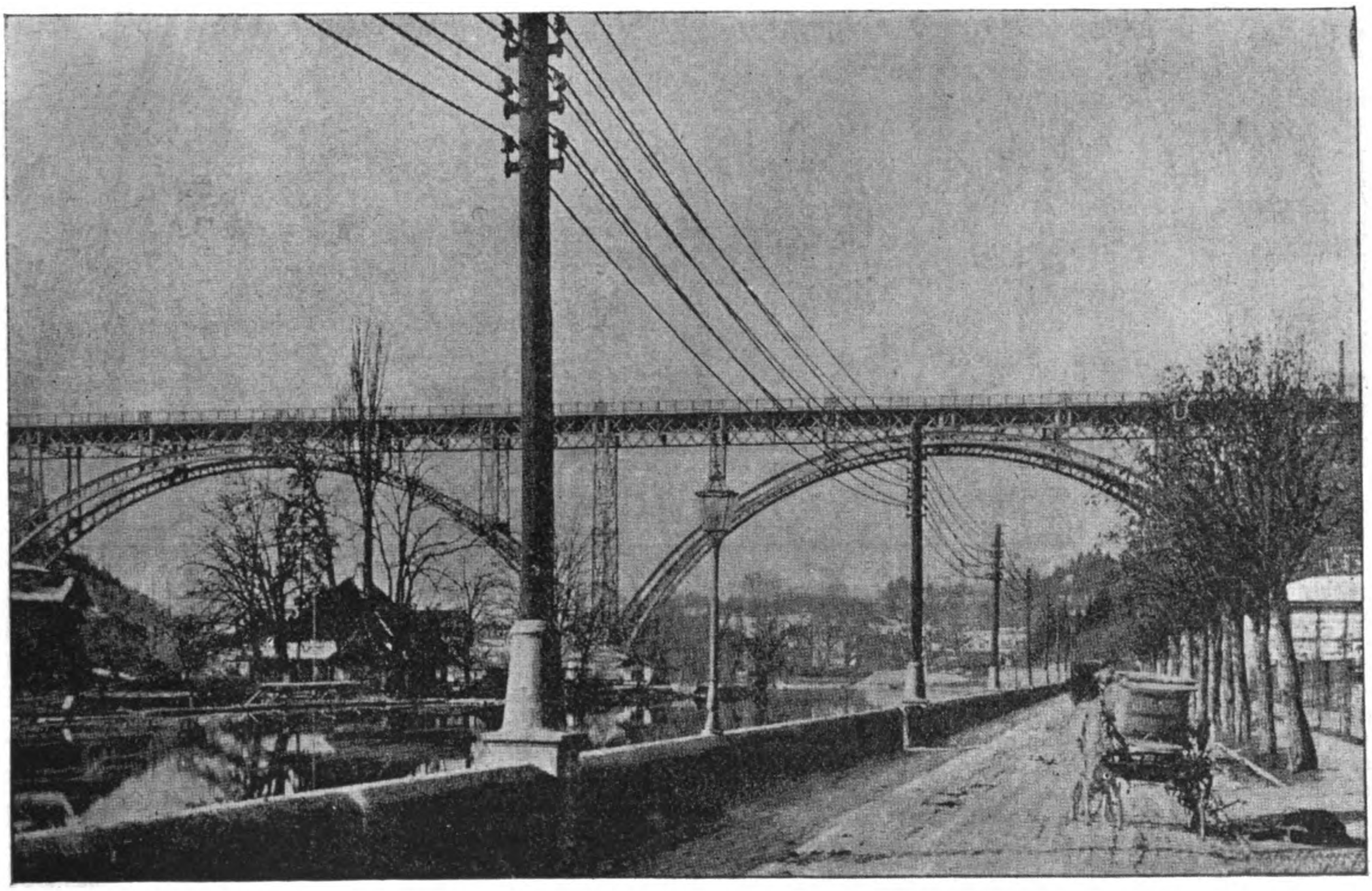
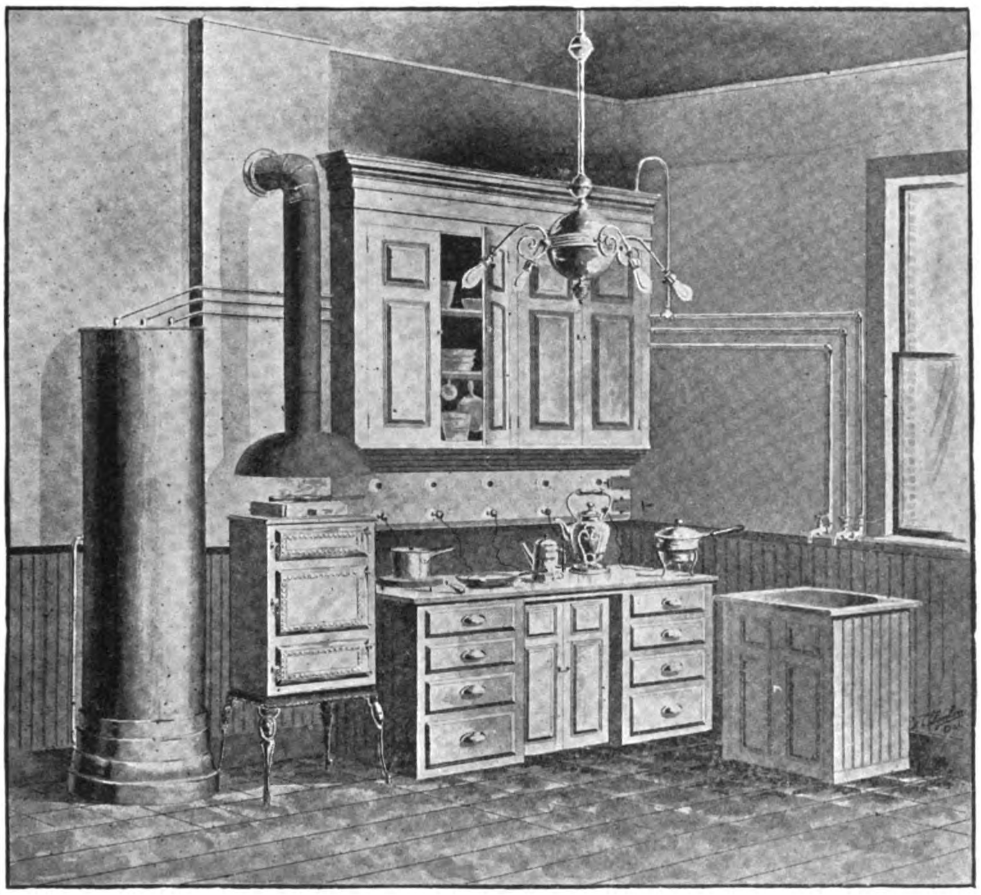


OVERHEAD CONSTRUCTION, BERNE POWER STATION. (SEE PAGE 303.)

Electric Heating.

BY W. S. KEY.

One after another the various departments in municipal, social and domestic economies are being entered by that subtle yet withal useful force, electricity; and so sure as it effects an entrance therein it makes itself so indispensable a factor that there is no thought entertained of retiring it again, for it is impressed into service as human ingenuity supplies the mechanical adjuncts, and all that remains is for some one to touch a button and electricity does the rest. Who could have thought fifteen years ago, nay, even ten years ago, that the business of electric lighting alone would have assumed the proportions it has to-day, to say nothing of the phenomenal growth of electric railways and the utilization of electricity for general power purposes? And yet there are the facts that never before in the history of theoretical or applied science has success been so quickly achieved as in this particular field, and the end is not yet.



A MODEL ELECTRICAL KITCHEN. (FIG. 1.)

The most recent development in electrical applications is that of heating; and while the world has almost had to gasp for breath as it has noted the rapid changes and improvements taking place in lighting and power, it will require a prophet and more than a prophet to predict when or where the ultimate limit shall be reached in the field of electric heating. This assertion is prompted by an unique experience the writer had a few days ago in Boston. It was a hungry and famishing crowd consisting of an even dozen newspaper men that assembled in a cosey kitchen belonging to the American Electric Heating Company, Boston, to watch the cooking of a first-class dinner by an Italian chef, after which the company were invited to partake of the toothsome viands which had been duly prepared without a spark of fire or a live coal or cinder being utilized.

The dinner was announced for 1 P. M., and at that hour the dozen guests were on hand and ready for the onslaught. Before that act was possible, however, they were invited to take possession of the kitchen and have their appetites whetted by watching the entire process of preparing and cooking every morsel of food they had been invited to partake of. The guests were naturally curious to watch the culinary operations, and in vain looked round to find anything resembling a stove or a cooking range. Instead of these usual devices there was a large cupboard overhead, as seen in the accompanying cut of this kitchen, wherein were ranged the various utensils. Extending along and fixed to the wall immediately below said cupboard was an electric switchboard, with plugs, sockets, cut outs, etc., such as are usually found where electricity is used. Then, as will be seen, there was a dresser or table on which the utensils in actual use stood, including coffee pot, plate warmer, saucepans, spider, steamer, pie plate, etc., each article looking identically like similar articles used in any ordinary kitchen, with this difference, that by means of a flexible silk cord, or incandescent lamp wire, each utensil was connected with the switchboard. At the end of this dresser stood a large oven; on top of this a grill, the fumes from which were conveyed away by means of a flue. Next there was a vertical copper boiler, such as is used in any house, the water pipes from which were conveyed to a sink stone and wash bowl on the opposite side of the kitchen where a plentiful supply of hot water could be obtained through ordinary faucets. Now every one of these pieces of domestic apparatus was being heated by electricity and doing as fine a piece of cooking as could be desired. The joint of beef in the oven sputtered in its gravy and emitted a most fragrant odor; the steak on the grill sizzled in an appetizing way for a few minutes till it was done to a turn, while the fragrant green peas steaming over the potatoes, and the aromatic Mocha brewing in the coffee urn, gave zest to the appetite, and held out promise of some interesting gastronomic exercises to follow. When dinner was at last announced—the cooking throughout taking about one-half the usual time—the guests fell to and did ample and speedy justice to the good things set before them, including fillet of soles, beautifully browned; lobster in sauce; roast of beef; steak, green peas, potatoes, French rolls and black coffee, which all declared were first class in every particular, and certainly more tasty than when cooked in the ordinary way.

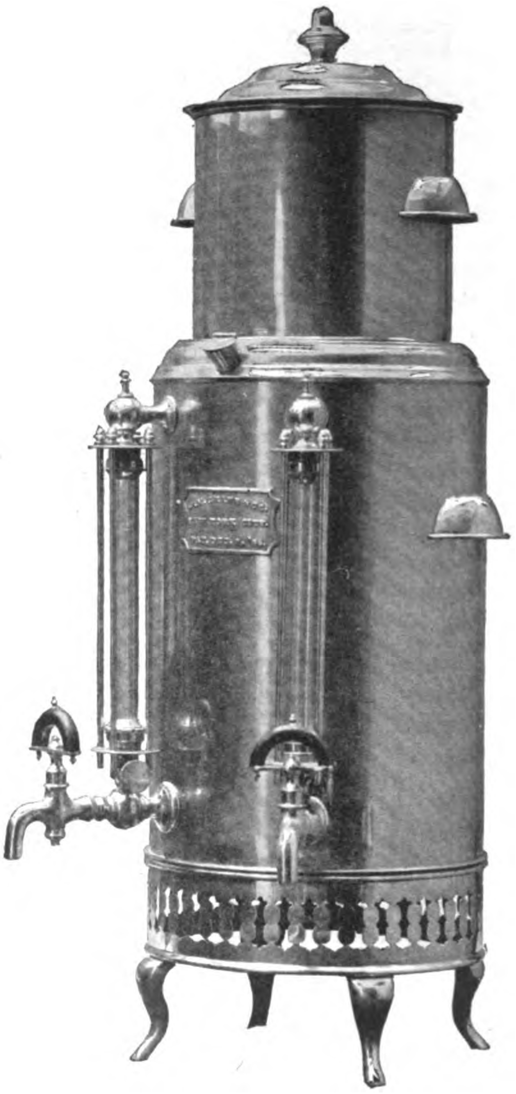
There were no post-prandial exercises, but during dinner the new departure in electrical science and its adaptability to the purposes of the cuisine were fully and freely discussed.

Then all were escorted to see the exhibition of devices which this company now own and are putting on the market, as well as to watch several of their experts at work evolving and developing new appliances and new uses for this process of electric heating, which uses bid fair for being to all intents and purposes illimitable.

Having thus given some account of the electrical kitchen, which is herewith accurately reproduced in Fig. 1, we may proceed to state that Fig. 2 represents an electric tea or coffee urn, Fig. 3 an electric plate or dish on which to keep a steak, chop or joint hot while being carved or eaten.

In this article it is impossible to enumerate one tithe of the devices shown. Suffice it to say that this electric heating process is being applied to tailors' irons, better known as "tailors' gooses"; to pressing irons for hatmakers; soldering irons for tinsmiths and braziers; cigar lighters; branding irons for stock-breeders; smoothing irons for laundry work; glue pots for carpenters' use, and many other similar uses.

The foregoing, however, do not exhaust the list, for this company have apparatus whereby, without the aid of furnace or any other heating device in cellars, houses and buildings of whatever kind can be heated by hot air or hot water. To accomplish this by hot air all that is needed is to place the electric radiator, Fig. 4, in a floor



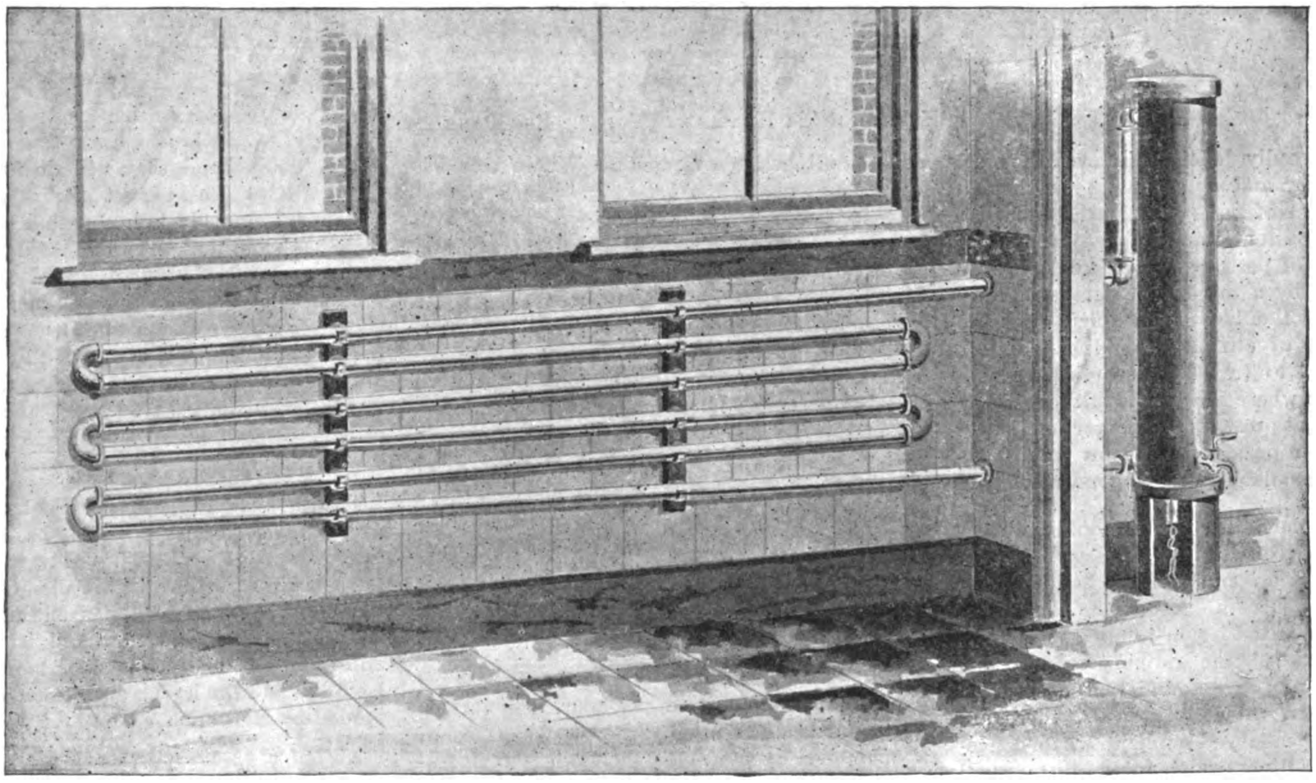
COFFEE AND TEA URN. (FIG. 2.)

register and turn on the current, when the air passing from the cellar, a cold air box, or from the outside, will be instantly heated, passing into the room and thereby creating a draught ensuring perfect ventilation. Or an ordinary water boiler, Fig. 5, can be heated with these radiators, thereby securing a circulation of steam or water, as the case may be, through the pipes and ordinary radiators as in daily use. The company likewise own a combination which secures certain degrees of heat sufficient to heat any place for hours after the current has been turned off, the necessary amount of heat having first been evolved.

PLATE STOVE. (FIG. 3.)

As will be seen from Fig. 6, which shows how a street car is heated by electricity, the pipes are arranged beneath the seats, and so perfect is this system, after many exhaustive experiments and tests, that an even and equable temperature of 55 degrees Fahr. can easily be maintained in the cars continuously whatever be the temperature outside, even down to zero or far below. The advantage of such a system of heating, doing away with the cost, care and dirt incidental to the use of stoves, will be appreciated by all. Incidentally it may be stated that this company own nearly all fundamental patents issued on car heating devices, whether the heat be produced by radiation or by connection, by the direct circulation of hot air or by the radiation of heat from suitable pipe surfaces. Of course it hardly needs to be stated that the current needed for car heating is taken from the trolley wire overhead.

In the metallurgical arts there is a wide field opening out for electric heating, and the assayer can heat his muffles to the finest shade of temperature by devices now available, while the smelter can dispense with all the smoke and dirt which accompany the use of coal or coke. During the exhibition last week a heat running up to something like 2,400 or 2,500 deg. Fahrenheit was evolved by electric current in very few minutes, melting white flinty sand so thoroughly in a crucible that when it cooled off it was converted into stone.



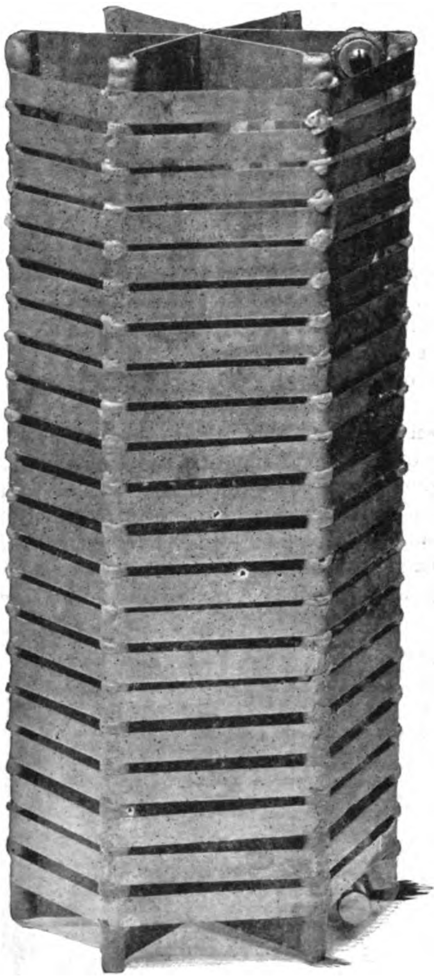
ELECTRIC HEATING BY HOT WATER CIRCULATION. (FIG. 5.)

For manufacturing jewelers there is a certain and complete revolution of business methods pending, for apparatus has been perfected by means of which gold and silver rings can be almost instantly soldered, and the welding of links in watch and other chains becomes child's play. And in the use of any and all of these various devices the question of economy is of supreme importance. The ordinary street current can be utilized, suitable devices having been perfected for transforming current to exactly what is needed for any purpose. Hitherto the costliness of electricity has stood in the way of its more general use; now this objection has become a thing of the past, and it goes without saying that it cannot and will not be long ere every one of the devices introduced to the world by this company will be in universal use and demand.

We have said but little of this remarkable step forward as compared with all we might have said, yet we have said sufficient to interest our readers in the most recent and promising departure in electrical science.

Before concluding we may state that the American Electric Heating Corporation, with a capital of $5,000,000, having its chief offices at 274 Purchase street, Boston, is composed of Mr. Edward Jewell, Boston, president; Arthur B. Smith, Boston, treasurer, and the following directors: A. M. Dodge and J. F. Tams, New York; H. C. Duell, Syracuse; F. D. Hager, St. Paul; Charles Odell, Salem; Ambrose Eastman and Ed. Jewell, Boston, and A. B. Smith, Cliftondale, all well known and wealthy business men in their respective communities. They have purchased all inventions and patents of any value on electric heating, and propose to do business on a most extensive scale.

The American Electric Heating Corporation will not manufacture or sell these goods, sub-companies having been organized for the manufacture and sale of these varied devices. Among these companies in the East are the Central Electric Heating Company, 26 Cortlandt street, New York, and the New England Electric Heating Company, 629 Atlantic avenue, Boston. These



COIL HEATER. (FIG. 4.)

and other sub-companies are already doing a flourishing business, though hitherto no effort has been made to interest the general public until now.

That the undertaking is bound to be an unqualified success is beyond all question, the demand having suddenly become both great and promising.

Electric Cooking and the Load Factor.*

The demand which is slowly, but surely, being coaxed into existence for electric sundries in the household is likely to have a most healthy action in increasing the load factor of our central stations, and in coming to the rescue of those engineers who have at present reason to groan over the day-load, or, rather, want of it. It is in its effects, rather than in itself, that electric cooking is of interest to us; but it may be well to chronicle the advances which have been made in some directions in the art. Of course, for some time to come electricity will be a luxury, or at the best an expensive necessity, to those who dabble in the enticing and scientifically-cleanly appliances which are now so much in evidence at the hands of Mr. Dowsing, and associated with the names of Carpenter, Binswanger, Crompton, Hirst and others.

The first asbestos-covered wire resistance coil appliances were sadly deficient in even the most elementary design and the wonder is that they do so well; but some of the recent patterns have a claim upon our attention, if only as examples of evolution, a proof positive that efficiency is only to be obtained by a mastery of details and by keeping in view the laws upon which even the simplest action of our domestic life is based. Where heat has to travel, air spaces have been done away with where not wanted, although they are very useful at present until the vacuum jacket which has been promised becomes *un fait accompli* and is available as a non-conducting wall for heat vessels.

Carpenter in the States and Crompton in England have buried highly-resisting wires in enamel, and such an arrangement has been exploited with fair success. About the same time, Binswanger and Hirst began to use a special vitreous cement, with platino-iridium wire embedded in it, and they, too, have found that despite the present costliness of such utensils, there are members of the moneyed public to whom convenience and novelty outweigh the, to them, small additional expense. Of course, the dealers benefit in the first instance, and the central stations always, so the latter cannot but regard such enterprising firms as their best friends in a time of need. The last-named vitreous enamel can be applied to any existing vessel, and the absence of firing marks the distinction between it and the Carpenter system. Recent tests have shown that the heating of water is practically (a self-evident fact to the most primitive physicist) the most trying task electricity can be given.

The first design of heater was akin to the toddy ladel, but was soon displaced by a kettle provided below with the resistance wire. In such a form a kettle containing two pints of cold water can, it is said, be brought up to boiling point with five amperes at 100 volts, in from 16 to 18 minutes. If we say 20 minutes, to be on the safe side, it may be taken that one-sixth of a unit would be required for each charge; that is, at present average prices, it costs ½d. to boil 1 pint of cold water by electricity. Sixty watt hours have achieved this feat under test conditions, and the application of the principles of calorimetry have caused the efficiency to go up till little further can be expected as to improvement in this direction.

Seventy-five per cent. to 80 per cent. can be guaranteed as a return of the total heat energy of the current supplied, and no perceptible difference has yet been found between the effectiveness of alternating and continuous supply. The loss is simply one of radiation which it is impossible to altogether overcome. Where this has been counteracted, 90 per cent. return has resulted. Bolder attempts are being made with large ovens and appliances for hotel kitchens, and with these notable results have been obtained. Mr. Binswanger's latest oven, 20 inches by 14 inches by 18 inches, can be kept up 350 degs. F. to 400 degs. F. for three hours by an expenditure of 1,200 watts if it has been brought up to working heat with 1,800 watts, and the first heating of the contents done with this energy.

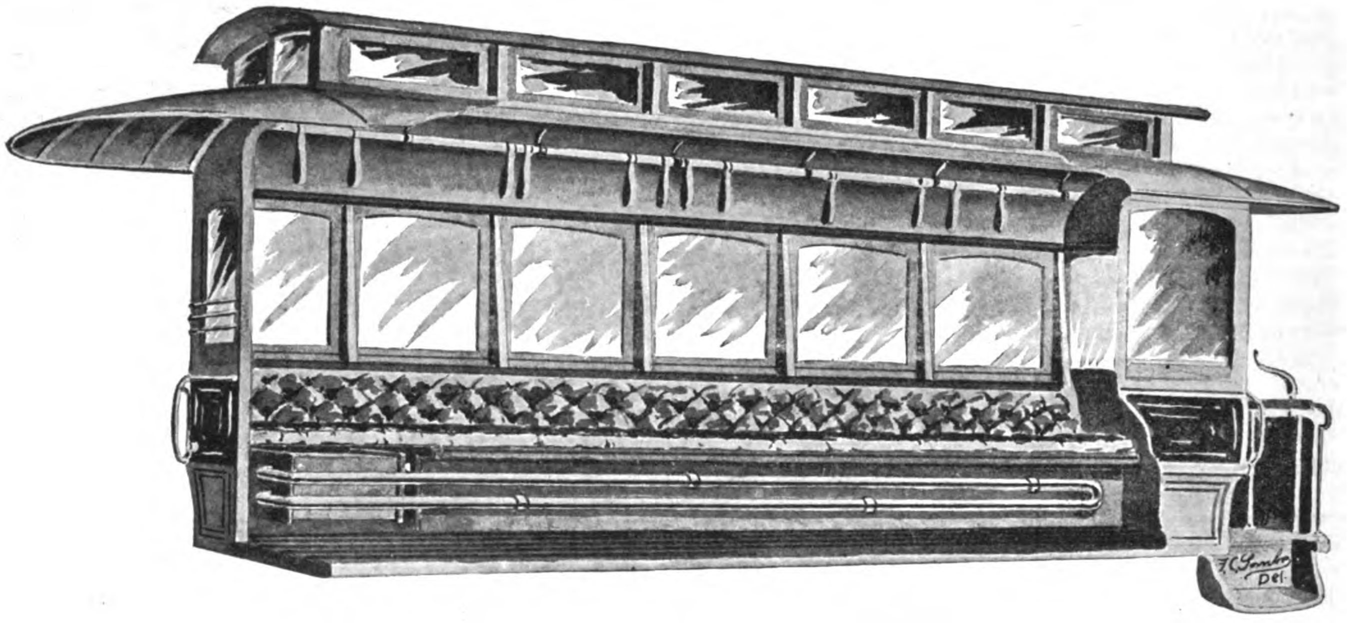
In the latest small heater, one pint of water can be raised from 15 degs. C. to 100 degs. C. by 75 watt-hours, showing an efficiency of 73 per cent. The small curling-iron heater takes ¾ ampere at 100 volts for 1½ minutes to raise it from 15 degs. C. to 200 degs. C., say, a demand of 75 watts for an infinitesimal time per diem. Irons of large sizes are being handled. A tailor's goose, weighing 15 lbs., while at work, takes 4 amperes at 100 volts, or 400 watts, say 2d. per hour. The surface heater for badly-ventilated rooms and offices of about 10 feet by 12 feet, to maintain a temperature of 60 degs. F. during winter weather, absorbs five amperes at 100 volts, or half a unit per hour, and although outrageously extravagant compared with gas fires, there seems to be a likelihood of many a city man blessing the company which burns coal across the river to supply the heat for his comfort in the densest part of the city itself.

It cannot be enforced too strongly that the cost of all such service performed by electrical means must always be far above anything chargeable to gas. To produce heat by the operation of the $C^2 R$ law means the erection and maintenance of three separate sets of plant at one locality, the losses in which must certainly be paid for by the consumer, and in addition to this he has to pay his share of the maintenance of a costly and extensive system of mains and converters—a system whose capitalized cost reduced to per unit per consumer is out of all proportion to the equivalent in a net-work of gas mains.

To supply 200 heaters of the size mentioned would require a boiler, an engine, and a dynamo plant, each of 100 kilowatt capacity, whereas for gas supply the storage provided would be capable of dealing with many thousand such appliances and call for no increase.

Notwithstanding this fact, there is no doubt that the sooner central stations follow the lead of the gas companies and inaugurate, by their own efforts, a system of hiring, of hire-purchase and rental of domestic heating and cooking appliances, the sooner will their profits be proportionate to the scientific success of the industry.

If the domestic applications do not do all that some fondly hope they will do for electricity, they will at least assist the other economies which are already being practised by station managers, and tend towards that desirable result—the payment of a fair dividend to the shareholders, and a proportionate remuneration to those engaged in the operations of supply. Approximately, the cost of heating by electricity is about ten times the cost of gas, taking gas at 2s. 6d., electricity at 3d., and theoretical efficiency.



ELECTRIC CAR HEATING. (FIG. 6. SEE PAGE 299.)

A Long Cable.

The duplicate cable of the Central and South American Telegraph Company has been successfully laid by the steamship Silvertown. It extends in three sections from Salina Cruz, Mex., to Chorillos, Peru, via San Juan del Sur, Nicaragua, and Santa Elena, Ecuador, and is nearly 2,500 miles long. The cable was manufactured in London, and the laying operations were superintended by Herbert Kingsford, engineer and electrician.

It Shows Progress.

The *Architects' Electrical Bulletin* for June shows a marked improvement over previous issues. It is entirely creditable to its publishers, and is indeed a well edited "monthly review of the art of electric wiring."

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* From the *Electrical Review*, London

ON LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.—III.

BY NIKOLA TESLA.*

It is desirable, in order to maintain the vibration economically, to reduce the impact and frictional losses as much as possible. As regards the latter, which in the electrical analogue correspond to the losses due to the resistance of the circuits, it is impossible to obviate them entirely, but they can be reduced to a minimum by a proper selection of the dimensions of the circuit and by the employment of thin conductors in the form of strands. But the loss of energy caused by the first breaking through of the dielectric—which in the above example corresponds to the violent knock of the bottom against the inelastic stop—would be more important to overcome. At the moment of the breaking through, the air space has a very high resistance, which is probably reduced to a very small value when the current has reached some strength and the space is brought to a high temperature. It would materially diminish the loss of energy if the space were always kept at an extremely high temperature, but then there would be no disruptive break. By warming the space moderately by means of a lamp or otherwise, the economy as far as the arc is concerned is sensibly increased. But the magnet or other interrupting device does not diminish the loss in the arc. Likewise, a jet of air only facilitates the carrying off of the energy. Air, or a gas in general, behaves curiously in this respect. When two bodies, charged to a very high potential, discharge disruptively through an air space, any amount of energy may be carried off by the air. This energy is evidently dissipated by bodily carriers in impact and collisional losses of the molecules. The exchange of the molecules in the space occurs with inconceivable rapidity. A powerful discharge taking place between two electrodes, they may remain entirely cool, and yet the loss in the air may represent any amount of energy. It is perfectly practicable, with very great potential differences in the gap, to dissipate several horse-power in the arc of the discharge without even noticing a small increase in the temperature of the electrodes. All the frictional losses occur then practically in the air. If the exchange of the air molecules is prevented, as by enclosing the air hermetically, the gas inside the vessel is brought quickly to a high temperature, even with a very small discharge. It is difficult to estimate how much of the energy is lost in sound waves, audible or not, in a powerful discharge. When the currents through the gap are large, the electrodes may become rapidly heated, but this is not a reliable measure of the energy wasted in the arc, as the loss through the gap itself may be comparatively small. The air or a gas in general is, at ordinary pressures at least, clearly not the best medium through which a disruptive discharge should occur. Air or other gas under great pressure is of course a much more suitable medium for the discharge gap. I have carried on long-continued experiments in this direction, unfortunately less practicable on account of the difficulties and expense in getting under great pressure. But even if the medium in the discharge space is solid or liquid, still the same losses take place, though they are generally smaller, for just as soon as the arc is established the solid or liquid is volatilized. Indeed, there is no body known which would not be disintegrated by the arc, and it is an open question among scientific men whether an arc discharge could occur at all in the air itself without the particles of the electrodes being torn off. When the current through the gap is very small and the arc very long, I believe that a relatively considerable amount of heat is taken up in the disintegration of the electrodes, which partially on this account may remain quite cold.

The ideal medium for a discharge gap should only *crack*, and the ideal electrode should be of some material which cannot be disintegrated. With small currents through the gap it is best to employ aluminum, but not when the currents are large. The disruptive break in the air, or more or less in any ordinary medium, is not of the nature of a crack, but is rather comparable to the piercing of innumerable bullets through a mass offering great frictional resistance to the motion of the bullets, this involving considerable loss of energy. A medium which would merely crack when strained electrostatically—and this possibly might be the case with a perfect vacuum, that is, pure ether—would involve a very small loss in the gap, so small as to be entirely negligible, at least theoretically, because a crack may be produced by an infinitely small displacement. In exhausting an oblong bulb provided with two aluminum terminals with the greatest care I have succeeded in producing such a vacuum that the secondary discharge of a disruptive discharge coil would break disruptively through the bulb in the form of fine spark streams. The curious point was that the discharge would completely ignore the terminals and start far behind the two aluminum plates which served as electrodes. This extraordinarily high vacuum could only be maintained for a very short while. To return to the ideal medium, think, for the sake of illustration, of a piece of glass or similar body clamped in a vise, and the latter tightened more and more. At a certain point a minute increase of the pressure will cause the glass to crack. The loss of energy involved in splitting the glass may be practically nothing, for though the force is great the displacement need be but extremely small. Now imagine that the glass would possess the property of closing again perfectly the crack upon a minute diminution of the pressure. This is the way the dielectric in the discharge space should behave. But inasmuch as there would be always some loss in the gap the medium, which should be continuous, should exchange through the gap at a rapid rate. In the preceding example, the glass being perfectly closed, it would mean that the dielectric in the discharge space possesses a great insulating power; the glass being cracked, it would signify that the medium in the space is a good conductor. The dielectric should vary enormously in resistance by minute variations of the E. M. F. across the discharge space. This condition is attained, but in an extremely imperfect manner, by warming the air space to a certain critical temperature, dependent on the E. M. F. across the gap, or by otherwise impairing the insulating power of the air. But as a matter of fact the air does never break down *disruptively*, if this term be rigorously interpreted, for before the sudden rush of the current occurs there is always a weak current preceding it, which rises first gradually and then with comparative suddenness. That is the reason why the rate of change is very much greater when glass, for instance, is broken through than when the break takes place through an air space of equivalent dielectric strength. As a medium for the discharge space a solid, or even a liquid, would be preferable therefore. It is somewhat difficult to conceive of a solid body which would possess the property of closing instantly after it has been cracked. But a liquid, especially under great pressure, behaves practically like a solid, while it possesses the property of closing the crack. Hence it was thought that a liquid insulator might be more suitable as a dielectric than air. Following out this idea, a number of different forms of dischargers in which a variety of such insulators, sometimes under great pressure, were employed, have been experimented upon. It is thought sufficient to dwell in a few words upon one of the forms experimented upon. One of these dischargers is illustrated in Figs. 4*a* and 4*b*.

A hollow metal pulley P (Fig. 4*a*) was fastened upon an arbor *a*, which by suitable means was rotated at a considerable speed. In the inside of the pulley, but disconnected from the same, was supported a thin disc h_1 (which is shown thick for the sake of clearness) of hard rubber, in which were embedded two metal segments *s s* with metallic extensions *e e* into which were screwed conducting terminals *t t* covered with thick tubes of hard rubber *t t*. The rubber disc *h* with its metallic segments *s s* was finished in a lathe, and its entire surface highly polished so as to offer the smallest possible frictional resistance to the motion through a fluid. In the hollow of the pulley an insulating liquid such as a thin oil was poured so as to reach very nearly to the opening left in the flange *f*, which was screwed tightly on the front side of the pulley. The terminals *t t* were connected to the opposite coatings of a battery of condensers so that the discharge occurred through the liquid. When the pulley was rotated the liquid was forced against the rim of the pulley and considerable fluid pressure resulted. In this simple way the discharge gap was filled with a medium which behaved practically like a solid, which possessed the quality of closing instantly upon the occurrence of the break, and which moreover was circulating through the gap at a rapid rate. Very powerful effects were produced by dischargers of this kind with liquid interrupters, of which a number of different forms were made. It was found that, as expected, a longer spark for a given length of wire was obtainable in this way than by using air as an interrupting device. Generally the speed, and therefore also the fluid pressure, was limited by reason of the fluid friction, in the form of discharger described, but the practically obtainable speed was more than sufficient to produce a number of breaks suitable for the circuits ordinarily used. In some instances the metal pulley P was provided with a few projections inwardly, and a definite number of breaks were then produced which could be computed from the speed of rotation of the pulley. Experiments were also carried on with liquids of different insulating power with the view of reducing the loss in the arc. When an insulating liquid is moderately warmed the loss in the arc is diminished.

A point of some importance was noted in experiments with various dischargers of this kind. It was found, for instance, that whereas the conditions maintained in these forms were favorable for the production of a great spark length, the currents so obtained were not best suited to the production of light effects. Experience undoubtedly has shown that for such purposes a harmonic rise and fall of the potential is preferable. Be it that a solid is rendered incandescent, or phosphorescent, or be it that energy is transmitted by condenser coating through the glass, it is quite certain that a harmonically rising and falling potential produces less destructive action, and that the vacuum is more permanently maintained. This would be easily explained if it were ascertained that the process going on in an exhausted vessel is of an electrolytic nature.

In the diagrammatical sketch, Fig. 1, which has been already referred to, the cases which are most likely to be met with in practice are illustrated. One has at his disposal either direct or alternating currents from a supply station. It is convenient for an experimenter in an isolated laboratory to employ a machine G such as illustrated, capable of giving both kinds of currents. In such case it is also preferable to use a machine with multiple circuits, as in many experiments it is useful and convenient to have at one's disposal currents of different phases. In the sketch, D represents the direct and A the alternating circuit. In each of these, three branch circuits are shown, all of which are provided with double lines switches *s s s s s s*. Consider first the direct current conversion; 1*a* represents the simplest case. If the E. M. F. of the generator is sufficient to break through a small air space, at least when the latter is warmed or otherwise rendered poorly insulating, there is no difficulty in maintaining a vibration, with fair economy by judicious adjustment of the capacity, self-induction and resistance of the circuit L containing the devices *l l m*. The magnet N, S, can be in this case advantageously combined with the air space. The discharger *d d* with the magnet may be placed either way, as indicated by the full or by the dotted lines. The circuit 1*a* with the connections and devices is supposed to possess dimensions such as are suitable for the maintenance of a vibration. But usually the E. M. F. on the circuit or branch 1*a* will be something like 100 volts or so, and in this case it is not sufficient to break through the gap. Many different means may be used to remedy this by raising the E. M. F. across the gap. The simplest is probably to insert a large self-induction coil in series with the circuit L. When the arc is established, as by the discharger illustrated in Fig. 2, the magnet blows the arc out the instant it is formed. Now the extra current of the break, being of high E. M. F., breaks through the gap, and a path of low resistance for the dynamo current being again provided, there is a sudden rush of the current from the dynamo upon the weakening or subsidence of the extra current. This process is repeated in rapid succession, and in this manner I have maintained oscillation with as low as 50 volts, or even less, across the gap. But conversion on this plan is not to be recommended on account of the too heavy currents through the gap and consequent heating of the electrodes; besides, the frequencies obtained in this way are low, owing to the high self induction necessarily associated with the circuit. It is very desirable to have the E. M. F. as high as possible, first, in order to increase the economy of the conversion, and secondly, to obtain high frequencies. The difference of potential in this electric oscillation is, of course, the equivalent of the stretching force in the mechanical vibration of the spring. To obtain very rapid vibration in a circuit of some inertia a great stretching force or difference of potential is necessary. Incidentally, when the E. M. F. is very great, the condenser which is usually employed in connection with the circuit need have but a small capacity, and many other advantages are gained. With a view of raising the E. M. F. to a many times greater value than obtainable from ordinary distribution circuits, a rotating transformer *g* is used, as indicated in Fig. 2*a*, or else a separate high potential machine is driven by means of a motor operated from the generator G. The latter plan is in fact preferable, as changes are easier made. The connections from the high tension winding are quite similar to those in branch 1*a* with the exception that a condenser C, which should be adjustable, is connected to the high tension circuit. Usually, also, an adjustable self-induction coil in series with the circuit has been employed in these experiments. When the tension of the currents is very high the magnet ordinarily used in connection with the discharger is of comparatively small value, as it is quite easy to adjust the dimensions of the circuit so that oscillation is maintained. The employment of a steady E. M. F. in the high frequency conversion affords some advantages over the employment of alternating E. M. F. as the adjustments are much simpler and the action can be easier controlled. But unfortunately one is limited by the obtainable potential difference. The windings also break down easily in consequence of the sparks which form between the sections of the armature or commutator when a vigorous oscillation takes place. Besides, these transformers are expensive to build. It has been found by experience that it is best to follow the plan illustrated in Fig. 3*a*. In this arrangement a rotating transformer *g* is employed to convert the low tension direct currents into low frequency alternating currents, preferably also of small tension. The tension of the currents is then raised in a stationary transformer T. The secondary S of this transformer is connected to an adjustable condenser C, which discharges through the gap or discharger *d d*, placed in either of the ways indicated, through the primary P of a disruptive discharge coil, the high frequency currents being obtained from the secondary S of this coil, as described on previous occasions. This will undoubtedly be found the cheapest and most convenient way of converting direct currents.

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* A lecture delivered before the Franklin Institute at Philadelphia, Feb. 24, 1893, and before the National Electric Light Association at St. Louis, Mo., March 1, 1893.

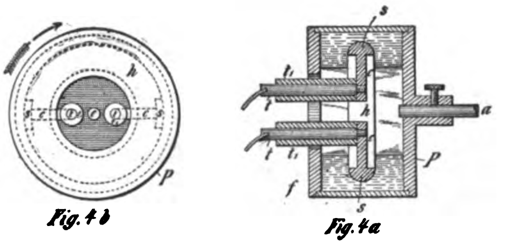

Fig. 4 b *Fig. 4 a*

FORM OF DISCHARGER WITH LIQUID INTERRUPTER.

The three branches of the circuit A represent the usual cases met in practice when alternating currents are converted. In Fig. 1*b* a condenser C, generally of large capacity, is connected to the circuit L, containing the devices *l l*, *m m*. The devices *m m* are supposed to be of high self-induction so as to bring the frequency of the circuit more or less to that of the dynamo. In this instance the discharger *d d* should best have a number of makes and breaks per second equal to twice the frequency of the dynamo. If not so, then it should have at least a number equal to a multiple or even fraction of the dynamo frequency. It should be observed, referring to 1*b*, that the conversion to a high potential is also effected when the discharger *d d*, which is shown in the sketch, is omitted. But the effects which are produced by currents which rise instantly to high values, as in a disruptive discharge, are entirely different from those produced by dynamo currents which rise and fall harmonically. So, for instance, there might be in a given case a number of makes and breaks at *d d* equal to just twice the frequency of the dynamo, or in other words there may be the same number of fundamental oscillations as would be produced without the discharge gap, and there might even not be any quicker superimposed vibration; yet the differences of potential at the various points of the circuit, the impedence and other phenomena, dependent upon the rate of change, will bear no similarity in the two cases. Thus, when working with currents discharging disruptively, the element chiefly to be considered is not the frequency, as a student might be apt to believe, but the rate of change per unit of time. With low frequencies in a certain measure the same effects may be obtained as with high frequencies, provided the rate of change is sufficiently great. So, if a low frequency current is raised to a potential of say 75,000 volts and the high tension current passed through a series of high resistance lamp filaments, the importance of the rarefied gas surrounding the filament is clearly noted, as will be seen later; or, if a low frequency current of several thousand amperes is passed through a metal bar, striking phenomena of impedence are observed, just as with currents of high frequencies. But it is, of course, evident that with low frequency currents it is impossible to obtain such rates of change per unit of time as with high frequencies, hence the effects produced by the latter are much more prominent. It was deemed advisable to make the preceding remarks, inasmuch as many more recently described effects have been unwittingly identified with high frequencies. Frequency alone in reality does not mean anything, except when an undisturbed harmonic oscillation is considered.

In the branch 3*b* a similar disposition as in 1*b* is illustrated, with the difference that the currents discharging through the gap *d d* are used to induce currents in the secondary S of a transformer T. In such case the secondary should be provided with an adjustable condenser for the purpose of tuning it to the primary.

Fig. 2*b* illustrates a plan of alternate current high frequency conversion which is most frequently used and which is found to be most convenient. This plan has been dwelt upon in detail on previous occasions and need not be described here.

Some of these results were obtained by the use of a high frequency alternator. A description of such machines will be found in my original paper before the American Institute of Electrical Engineers, and in periodicals of that period, notably in the *Electrical Engineer* of March 18, 1891.

ON PHENOMENA PRODUCED BY ELECTROSTATIC FORCE.

The first class of effects I intend to show you are effects produced by electrostatic force. It is the force which governs the motion of the atoms, which causes them to collide and develop the life-sustaining energy of heat and light, and which causes them to aggregate in an infinite variety of ways, according to Nature's fanciful designs, and to form all these wondrous structures we perceive around us; it is, in fact, if our present views be true, the most important force for us to consider in nature. As the term *electrostatic* might imply a steady electric condition, it should be remarked that in these experiments the force is not constant, but varies at a rate which may be considered moderate, about one million times a second, or thereabouts. This enables me to produce many effects which are not produceable with an unvarying force.

When two conducting bodies are insulated and electrified, we say that an electrostatic force is acting between them. This force manifests itself in attractions, repulsions and stresses in the bodies and space or medium without. So great may be the strain exerted in the air, or whatever separates the two conducting bodies, that it may break down, and we observe sparks or bundles of light or streamers, as they are called. These streamers form abundantly when the force through the air is rapidly varying. I will illustrate this action of electrostatic force in a novel experiment in which I will employ the induction coil before referred to. The coil is contained in a trough filled with oil, and placed under the table. The two ends of the secondary wire pass through the two thick columns of hard rubber which protrude to some height above the table.

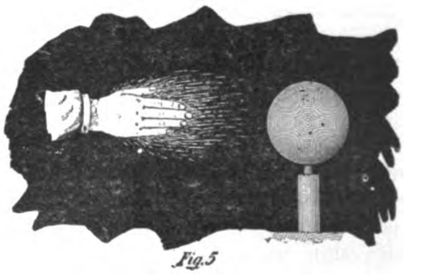

Fig. 5

ILLUSTRATING THE EFFECT OF VARYING ELECTROSTATIC FORCE WITH A TRANSFORMER OF 200,000 VOLTS PRESSURE.

It is necessary to insulate the ends or terminals of the secondary heavily with hard rubber, because even dry wood is by far too poor an insulator for these currents of enormous potential differences. On one of the terminals of the coil, I have placed a large sphere of sheet brass, which is connected to a larger insulated brass plate, in order to enable me to perform the experiments under conditions which, as you will see, are more suitable for this experiment. I now set the coil to work and approach the free terminal with a metallic object held in my hand, this simply to avoid burns. As I approach the metallic object to a distance of eight or ten inches, a torrent of furious sparks breaks forth from the end of the secondary wire, which passes through the rubber column. The sparks cease when the metal in my hand touches the wire. My arm is now traversed by a powerful electric current, vibrating at about the rate of one million times a second. All around me the electrostatic force makes itself felt, and the air molecules and particles of dust flying about are acted upon and are hammering violently against my body. So great is this agitation of the particles that when the lights are turned out you may see streams of feeble light appear on some parts of my body. When such a streamer breaks out on any part of the body it produces a sensation like the pricking of a needle. Were the potentials sufficiently high and the frequency of the vibration rather low, the skin would probably be ruptured under the tremendous strain, and the blood would rush out with great force in the form of fine spray or jet so thin as to be invisible, just as oil will when placed on the positive terminal of a Holtz machine. This breaking through of the skin, though it may seem impossible at first, would perhaps occur by reason of the tissues under the skin being incomparably better conductors. This at least appears plausible judging from some observations.

I can make these streams of light visible to all by touching with the metallic object one of the terminals as before, and approaching my free hand to the brass sphere, which is connected to the second terminal of the coil. As the hand is approached the air between it and the sphere, or in the immediate neighborhood, is more violently agitated, and you see streams of light now break forth from my finger tips and from the whole hand (Fig. 5). Were I to approach the hand closer, powerful sparks would jump from the brass sphere to my hand, which might be injurious. The streamers offer no particular inconvenience, except that in the ends of the finger tips a burning sensation is felt. They should not be confounded with those produced by an influence machine, because in many respects they behave differently. I have attached the brass sphere and plate to one of the terminals in order to prevent the formation of visible streamers on that terminal, also in order to prevent sparks from jumping at a considerable distance. Besides, the attachment is favorable for the working of the coil.

(To be continued.)

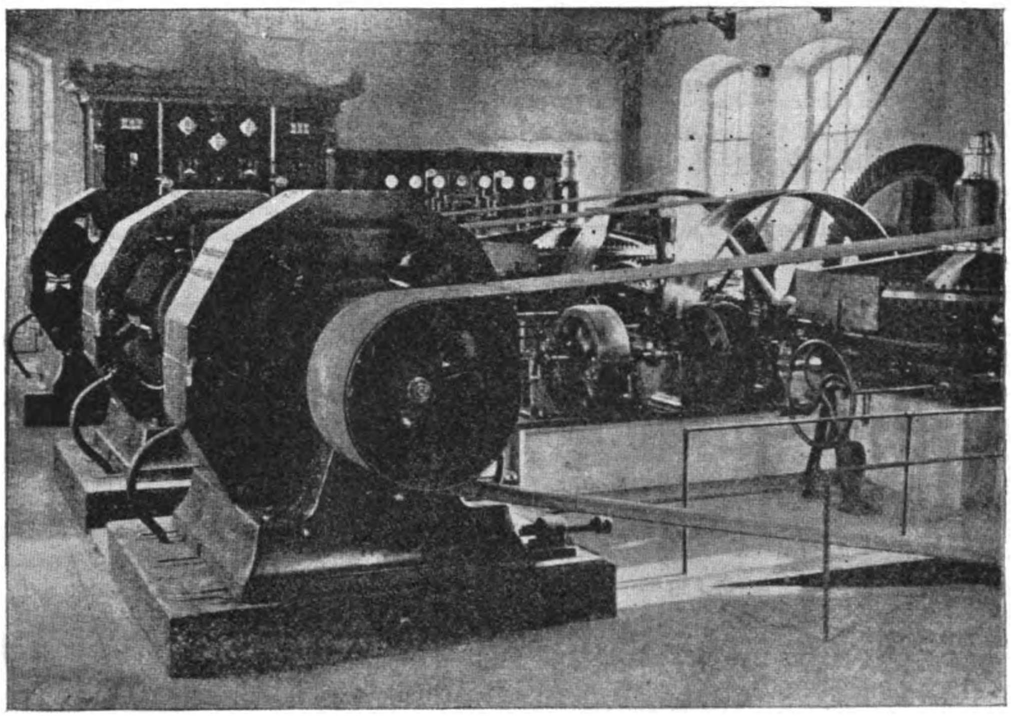

FIG. 2.

The Berne Hydraulic Power Station.

Berne, Switzerland, is one of those fortunate towns which have water power available, and one of those still more fortunate towns which have authorities who are willing to advance with the times. The power station, which is described in *Industries*, is driven by water power from the river Aare, which has a fall of about ten feet, with a volume of water representing about 400 H. P. Fig. 1 shows in elevation the arrangement of the station, which is built above the water race, while Fig. 2 shows a general view of the turbines and dynamos. There are three turbines of 120 H. P. each, and three direct-current dynamos to correspond. The third turbine, however, is also coupled to a shaft from which power is taken to drive a neighboring tramway system. The turbines all work on one shaft, which runs at 125 revolutions per minute. A spur wheel takes off power for the compressors of the tramway system. The turbines, which are of the Jonval type, can be uncoupled by clutches placed between them.

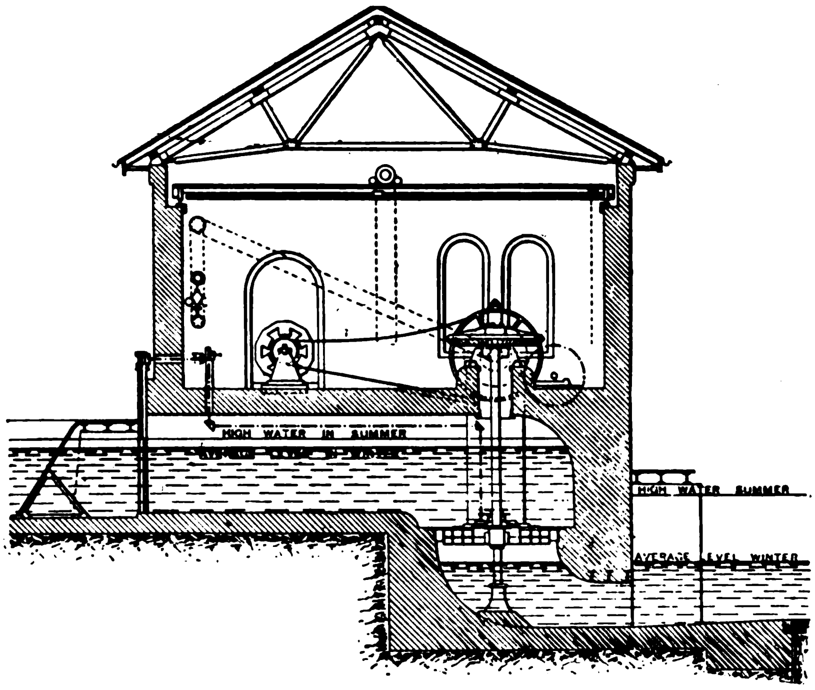

FIG. 1.

The dynamos are of the Maschinen Fabrik Oerlikon six-pole type. One is held in reserve; and accumulators of the Hagen type are employed, as the water power is not sufficient to run at full load without them. The dynamos are wound for charging accumulators, with three pairs of brushes in parallel, and give 120-140 volts and 84,000 watts at 450 revolutions per minute. The battery house is a well ventilated building containing 144 "Tudor" cells, of which 32 are connected to the switches; the capacity being 690 ampere hours.

The distribution is carried out on the three-wire system. An ingenious method of dealing with the batteries is employed. A couple of dynamotors are used, so that extra pressure can be given to the cell circuit even if the dynamos are connected to the town mains. In fact, an extra electromotive force can be put in the battery circuit. The battery is also regulated for discharging by an automatic switch, which is controlled by a relay, which is in its turn controlled by a sensitive voltmeter. This apparatus is found to work perfectly and promptly, and no variations of pressure are observed on the mains or lamps.

The station begins supply with what is equivalent to 6,000 eight C. P. lamps arranged on a network fed by three pairs of feeders and two compensation leads. The circuit is carried from the station for half a mile along the banks of the Aare. Eight overhead cables are employed. Pilot wires to the automatic governors are also led to the network. The leads are carried into an underground chamber in Münzt Terrace, where there are means of testing the cables when necessary, and lightning protectors are arranged for the overhead mains just mentioned.

The underground system, which supplies the whole town, is laid with Berthoud-Borel lead-covered cables, which are placed in impregnated wood casing. The public lighting is carried out with thirty Pilsen arc lamps. The railway station also takes fifty 10-ampere arc lamps.

The Frontispiece shows the overhead construction along the banks of the river Aare.

ELECTRICITY.

The Popular Electrical Journal.

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A Suicidal Mistake.

The reflections of the officers and directors of the Electric Trust, when they turn the pages of ELECTRICITY and scan them closely (as they all do), cannot be pleasant. They cannot fail to notice that in our advertising department there are no less than seven makers of incandescent lamps represented. They are as follows: The Packard, Novak, Columbia, New Sunbeam, American, Buckeye and Westinghouse. This list will be added to within a few days.

We say the reflections of the officers and directors of the Trust cannot be pleasant when they take notice of this list.

If the most sanguine man in the Trust, even Mr. Coffin himself, had been asked in January, 1892, if the Trust scheme could be successful without the Edison lamp patent, he would have answered emphatically "No."

This lamp patent, with the direct and indirect benefits attached to it, was the one thing on which the Trust relied to pull them through. It is indeed more than probable that an absolute monopoly of the lamp business, such as was thoroughly tried for, would have placed the Trust on a solid financial footing, and given it a grip on the entire business that could not have been shaken in the next generation.

It was estimated that before the closing down of the Sawyer-Man factory 25,000 lamps per day were being made by independent companies. If the Trust had secured all the business they might easily have made a profit of 30 cents per lamp, or $7,500 a day, which would have been an addition to their income of $2,500,000 a year on lamps alone.

But an absolute monopoly was an impossibility, and the stupendous blunder of the Trust was in not properly appreciating this fact after the New York, Hartford and Chicago decisions.

At that time, and we speak with full knowledge on the subject, every independent lamp company of consequence in the United States was willing to pay a royalty of 8 cents to 10 cents per lamp sold.

A proposition on this basis from one of the largest companies was laid before the Trust, and it is believed that Mr. Coffin was in favor of accepting it, but was finally induced to defer to the judgment of Mr. F. P. Fish, who was thoroughly convinced in his own mind that the lamp business could be bottled up. The proposition was not accepted. And herein was the error of judgment, the utter misunderstanding of the situation, which can only be called a suicidal mistake.

By allowing the independent companies to manufacture on a royalty basis, the Trust could have had a sure net income of about $750,000 a year from this source, an income which has been forever thrown away and which can never be recovered.

And moreover, the unreasonable and arbitrary treatment of the independent manufacturers, the threatening of their customers, has so stirred up public sentiment against the Trust that even its own legitimate lamp business will suffer serious injury within the next year.

When the reputation of the new lamps has been thoroughly established, consumers almost without exception will buy them in preference to Trust lamps. And central station men, even Edison licensees, are already buying the new lamps in large numbers, not as a matter of sentiment alone, but because they are better lamps.

* * *

Electric Heating and Cooking.

The latest trend of electrical work is in the direction of heating and cooking apparatus, and these applications are being diligently pursued both here and abroad. As is usual, the cost of operating these devices is raised as the final determination of their utility, but as electrical apparatus is used in a very different way from coal or gas, with which it is generally compared, it is hardly fair to the former to make a direct and unqualified comparison of these methods.

If we consider the cost of current necessary to maintain a certain degree of heat during a definite time in comparison to the cost of coal to produce the same heating effect during the same time, coal naturally has the advantage; but the time factor is the all-important one, which makes direct comparison of the two methods impossible. For ordinary household work, such as cooking, the cost per hour of maintaining a coal stove is considerably less than that of an electric heater, but with the latter the consumption of energy is limited to the time that the heat is actually utilized, while with the former at least a moderate fire must be kept up during the day in order to be available when desired.

For this reason it appears idle to make any general comparison between the costs of these methods, as the economy of either is only determined by the conditions under which it is used.

* * *

Telephones vs. Traction.

The question of the exclusive right of ground return circuit for telephone lines, which was hotly contested in this country on the introduction of electric railways, has been prominently brought before the public in England, where the same difficulty is arising between these rival claimants to the earth. There are two contentions in regard to this subject, each having too much merit to allow the decision to be given offhand. The railway companies claim an equal right to the use of a ground circuit with the telephone companies, which could hardly be questioned if both were entering the field at the same time, but the telephone companies claim that the railway circuits make part of their plant useless, and so interrupt and render almost worthless an already established business, and on this basis many suits have been brought to recover the expense of supplying the necessary metallic returns for the telephone lines.

The courts have generally settled this point in favor of the railway companies, but whichever way the decision may be it is of the greatest advantage to secure a complete metallic circuit for the telephone lines as the service is very materially improved by this means, and while the ground circuit is essential to the railways it is a decided defect in the telephone, and its adoption is only a matter of economy in the latter case which acts as a detriment to the service.

The Anti-Trust Congress. After a display of ignorance and buncombe which has never been excelled, the Anti-Trust Congress at Chicago has closed its sessions.

When the list of attendants was announced the general tone of the proceedings might have been accurately foretold. Wherever Ignatius Donnelly is a welcome guest, sensible men are not likely to be found. And it is a misfortune to the public that such a gathering was held.

The remedies proposed were varied, but were all socialistic in tendency. Not even Mr. Rosewater had a mild or sweet-scented policy to propose.

The present law is good enough, and if its provisions were properly carried out it would result in the disbanding of nearly all the Trusts.

But the common mistake in discussing the evils of Trusts and their remedies is in laying too much stress on the law and too little on personal effort.

There are laws to protect the respectable citizen from the highwayman, and officers for their enforcement. Yet if a man is attacked by a highwayman, and no officer is near, he does not wait for the law to protect him, he protects himself and fights.

This is the principle which has been acted upon in the electrical trade for nearly a year. Led by ELECTRICITY the independent concerns have been fighting a good battle, and the result is no longer in doubt.

It will require no special and extraordinary laws to rid the country of the Electric Trust.

* * *

The Entering Wedge. The Electric Trust, which abstained for nearly a fortnight from taking legal action against any one, has again endeavored to revive its lost prestige by bringing suit against the owners of the Holland House, Imperial Hotel and a large office building in Spruce street for infringing its expiring lamp patent, and it has announced that the present suits are but the entering wedge to more extensive litigation on the same lines to be prosecuted throughout the country. This will hardly be a surprise to those who have followed the course of the General Electric, as each decline in its stock is the signal for the announcement of an infringement suit of some sort, but these have followed each other recently with such monotonous regularity that the present announcement proved a failure and the stock continued to fall off.

In its previous lamp suits the Trust aimed entirely at the manufacturers of lamps and succeeded in closing the factories of most of its competitors for a few weeks until they could prepare a new style of lamp, which in most cases was promptly done. The influx of new lamps, added to the Trust's defeat in St. Louis, proved the futility of the line of attack which it had adopted and put the coveted lamp monopoly beyond hope of attainment. If this can be considered as success it was certainly dearly bought, as the same competition exists in the lamp business that was met before, to which is added the general enmity of the trade, which the Trust thoroughly earned.

Having failed to secure a monopoly by these measures, the Trust is apparently commencing an attack against private users of lamps to accomplish the same end. It has been evident for some time that the lamp patent was the strongest weapon of the Trust, and the present action is undoubtedly a desperate effort to recover the lost ground which its former suits involved, as there are now many places where the Trust's goods are absolutely excluded where they were previously employed. Moreover such an action cannot be of any financial advantage to the General Electric, as, even if it secures the injunctions asked for, this will not secure the custom of the defendants, which is practically demanded, so long as any other lamp can be bought.

The managers of the Trust in attempting to create a monopoly have, to use a homely but expressive phrase, bitten off more than they can chew, and in view of the short remaining life of the patent upon which it chiefly relied for support, it is not probable that these infringement suits will be brought to trial even if the Trust itself, contrary to expectations, should outlive this short period.

* * *

WE'RE laughin'
At Coffin.

* * *

THE indicted publisher of ELECTRICITY extends his profound sympathy to the indicted President of the General Electric Company.

* * *

A FOOLISH correspondent asks us : Why was not Mr. S. D. Greene indicted for conspiracy along with Mr. Coffin and Mr. Clark ? To which we reply: Why was not our office boy indicted for libel ?

* * *

WE ARE enabled to state, with positive information on the subject, that papers have already been prepared by counsel of the General Electric Company in some very important patent litigation soon to be begun.

A New Insulating Material.

A new insulating material, bearing the name of "Stabilit," has been tested by the Electrical Company, Limited, and the results having proved satisfactory it is now being brought into commerce. This material, which has for some time past been used in the insulation of armatures and magnet and transformer coils, is made in plates, bars and tubes, or in any desired form, in red or grey-black color. It can be turned, bored and polished more easily than indiarubber or vulcanized fiber. It is free from acidiferous or corroding substances, and does therefore not attack metal, and is consequently considered better than any material for the insulation of commutators, magnet coils, switches, etc. After four weeks' exposure to a damp atmosphere, stabilit showed no alteration in weight or in its insulation resistance, and after being boiled for twelve hours no increase in weight was noticed. Stabilit, the specific weight of which is 1·6, is not attacked by muriatic acid or dilute sulphuric acid, and is therefore suitable for accumulator cells and battery jars, as experiments have shown. In the course of tests made to determine the usefulness of stabilit for high tension insulation, plates of 0·7 mm. in thickness were not pierced or broken at 5,000 volts.

Mr. Coffin Indicted for Conspiracy.

The Grand Jury Find True Bills Against All of the Accused Men in the Westinghouse Blue-Print Case.

The Grand Jury at Pittsburg on June 7 found true bills for conspiracy against the following officials of the General Electric Company: C. A. Coffin, president; W. J. Clarke, manager of the railway department ; Milton H. Hamilton, E. W. Rice and H. W. Knight.

True bills were also found against Morris W. Mead, superintendent of the Bureau of Electricity, for conspiracy, and against C. Christian, John Butler and Frank Carey, former employes of the Westinghouse Company, for conspiracy and larceny.

Mr. W. D. Niles, counsel for the General Electric Company at Boston, is quoted as follows in the Boston *Herald :*

"I know absolutely nothing about these indictments, except what I have read in the newspapers. Some of the Westinghouse officials are very persistent, but I cannot believe they have a scintilla of honest evidence implicating any of the officials here.

"As to the proceedings here we have entered our appearance in the Supreme Court for the Thomson-Houston Company and for each of the officials named in the bill, but have not filed an answer on account of other engagements. We are allowed thirty days from June 5 in which to answer. The bill is very long, and each allegation must be specifically answered."

At Harrisburg, on June 10, the matter of issuing requisition papers for the indicted men came up before Gov. Pattison. The General Electric Company were represented by counsel who were there to oppose the granting of such papers for Messrs. Coffin, Rice and Knight. Counsel for the Westinghouse Company asked for the requisition of Messrs. Clark and Hamilton only, as they were in the State of Pennsylvania at the time of the alleged conspiracy. There was no opposition to the latter request, and the papers were accordingly issued by Gov. Pattison.

Competition for the New York Edison Company.

A Healthy Rival in the Field.

Siemens & Halske Apparatus to be Used.

It has leaked out that there will soon be smart competition in the matter of incandescent lighting in New York City.

The New York Light, Heat and Power Company, whose offices are in the Excelsior Building in Gold street, near Fulton, has purchased apparatus from Siemens & Halske which is now on its way from Berlin, and the company expects to be ready for business early in July.

The franchise under which the company is operating is the one originally granted to the old Daft Company in the early eighties, and in which there appear to be no flaws.

The wires are already laid from Houston street to the Battery.

The New York Light, Heat and Power Company is strong financially, and will, it is said, make rapid extensions of its service mains. The company will also make a feature of the supply of power for motor work.

General Electric.

What is Said of it Nowadays.

What Rot.

(From the Wall Street Daily News.)

One of the news agencies issued the following yesterday:

"We have authority to state that a director and a large holder of General Electric stock has not sold a share during the decline from par."

Isn't this the silliest kind of bull guff? Now, who under the sun cares whether one solitary "director and a large holder" has sold his stock or not. Is he the only individual in the company, that the fact [?] of his not having sold out has to be recorded, particularly when he is either afraid or ashamed to have his name mentioned? All this kind of slush is a waste of ink and paper as it accomplishes nothing. The fact is not disputed that the company had to and did sell its gilt-edged treasury stocks; that the price declined from 114⅛ to 58 within a few weeks; that the stock though paying 8 per cent. could not and does not find support in the market, and that its largest, most influential and richest stockholders have sold out, or very much reduced their holdings in the company, and invested the proceeds in securities of other companies paying a much less return. To tell what one man did or did not do simply shows to what straits the manipulators have been driven.

Business is Booming.

The Treasury is Full to Overflowing.

(From the Cincinnati Times-Star.)

Judging by the present business of the General Electric Company, the cry of tight money and dull trade has not yet struck them to any appreciable extent.

They have recently concluded contracts for the building of three 750 h. p. generators for the Cincinnati Street Railway. They have also sold one 750 h. p. generator to Toledo, Ohio; two 750 h. p. generators to Louisville, Ky.; two 750 h.p. generators to Cleveland, Ohio—besides having sold Louisville 65 cars. They have on hand orders for the construction of a number of electric railways and power plants.

The company's financial condition is in good shape. They have money enough in its treasury to pay all expenses and dividends up to and including September, should they not receive a cent from their customers before that time, and when we say that they have in their employ some ten thousand men it will give an idea of their present financial standing. We understand that they have recently concluded contracts for the Brooklyn Traction Company of Brooklyn, N. Y., amounting to $5,000,000; New Orleans, $3,000,000; West End Street Railway, Boston, $1,500,000; besides large contracts in the following cities: Dayton, Cleveland, Toledo, O.; Louisville, Ky.; Buffalo, Syracuse and Albany, N. Y., and many other large contracts in the West and South—in no way including the foreign trade.

An Electrically Equipped Dwelling House.

The *Herald* furnishes the following description of the electrical equipment of the home of Mr. George Foster Peabody in Brooklyn, N. Y., in which all the heating, cooking and lighting are done by the aid of electricity:

To heat a house by electricity nowadays requires no more labor than to equip a habitation with electric lights. All that is necessary is to tap the regular electric mains and wire the house in the same form as for light, the only difference being that the terminals lead to heaters instead of incandescent or arc lights.

In the case of this Brooklyn dwelling a separate circuit is used for the heating, cooking and lighting, so as to determine the amount of current used for each service. Starting from the switchboard, to which all branches lead, and passing into the cellar, the ordinary hot air furnace is found there, but its occupation as a coal consumer and heater is gone, for from the furnace cold air box leads one large main pipe in which is placed an electric heater, then from this main branches start in each of which is also placed an electric heater, the idea being to heat the cold air in the main pipe to a certain degree and then superheat it in the separate pipes.

In mild weather the main heater suffices, but in colder times all the auxiliary heaters are required. A constant circulation of air is kept in the pipes by an electric fan placed in the cold air box, thus insuring a steady supply of fresh air. Even with a winter as rigorous as the last one not a shovelful of coal has been used in the house during the entire season.

Though nearly all of the heating is done through the old furnace pipes, thus entailing no extra expense for running wires, other heating accessories are used in some of the rooms. This only needs a peculiar form of electric radiator and the wires leading thereto. The heat given out is the mildest, most wholesome and most enjoyable of all heats, and when it is no longer required, by simply turning a switch all expense is stopped.

But it is in the kitchen where electricity will probably be mostly appreciated by the housewife. In this electric house every morsel of food that requires cooking is cooked by electricity. The kitchen range is still there, but instead of the old time roasting fire an electric broiler, oven and water heaters are placed upon the stove, none of which differ particularly in shape or form from ordinary kitchen utensils, with the exception of the small heater placed in each one.

Electricity's services are required to heat every drop of water used in the house. This necessitated no great change, nothing more than the insertion of heaters in the old boilers and removing the range pipes. Another feature of domestic appliances where electricity is aptly employed is ironing, but from the insulated wire which is attached to an electric flatiron no one would know it by outward appearances from the common type, though here again a little electric heater is stowed away. This form of flatiron lightens the burdens of the laundress and saves both time and steps in avoiding the need of reheating irons. The heat in the flatirons is always at an even temperature, with a consequent improvement in the work.

The house is, of course, lighted throughout with electricity in the most artistic manner, and no other form of artificial light is allowed to penetrate the grounds. Whenever any motive power is required, as in running sewing machines or ventilating fans, etc., the electric motor is called into action and does its work noiselessly and most efficiently.

Legal Notes.

A supplemental bill of complaint has been filed by the Accumulator Company of Newark, N. J., in its case against the Consolidated Electric Storage Company in the United States Circuit Court at Trenton.

The complainants obtained a preliminary injunction against the defendants in January last. They requested the latter to return the profits and gains made by infringing, but have not been recompensed. They now ask that the defendants be made to appear and answer to the bill of complaint They also ask for a provisional or preliminary injunction.

The Edison Illuminating Company of New York recently brought suit against one of its customers for $180. The customer had offered the company $30 in settlement of his bill, and denied that he had received the amount of light charged for. A verdict was rendered in favor of the defendant.

In the Supreme Court at Trenton, N. J., on the 8th inst., Justice Depue rendered a decision defining the powers of the New Jersey Electrical Subway Commission. The case was founded on a resolution of the Subway Commission which gave the right to erect poles and string wires. The Supreme Court declares that the Subway Commission cannot grant any franchises, their functions being simply supervisory over the exercise of franchises derived from other legislative authorities.

A suit has been filed by the McKeesport (Pa.) Telephone Company, Limited, for use of the McKeesport Telephone Company, against the Shaver Company of New Jersey, to recover $5,500. The defendant, it is alleged, was to build and furnish an electric telephone exchange, which was to be in working order by March 7, 1893. Money was advanced by the plaintiff company. The contract is not yet completed. It is further alleged that the American Bell Telephone Company has obtained an injunction against the Shaver Company, restraining it from using certain patents.

The Western Electric Company of Chicago has filed with the Clerk of the United States Circuit Court in Utica complaints in three actions against the Fire Alarm Telegraph Company. The complainant alleges that the defendant has infringed upon a patent issued to Thomas H. Watson in April, 1878, on a telephone call signal apparatus; also upon a patent issued to Ezra T. Gilliland, of Indianapolis, in July, 1880, on a magnetic generator for telephone signals, and also upon a patent on a polarized armature for electric bells, the original patent being granted to Thomas H. Watson, of Boston, in December, 1878.

The Ohio Valley and West Virginia Coal Company has begun a suit for damages against the Cleveland, O., General Electric Company, for some high-handed proceedings in tearing down buildings and sheds on premises under lease to the coal company. The General Electric Company recently purchased the property for the erection of a new power house.

The Usher Battery Suit.

In his testimony in the Brush suit against the Milford and Hopedale Street Railway Company for alleged infringement of the Brush patents in using the Usher battery, Prof. Trowbridge said in speaking of the Usher battery: "It has a very remarkable efficiency, and has developed certain novel properties which seem to indicate that its mode of operation is peculiar to itself. . . . It improved under rates of discharge which would speedily ruin a Faure or a Brush cell. I have often discharged an Usher cell at the rate of 150 amperes and have found the cell improved by this treatment. I have completely exhausted a Brush cell of the same weight as an Usher cell in forty-five minutes by discharging at a sixty-ampere rate. The Usher cell maintained this rate of discharge for one hour and a half and then was not exhausted. . . . The great question now is, how much power will the battery return in comparison with the power put into the battery. When I found that they would exert the power necessary to propel a car from Bowdoin Square to Harvard Square with a loss of only 20 to 25 per cent. of the power used to charge the cell, and I found after using the cells for six months that they showed no sign of diminishing capacity, I saw that the Usher cell was a radical departure from the Brush cell. At high rates of discharge, which are the only practical and useful rates of discharge for car traction purposes, there is no possibility of comparing an Usher cell with a Brush cell."

Current Items.

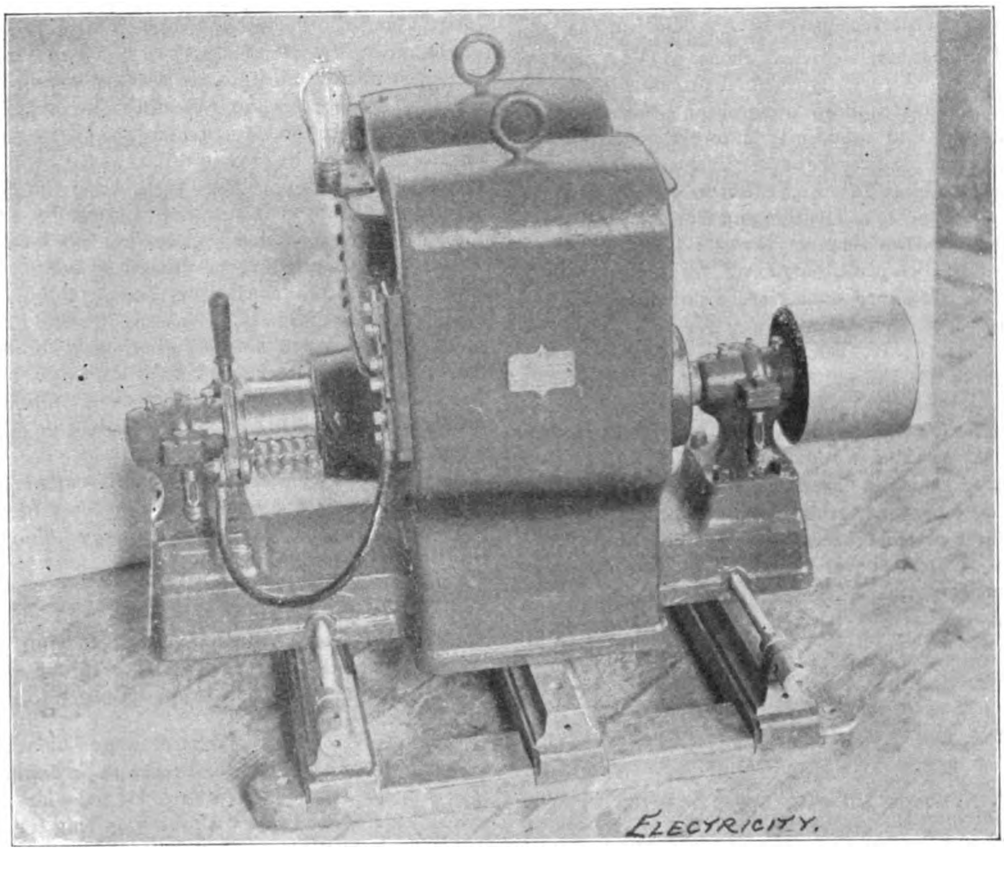
The proprietor of a laundry at Lauter, in Germany, has adopted electric heating for 60 of the flatirons used in his establishment. A 40 H. P. dynamo provides current for heating, for lighting, and for driving motors for the various washing and wringing and mangling machines. The core of the flatirons is formed of asbestos in which platinum wires are imbedded which are made incandescent by the current. As current is cheap and expense is saved when the irons are not in use, the application is not found expensive, while the cleanliness and convenience are beyond dispute.

It is said that a German firm in Munich is making a business of renewing the filaments of incandescent lamps by a process which costs 25 per cent. less than the operation of making new lamps. An opening is made in the glass globe at the upper end. The old filament is removed and a new one inserted, the latter being secured to the leading-in wires by means of a new cement, which becomes a conductor when a current is passed through it. The lamp is sealed and exhausted as usual.

The Muncie "Iron Clad" Machines.

The Muncie Electric Works, recently established at Muncie, Ind., has just put upon the market its new "Iron Clad," which is shown in the following illustration and which has been adopted by this company as its standard type for constant potential dynamos and motors.

The magnet consists of but one casting bringing the magnetic leakage down to a minimum by doing away with all joints. There is but one field coil, which is wound in three sections, so that in case of accident it would rarely be necessary to replace more than one. The armature is placed below the field coil, admitting of the lowest possible center of gravity and obviating the injurious effects from vibration. The brushholders are of a new and simple design and are arranged so that either holder complete can be removed without disturbing the yoke, or in case it should be necessary to replace one or more of the carbons, of which there are five to each holder, any one of the separate sockets containing the carbons can be removed and replaced without interfering with the operation of the machine. The boxes are self-oiling and aligning, with phosphor-bronze bearings and are fitted with sight oil gauges. The shaft is of the best grade of steel and is extra large in diameter. The armature is drum-wound and is of very low resistance, and the commutator is of tempered copper, thoroughly insulated with mica.



THE MUNCIE "IRON CLAD" DYNAMO.

The connection boards are of marbleized slate arranged in the simplest manner possible, and the rheostats have metal frames with slate bases and lava insulators, making them thoroughly fire-proof. The machine as a whole has been designed with the utmost care, both mechanically and electrically, is simple and efficient, and runs at a slow speed. The cut shown is of an 8½ K. W. machine, which has given an efficiency of 90 per cent. on actual tests. Its speed is 1,100 revolutions per minute. It is designed so as to permit the commutator to run entirely free from sparking, there being no lead of brushes between no load and full load. The company is now in full operation, manufacturing all sizes from ½ to 50 K. W. machines.

Pocket-Books.

How is it that compilers of pocket-books do not compile what is wanted? There is, as yet, no absolutely satisfactory electrical engineer's pocket-book, though several authorities have tried their hands at the production of such a work: these usually containing both too much and not enough, and the information is not always that which is really wanted when it is given. When all is considered, what are the requirements? Is it necessary for the pocket-book to go into the waistcoat, like Prof. Thompson's. Should it really be a pocket-book at all? Should it contain electrical information only, or mechanical engineering as well? All these are questions for the engineers themselves to decide; but as very few electrical engineers, if asked, confess to having found the pocket-book they want, it is evident an ideal book is yet to be made. One well-known electrical engineer gives it as his opinion that if one wants a useful pocket-book one must go to Germany; he swears by Hütte's "Pocket-book of General Engineering," published by the Verein Hütte, which gives succinctly both theory and formulæ on usual engineering matters, with a chapter on electrical subjects. As work goes nowadays, the questions of general engineering—buildings, girders, engines, pulleys, belting, rails and traction—play quite as important a part in electrical work as purely electrical problems. An electrical engineer's pocket-book should contain formulæ for dealing with these; it should avoid redundant matter; it should not aim to teach, but to remind; and it should contain the formulæ in their most workable form.—*Electrical Engineer*, London.

Insulating Wire by Paper.

This paper, which is specially made, is thoroughly cured before being used. The rolls are mounted on machines, and are cut into strips by circular shears, which leave the paper resembling "ticker tape." The spools of paper are then placed on mandrels in the covering machines, and as the wire feeds through the paper is laid on in overlapping spirals at the rate of from 60 to 500 revolutions of the mechanism per minute. The wire is then passed through dies, which materially increase the tightness and compactness of the insulation. The next step is the winding of the wire on iron reels, which are placed in drying ovens that have a temperature of 250 degs. Fahrenheit. This expels all moisture, and the wire is suddenly plunged in a special secret compound and for some time subjected to a stewing process at a temperature of about 275 degs. The wires in due course go from the tanks to the braiding or leading department, where they are finished. Although paper-insulated wire is used largely in telephone work, it has been found very effective and reliable with high potential currents, even up to 10,000 volts.—*Electricity*, London.

The Johns Hopkins Electrical Engineering Course.

We have received a prospectus from this university calling attention to the course in electrical engineering, which has been established with the object of preparing students to keep pace with the latest advances in electricity, and consists of both theoretical and practical work.

The course extends through two years and is primarily intended for graduates, but special students are admitted on passing certain examinations.

The instruction in electricity includes lectures on theoretical and applied electricity, with constant laboratory work. The lectures aim to give a clear working-knowledge of the science, while in the laboratory the student receives what help and instruction he may need, yet at the same time he is taught to depend upon and think for himself, and is given every encouragement to undertake original work.

Laboratory Work.—The students are expected to spend all of their available time in laboratory work, and the minimum time allowed is nine hours per week.

During the first year the fundamental measurements in electricity and magnetism are made, and also tests of dynamos, motors, incandescent and arc lamps, etc. The work is largely individual and the character and grade of the work given to the student is determined by his qualifications.

During the second year more advanced work is done and the students are given original problems to work out in the laboratory, and research work is engaged in. Tests of steam engines and boilers, experiments and investigations in alternating currents and transmission plants form an important part of the work. During the latter half of the year complete tests of electric cars and central stations are made and the results carefully worked out.

The allied subjects of steam and hydraulic engineering, machine design and mechanical drawing are also included in this course.

The instruction is given by Dr. Louis Duncan, Mr. Herman S. Hering, M. E., and Mr. Francis Head, M. E.

The Electric Tramway in its Social Bearing.

It does not seen unlikely that the electric tramway will be the means of revolutionizing domestic life in our Colonies, and of considerably modifying several of the more general classes of business. Toronto, Canada, has to-day twenty-seven miles of shop fronts, but the tendency is for many of the smaller shops on principal thoroughfares, such as King and Yonge streets, to revert to residential purposes, they having found their occupation gone. The principal cause at work tending to bring about this change is the partial solution of the rapid transit problem by electric tramways. By such means the residents in the outlying districts of the city can be transported to the business centre in a few minutes. The larger down town establishments are benefiting by this to the detriment of the smaller concerns on the less important street in the suburbs. The lesser influence is that of the "store," in which the business of almost every class is congregated, and where comfort is assisted by electric lighting, electric lifts and general sumptuousness. These changes are most seriously affecting the value of a large amount of property now used for business purposes, and it may not be long before similar conditions impress themselves upon our communities at home.—*Electrical Review*, London.

Detroit Electrical Works.

Prospects of a Reorganization.

It is reported from Detroit that arrangements have been practically concluded for a thorough reorganization of the Detroit Electrical Works, a deal having been made with an Eastern syndicate who will put in plenty of capital.

There is no reason why this company, under competent management, should not be a thoroughly prosperous concern. They have an efficient apparatus, on a par with the best, and nothing but gross incompetency could have reduced the company to its present condition.

Mr. L. E. Myers, of the Chicago office, has done splendid work, and is capable of doing better still properly backed by good management at the home office.

The first step after reorganization should be to again secure the services of Mr. Frank Rae, who made the apparatus all that it was at its best, and who presumably knows more about it than any one else.

John F. Schaefer Arrested.

John F. Schaefer, who has of late been superintendent of the Illinois Lamp Company of Chicago, was arrested on June 5, charged with stealing 115 incandescent lamps from that company. The case was postponed until June 13, Schaefer being released on $300 bail.

We are advised by a personal letter from Chicago that Schaefer, at the time he was arrested, was trying to sell a patent (the property of the Illinois Lamp Company) to the General Electric Company.

No Compromise.

It has been erroneously stated in the daily press that a compromise has been effected in the matter of the infringement suits brought by the General Electric Company against various users of Sawyer-Man lamps in this city. There has been no compromise, but a postponement of the hearing, which was made necessary by the illness of Mr. Edmund Wetmore and Leonard E. Curtis, of counsel for the Westinghouse Company.

The McKeesport Case.

Mr. E. L. Porter, who was appointed to report a schedule of distribution of the proceeds of the sale of the McKeesport Edison station under the receivership of Mr. S. A. Duncan, has filed his report. The case presented some unique features, and is of more than passing interest to Edison licensees. Mr. Porter gives the following summary of the difficulties and their favorable outcome:

> There were originally two factions, a local faction and a faction of the parent Edison Company. At the annual election in 1890 the Edison faction attempted to make a change in the directory of the company. The local faction avoided this by bolting the meeting and preventing a quorum, thus holding over until the election in 1891 when the Edison Company got control. During this time the company had contracted a larger indebtedness, and when the Edison faction got hold it was deeply involved in debt. The creditors pressed the company and a number of them got judgments, some by confession and others by default, and in February, 1892, T. L. White and others of the local faction brought the present suit, alleging mismanagement and asking for the appointment of a receiver. S. A. Duncan was appointed receiver and eventually a sale was directed. The local stockholders then tried to get control of the outstanding indebtedness and arrange for bonding the company to take care of it. T. L. White paid and had assigned to himself as trustee $25,000 of the indebtedness, but the board of directors refused to bond the company. The plant of the company was then sold by the receiver and the auditor appointed to report a schedule for the distribution of the funds in his hands arising from the sale.
>
> The auditor shows the total amount in possession of the receiver was $58,549.18. The expenses of the audit, etc., amounted to $1,102.68, leaving for distribution among the creditors $57,446.50. This almost paid the creditors in full. White, as trustee, receives $24,984.64. The other claims are small.

Personal.

Mr. J. Holt Gates, who has been with the Siemens & Halske Company at Chicago for some time, has formed a connection with the Waddell-Entz Company of this city, and will hereafter act as Western agent of the latter company, with temporary offices at 1,122 Monadnock Building, Chicago. The Waddell-Entz Company has established a high reputation, not only for its apparatus, but for straightforward business methods, and we predict that Mr. Gates's new office will be a profitable one for everybody concerned.

Mr. C. A. Daigh has been appointed General Sales Agent of the Siemens & Halske Company to succeed Mr. Gates. Mr. Daigh enjoys a wide acquaintance in the trade, his most recent engagement having been with the National Electric Manufacturing Company of Eau Claire.

The Washington Association.

The leading electrical firms of Washington, D. C., have recently formed an association for establishing a more general and better understanding and unanimity among themselves, and for their mutual benefit. The association was organized last July and is known as the "Association of Electrical Dealers and Contractors." The officers for the ensuing year are: President, C. W. Jordan; vice-president, J. W. Burkett; secretary, C. W. Hessner; treasurer, John R. Calloway. The firms represented are Messrs. Jordan & McLeod, J. W. Burkett & Company, Royce & Mareau, The Washington Construction Company (Pardee and Messner), The Bliss Engineering Company (Bliss and Lewis), John R. Calloway, D. H. Washburn and J. H. Kueling. The association is in a flourishing condition and has already shown to its members that it is a valuable aid to electrical interests in Washington.

The International Maritime Congress.

The second meeting of the International Maritime Congress is to be held at the headquarters of the English Institution of Civil Engineers beginning July 18, 1893.

The first meeting was held in Paris in 1889 at which a permanent organization was effected, with headquarters in Paris, comprising representatives of thirteen European countries.

The following arrangements have been made for the consideration of the various subjects to be brought forward at the London meeting:

1st Section—Harbors; Breakwaters; Protection of Coasts.

2d Section—Docks, and their Equipment.

3d Section—Shipbuilding; Marine Engines; Auxiliary Machinery on board ship.

4th Section—Lighthouses, and their Illumination; Electrical Connection of Lighthouses and Light-ships with the Shore; Fog Signals.

After the London meeting, it is proposed that, in addition to an inspection of the docks along the Thames, visits shall be made to some of the other leading seaports of the kingdom.

Proposed Consolidation in St. Louis.

The Municipal and Missouri Companies Trying to Get Together.

It is reported on very good authority that the Missouri Electric Light and Power Company of St. Louis is to absorb its rival, the Municipal Electric Light and Power Company, and that the companies will be under one management after July 1.

A consolidation of these companies has been talked of for some time. Previous to the decision in the Columbia lamp case it was generally believed the Missouri Company would be the one to sell out, but that decision has put a very different phase on the lighting situation.

It will be remembered that last fall a "local" Edison company was organized in St. Louis with a capital stock of $5,000.

But it seems that this company is not a factor since Judge Hallett's decision.

World's Fair Notes.

The increased number of visitors during the last week has made the few exhibitors who were behind in their work realize what they were losing in the way of advertising by not having their exhibits in shape for inspection. The average attendance during the week reached nearly 75,000. With the exception of a very few exhibits it may be said that the Electricity Building is ready to be inspected and the attendance of any one need not be delayed for fear that he will not see it all. To judge from the crowds to be found in the Electricity Building and the remarks heard about the Park, the electrical display is one of the most attractive features of the Exposition. Very few of the buildings are without some novel form of its application. Besides the ordinary uses of lighting and furnishing power, its novel applications may be seen in different parts of the Electricity Building. The Wellington Catering Company has used electricity indirectly as a means to wash dishes, while another concessionary has applied it to blacking boots and shoes. The Carpenter Electric Heating Company, occupying a portion of the Ansonia Electric Company's booth, has a colored gentleman showing the good uses to which electricity can be put to in the kitchen. Every day about the noon hour a dinner is prepared in the electric oven or on other cooking utensils.

Another electrical device which is attracting the attention of the visitors is exhibited by the National Engraving Machine Company. The exhibit shows the application of electricity to engraving on metal, stone and wood.

In honor of the visit of the Princess Eulalia of Spain to the Exposition an extra decoration was added to the Edison tower. It consisted of a number of incandescent lamps arranged to read "Eulalia."

Professor Grey has at last arranged his much sought for exhibit of telautograph machines. Few people visiting the Fair during the last few weeks have gone away without inquiring for the machine that writes by electricity. The professor has nine machines on exhibition in his booth and a number of young men are on hand to show them in actual operation.

The Chicago Central Phonograph Company, in conjunction with the Long Distance Telephone Company, have arranged a novel entertainment for next Saturday evening. A specially constructed transmitter is to be attached to a phonograph on the Chicago end of the Chicago-New York wire and guests in New York are to be entertained by music and songs furnished by the phonograph located in the Electricity Building.

The Westinghouse Electric Company is engaged in decorating the south wall of the Electricity Building with a large picture of Columbus surrounded by the name of the company spelled out with groups of incandescent lamps.

The movable sidewalk, which is another example of the various applications of the electric current, was set in operation last Saturday. The sidewalk is located on the pier extending into the lake from the north end of the grounds.

A decision was rendered in the United States Court last Thursday which it is thought will effectually close the gates of the Exposition on Sunday. Although the decision was against the wishes of a majority of the exhibitors, it may operate indirectly to show the value of electric lighting, as a large number of people will be compelled to visit the Exposition at night who would otherwise put off their visits until Sunday.

Chicago Notes.

Geo. Cutter is on a trip to Boston and other Eastern cities.

John R. Fletcher, of Dayton, was a visitor in Chicago and at the World's Fair last week.

Geo. J. Percival, the well known electrical engineer of St. Louis, and Fred. Adams, of the Adams Electric Company at the same place, were among the electrical men in the city lately.

Mr. Hess, senior member of the Hess Electrical Company of Des Moines, was in Chicago last week. He is about to move into larger quarters so as to carry a larger stock of electrical goods.

The Western office of Claflin & Kimball, general selling agents for the Novak lamp, has been moved into a suite of offices in the Chamber of Commerce building.

The Star Electric Company report an increasing business since placing their new lamp on the market.

Boston Notes.

A big mortgage was recorded in Lawrence, Mass., last Monday, the amount being for no less than $1,900,000, the trustee being the American Loan and Trust Company of Boston. The deed was filed by the Lowell, Lawrence and Haverhill Street Railway Company to secure the issue of 5 per cent. gold bonds for thirty years.

The Rapid Transit Bill for Boston has at last been passed to be engrossed by the State Legislature so weighted down by conditions that the bill is practically useless, and it is very doubtful indeed if any action will be taken under such a bill when it has been finally passed. So after long and weary delay, the expenditure of a large sum of money, and the taking of almost endless testimony, the entire movement for improving city and suburban travel in and around Boston is as far off as ever.

The workmen employed by the General Electric Company in their Lynn factories began work under their new time schedule last Monday, and, now the excitement incident to the recent agitation for a reduction of four hours per week has subsided, they all appear fairly well satisfied.

There is a bill before the Massachusetts Legislature for enforcing the burial of electric wires throughout the city of Boston which stands a fair show of being deprived of all its prospective usefulness, if it ever had any, by reason of a misunderstanding as to purposes of such a bill. High potential wires are to go underground if the bill passes, while low potential wires are not considered of sufficient importance to need a change. As a fact, however, the number of high potential overhead wires is quite insignificant, while the low potential wires can be counted by thousands. If anything is to be done in that direction, it should be done thoroughly or not at all.

Last Friday evening a pleasant gathering took place at the Thomson Scientific Club House in Lynn, the occasion being a "send off" to Mr. John T. Morrow, one of the chief engineers in the factories, who has accepted an appointment out West. There was a large and jolly crowd of electricians who did justice to the excellent supper, each one contributing either song or speech towards the evening's entertainment. Mr. Morrow has accepted an appointment with the Boston and Montana Mining Company at Great Falls, Montana.

Mr. George F. Curtis, who is at the head of the Bureau of Information in the General Electric Company, has just returned from a three months' vacation in the Bahama Islands. Mr. Curtis's health is greatly improved by his trip South.

The American Railroad Improvement Company, having its principal offices in the New York Life Insurance Building, 95 Milk street, Boston, is the name of a corporation with $1,000,000 capital that has been formed for the purpose of acquiring, operating, constructing and dealing in street railways, electric light, steam and water power plants and properties throughout the New England States. The company has already purchased a well established business of the kind and owns a number of valuable patents for various railway devices, all of which will be worked in connection with their business. Mr. George A. Bratey, a well-known electrical constructing engineer, who by his energy and skill has achieved great success, is treasurer and general manager of this big company.

Dr. George L. Austin, proprietor and editor of the two New England journals, *Practical Electricity* and *Electricity and Railroading*, succumbed to an attack of pneumonia at his home in Melrose a few days ago. Dr. Austin was as well known as any man in the electrical business.

General News.

What is Going on in the Electrical World.

Rockville, Conn.—The council has voted to appropriate $2,500 for an electric fire alarm system.

Sing Sing, N. Y.—The Ossining electric road, which lies in the principal streets of Sing Sing, has been opened for traffic.

Newburgh, N. Y.—There is some talk here of constructing a trolley railroad from Newburgh to Walden with an extension to Goshen.

Norwalk, Ohio.—The plant of the Norwalk Incandescent Light and Power Company is advertised to be sold at auction by the assignees.

Brooklyn, N. Y.—The trolley is now in operation on the Fulton street line of the Brooklyn City Railroad from Fulton Ferry to East New York.

Auburn, N. Y.—The contract for lighting the city for two years has been awarded divisionally to the Electric Light and Gas Light Companies.

Bridgeport, Conn.—The Bridgeport Horse Railroad Company will, it is said, shortly establish an electric plant here and convert their road into an electric system

Abbeville, La.—It is proposed to organize a telephone company to connect Abbeville and the surrounding towns by wires, extending the lines as far as Lake Charles.

Rhinecliff, N. Y.—A project is on foot to establish a trolley line between the N. Y. Central Railroad station here and the village of Rhinebeck, two and a half miles distant.

New Haven, Conn.—The State street line is making good progress in its electrical equipment. The Whitney avenue line, it is thought, will also be granted permission to use electricity.

Washington, Pa.—The Electric Light and Power Company having refused to furnish power any longer to the Electric Street Railway Company, the latter has suspended the running of its cars.

New York.—The General Electric Company has declared a dividend of 3½ per cent. payable July 1 to the holders of preferred stock at the close of business June 19. Transfer books close July 3.

Jamestown, N.Y.—The Jamestown Consumers' Arc Light and Power Company, now being organized, proposes to utilize the water power known as the Dexterville dam in the generation of electricity.

Bridgeton, N. J.—J. P. Newbold and Walter Bacon, residents of this place, have been getting signatures of property holders along the route between Bridgeton, Fairton and Cedarville for a proposed electric railroad.

Lockport, N. Y.—It is understood that Lockport is to be connected to Buffalo by means of the Buffalo and Williamsville Electric Railway, a branch of which is to be run to Swarmsville and thence down the Transit road to Lockport.

Edgewater, Staten Island.—The trustees have requested the Electric Power Company to continue lighting the streets of the village until such time as a contract could be made, and the clerk was directed to readvertise for bids.

Springfield, Ohio.—Work on the extension of the Ohio Southern Railway from Springfield to Lima is being hurried through day and night. upectric light is used at night, the plant being set El in advance of the construction parties.

Pittsfield, Mass.—The building in which were the insulation and drying rooms of the Stanley Electric Manufacturing Company was destroyed by fire last week. The damage was about $7,000; insured. The company will rebuild at once.

New Orleans, La.—A meeting of the stockholders of the St. Charles Street Railroad Company is to be held on July 10 to vote on an increase of the capital stock to $1,000,000, to provide funds to equip the various lines of the company with electricity.

Jersey City.—Mayor Wanser has signed the ordinance granting the Jersey City, Hoboken and Rutherford Electric Railway Company the right to run its lines within the city limits, the company having bound itself to pay to the city five per cent. on its gross receipts.

Westchester, N. Y.—The Westchester Electric Company has obtained permission from the State Board of Railroad Commissioners to use the electric trolley power on the recently acquired roads in South Mount Vernon, East Chester, Pelham, New Rochelle and Rye.

Augusta, Ga.—Work on the Richmond County Belt Line has been stopped. The *Chronicle* states that liens have been filed against the road amounting to over $35,000, among which is one of $12,000 by the firm of J. G. White & Co., of New York, and one of $20,000 by the Pennsylvania Steel Company.

Jamaica, L. I., N.Y.—The town board has resolved to advertise for bids for lighting the Woodhaven district with electric lights. The bids will be opened at 10 A. M. on July 7. Eighty arc lights are called for in a district which embraces Woodhaven, Ozone Park, Brooklyn Hills and Union Course.

Richmond, Va.—At a recent meeting of the stockholders of the Johnston Safe Automatic Electric Company, the old board of directors was re-elected, as follows: Colonel William D. Rice, Major A. W. Garber, Colonel Tazewell Ellett, F. B. Jacobs, C. E. Boiling, John Rutherford and Langstaff Johnston.

Rahway, N. J.—A beginning was made last week in the construction of the Rahway Electric Railway, which will connect Rahway with Woodbridge, Papiac (Boynton Beach) and Carteret. The road will be about seven miles long, trolley system, and power will be furnished by the Rahway Electric Light and Power Company.

Woodbury, Conn.—The Woodbury electric road charter has been secured and its limitations embrace a line from that place to Washington. The line goes from Woodbury to a point near the New England railroad station in Southbury, a distance of four miles; from that place to Southford, a distance of three miles, and on to Washington.

Charleston, S. C.—At the annual meeting of the Charleston Light and Power Company, held last week, the following officers were elected: George B. Edwards, president; B. T. Burt, secretary and treasurer; directors, George B. Edwards, Samuel G. Stoney, G. E. Gibbon, B.T. Burt and C. A. Coffin.

Frederick, Md.—The organization of the Frederick and Middletown Electric Railway Company has been completed by the election of the following officers: Loren N. Downs of New York, president; Dr. Upton A. Sharretts of Frederick, vice-president; Edgar L Miller of Frederick, secretary; George William Smith of Frederick, treasurer, and C. V. S. Levy of Frederick, attorney.

Hartford, Conn.—Among the acts passed lately by the Connecticut Senate was one empowering the Ponemah Mills Company of Tariffville, manufacturers of fine cotton goods, to sell electricity in Norwich, Lisbon, Franklin, and neighboring places. This is the first instance so far as known where a cotton manufacturing firm has been permitted to engage in the manufacture and distribution of electricity.

Omaha, Neb.—City Electrician Cowgill has photometrically tested some of the street arc lights furnished by the Thomson-Houston Company and found them varying from the 2,000 candle-power required by the contract, in one instance minus 1,000 C. P., in another 1,400 C. P. Mr. Cowgill has full confidence in the accuracy of his instrument, and will continue his tests.

Morrisville, Pa.—A trolley road to pass through lower Bucks County is proposed. The route runs from Morrisville, passing through Fallsington, Langhorne, Neshaminy Falls, Trappe, Byberry Point, Bustleton, Frankford, and thence to Sixty-third and Market streets, Philadelphia. The charter name of the company is the Suburban Railroad Company.

Austin, Tex.—The great dam across the Colorado River is completed. The length of the dam is 1,150 feet; it is 66 feet high, 60 feet broad at the base and 16 feet at the crest. The purpose of the dam is to furnish a water supply and power for the electric light system of Austin. Besides accomplishing these purposes, 14,000 horse power has been developed, which will be disposed of to manufacturers at nominal cost. The cost of the dam was over $600,000.

Wilmerding, Pa.—The Pennsylvania Railroad Company has bought a site for a new station at this place and will stop all trains here but the limited as soon as the McKeesport and Wilmerding Electric Railway is completed, which will be in a short time. By October it is thought that an electric line will extend from McKeesport to Pittsburg, passing through Wilmerding.

Long Branch, N. J.—The scheme to connect a number of pleasure resorts from Pleasure Bay to Point Pleasant, a distance of twenty-five miles, is backed by several capitalists and railroad men, among them being J. C. Shaffer, president of the Seashore Electric Railway of Asbury Park and a large stock owner in the Indianapolis Street Railway. The company have received letters asking them to extend the road to Trenton and Camden.

Charleston, W Va.—The Kanawha Electric Street Railway Company has asked council for a franchise to operate an electric railway on streets in the city not now in use by the Street Railway Company. The Kanawha Company agrees to put up a forfeit and to begin work in thirty days, to complete one mile within six months and six miles within three years, and to pay the city $500 for each mile of railway constructed.

Gettysburg, Pa.—The War Department at Washington has compelled the company who were running a trolley line through portions of the battlefield to remove their tracks and directed them to fill in and resod the cuts made through the portions of the field that the Government has decided must be held intact. The road will be constructed, but only on such routes as may be determined by the Battlefield Commission.

Indianapolis, Ind.—The *Journal* says "the indications are that outside capital cannot be secured for railway enterprises in Indiana. A prominent railway man says: 'Capital is chary in regard to railway investments in this State, and the feeling is due to almost complete confiscation by unjust and excessive taxation of railways, and railway construction will have a decided check until there is a change in the manner of taxing such property.'"

Cumberland, Md.—The Cumberland Electric Railway Company has purchased and put on one of its cars a new motor of the Westinghouse system. The *News* says "the new motor is fifty horse power and capable of high speed. There is an absence of the ordinary noise or buzzing, and a ride on the car is smooth and delightful. The motor will soon be transferred to a car especially built for it, and in course of time all of the cars on the line will receive the new equipment."

Pottstown, Pa.—The Chester County Electric Railway Company, recently incorporated, intend to build an electric railway from Douglassville to Pottstown and Parker Ford, to connect at each end of the road with the Pennsylvania Railroad. The line will be laid on the south side of the Schuylkill, with a branch or river connection across to Pottstown, on a bridge to be built by the company. Other branches, running to Pughtown and probably to West Chester, are also contemplated.

Norristown, Pa.—The Chestnut Hill and Norristown Passenger Railway Company, recently chartered to construct and maintain an electric railway between Philadelphia and Norristown, have filed their acceptance of the ordinance passed by town council on May 16 last, extending to them a trolley franchise over certain streets in the borough of Norristown, and have submitted a bond in the sum of $5,000 as a forfeiture in case the road should not be completed and in operation within fourteen months from the date of the passage of the ordinance.

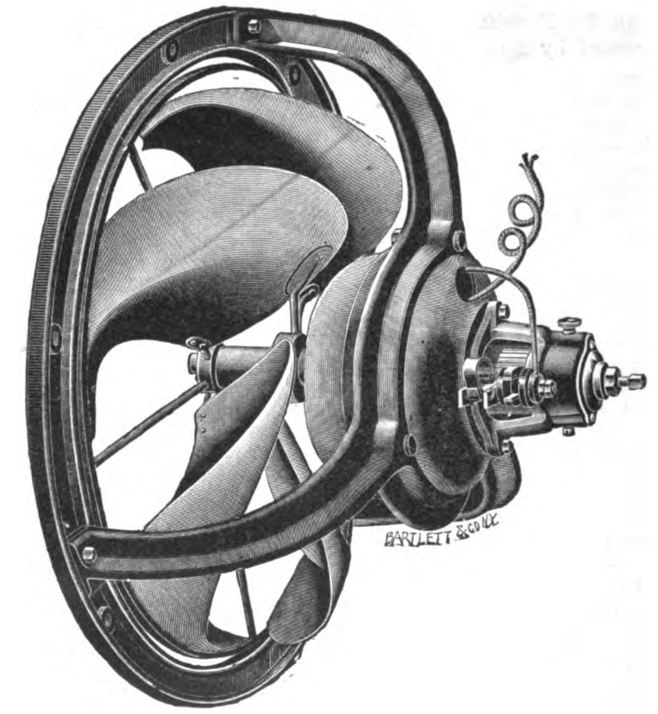
Cleveland, Ohio.—The city council has at last given its sanction to the consolidation of the street railroads comprising the Cleveland Electric Railway Company, the main condition being that "only one fare shall be charged for a continuous ride on or over any of said constituent companies and any other line of any other of said constituent companies within the limits of the city of Cleveland; and passengers on any of such lines paying one fare shall be entitled, without additional or extra charge to be transferred to any other of said lines and have a continuous ride thereon for said single fare." The companies consolidated were formerly the East Cleveland Railroad Company, the Broadway and Newburg Street Railroad Company, the Brooklyn Street Railroad Company and the South Side Street Railroad Company.

Gloversville, N. Y.—The Fonda, Johnstown and Gloversville Railroad and the Cayadutta Electric Railroad are now the property of the same company, the former road having recently been purchased by the Electric Railroad Company. After the purchase a new board of directors was elected, consisting of James S. Burr, W. J. Heacock, Charles W. Judson, A. J. Zimmer, S. H. Shotwell, Gustav Levor and George M. Place, of Gloversville; James P. Argersinger and John G. Ferres, of Johnstown; G. F. Mills, J. L. Hees, of Fonda; Thomas F. Kyne, of Amsterdam, and James Shanahan, of Tribes Hill. The new directors have elected as officers of the road: President, Hon. James Shanahan; vice-president, James P. Argersinger; treasurer, J. L. Hees; secretary, George M. Place. Lawton Caten has been appointed general manager or superintendent in place of R. T. McKeever, resigned. The headquarters of the road will remain at Gloversville.

W. C. Callman & Company.

Messrs. Wm. C. Callman & Company having recently moved their offices to the Electrical Exchange Building, 136 Liberty street, are now carrying a complete line of electrical supplies.

They are having quite a run on the Feldkamp Fans and Motors, and are at present negotiating for the Eastern agency of a well-known Western dynamo and motor house.


BARTLETT &CO NY.

THE LUNDELL EXHAUST FAN OUTFIT.

The Lundell Exhaust Fan Outfit.

We herewith illustrate a new outfit which is a combination of an ordinary exhaust fan directly coupled to a slow speed Lundell motor. The absence of belting and the absolute noiselessness of the outfit is particularly noticeable. An exposition of the adaptability of this outfit for certain places is found in the installation in the restaurant of Busse & Simoni, Delmonico's old place in New street. Guests sitting directly underneath the fan do not notice that it is running. The location of the fan is novel and serves a double purpose. It exhausts the air from both kitchen and restaurant and gives comfort to both guests and chefs. This ventilating outfit is adapted for all places and is a sure means of keeping the air in a pure and wholesome condition. The Lundell Exhaust Fan Outfit is placed on the market by the Interior Conduit and Insulation Company.

Automatic Short Circuit Alarm Bell.

This ingenious and novel device has only lately been devised and owing to its practicability, simplicity, reliability and cheapness will become very popular with the electric fitting trade.

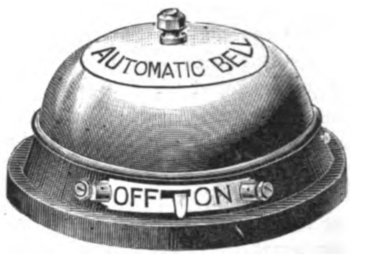
It combines in itself all of the features of the already well-known "Detached Relay" with local bell and battery, without the expense of the latter two, and further acts not only to give an alarm when a short circuit occurs, but also to interpose a resistance in the battery circuit, preventing deterioration of the battery while on short circuit within practical limits.

The cut shows its exterior appearance, there being on the base, besides the four inch gong, two binding posts, a switch and an adjusting screw (shown at the right side). The main gas-lighting circuit is cut at any point, and the two ends inserted in the binding posts.

This is absolutely all that is necessary to put it in use; no wires need be specially run, and no extra battery used.

The switch controls the battery entirely. When the lever is turned to "ON" the battery is then in circuit with the apparatus.

The bell itself is normally out of the circuit, and any or all burners may be operated as frequently as required, without the bell sounding at all. If, however, the battery becomes short-circuited or grounded, at the burner or elsewhere, for more than a given period of time for which the instrument is set by means of the adjusting-screw, then the bell is thrown into the circuit and sounds continuously while the trouble exists; but should it cease the bell is again out of circuit and the battery left in as before.



Another entirely new feature of this interesting instrument is that the bell is actuated by the main battery, and the current flowing through to the ground is diminished to so small an extent that the ground can be left on for hours without seriously affecting the battery.

Thus, while the current to a burner from the ordinary battery will be about one ampere, when the bell acts it will diminish immediately to less than three-tenths of an ampere.

The adjusting screw at the right side permits of the time adjustment. By slightly screwing it up, the time intervening between closing the circuit and the bell ringing will be shortened, and by unscrewing the reverse. They may be set to act at from any time between one-half a second and forty seconds. They are usually set for about five seconds when turned out from the factory of Mr. A. L. Bogart, the inventor.

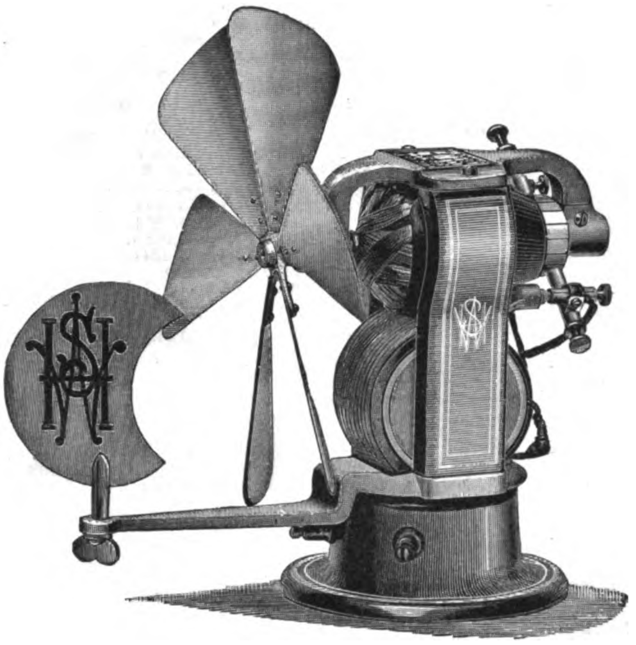
Whenever there is any one on the premises, this Automatic Short Circuit Alarm Bell will answer every purpose of a more expensive cut-off instrument, and can be attached to any gas-lighting circuit at any time by simply cutting the main wires and inserting them in the posts of this battery protector.

A Rotating Fan Motor.

The W. S. Hill Electric Company, Boston, is constantly introducing new specialties which instantly secure appreciation and sell right and left.

Their latest novelty is a rotating fan motor, of which we publish herewith a cut. It is similarly constructed to their well-known and efficient station fan motor in most details, but is mounted on a base which allows it to rotate by the action of the air from the fan. which impinges on a crescent shaped rudder, the rudder being adjustable at the end of a projecting arm to any angle, thus regulating the speed at which the entire machine shall rotate. This motor; when placed in the centre of a room, by its rotating motion will keep the air in motion in any part of said room, a feature the advantages of which are appreciable at a glance. This motor runs practically noiseless, keeps cool, is self lubricating, not requiring the use of a drop of oil for an entire season and without having to be touched.

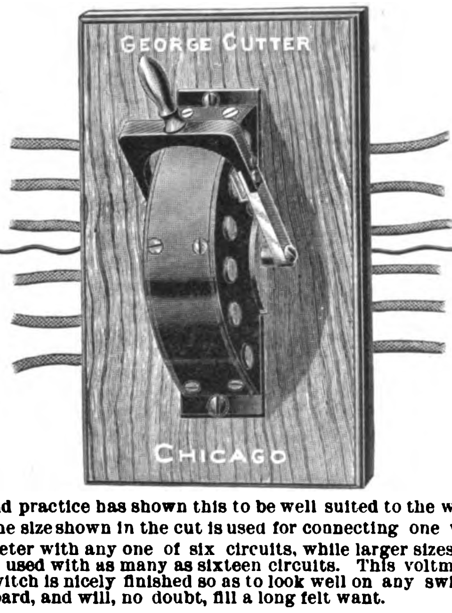
It has a twelve inch fan and makes 1,500 revolutions a minute on a 110 volt circuit, with less than one ampere of current. It is meeting with a phenomenal sale everywhere.



W. S. HILL ELECTRIC CO.'S FAN MOTOR.

Cutter's Voltmeter Switch.

The average incandescent station has quite a number of separate circuits running from it, and in order to maintain the proper voltage on each of these it has been the custom to have a voltmeter for each circuit. Then, since first-class instruments are rather expensive, the cheaper and more crude forms have almost always been used for this purpose. Of course, inaccurate voltmeters mean unsatisfactory service at the lamps, leading either to complaints regarding the light furnished or to a very short life of the lamps themselves. Any device that would allow a single and accurate voltmeter to be used with eight or ten circuits would do away with the faulty instrument and insure more satisfactory results. Mr. George Cutter, of Chicago, has perfected a special switch for this purpose, and practice has shown this to be well suited to the work. The size shown in the cut is used for connecting one voltmeter with any one of six circuits, while larger sizes can be used with as many as sixteen circuits. This voltmeter switch is nicely finished so as to look well on any switchboard, and will, no doubt, fill a long felt want.



The Ansonia Electric Company.

The Ansonia Electric Company have just closed a very large sale of Shield Brand Wire in Iowa.

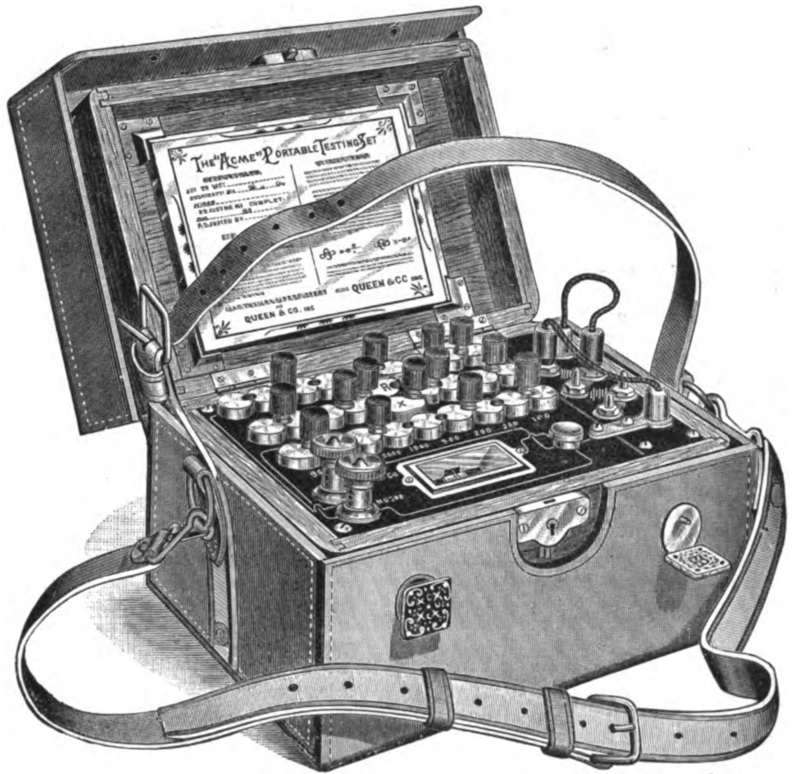
The many former buyers of the old Sunbeam lamps are taking advantage of the fact that the Ansonia Electric Company can again furnish the old standard Sunbeam incandescent lamp.

The Ansonia Electric Company advise that nothing but the best reports are coming in from the W.-W. Lightning Arrester.

The "Acme" Portable Testing Set.

The rapid and correct measurement of resistance under varying circumstances is an important factor in electrical engineering, and for this purpose it is highly essential to use apparatus that properly meets the requirements of everyday practical work.

In this connection the "Acme" Portable Testing Set, herewith illustrated and described, deserves more than passing notice as being one of the most perfect commercial instruments for testing resistance yet placed on the market, and embodying the result of long experience on the part of Queen & Company.


THE "ACME" PORTABLE TESTING SET
QUEEN & CO

ACME PORTABLE TESTING SET. (FIG. 1.)

It comprises a Wheatstone Bridge, Rheostat, D'Arsonval Galvanometer, "Aluminum-Iodine" Battery and Double Contact Key, all contained in a mahogany case, outside dimensions 8¼ inches x 5⅝ inches x 5 inches, and weighing less than six pounds complete. The leather case illustrated (Fig. 1) is very convenient when the apparatus is used by inspecting engineers, as it can be slung over the shoulder and carried as readily as a small handbag. The coils in both bridge and rheostat are wound with platinoid wire, which long use has conclusively shown to be far superior to German silver, and adjustments are made with great care, an accuracy of one-fifth of one per cent. being guaranteed. The arrangement is similar to the "Post Office" design, with three coils in each bridge arm, and eighteen coils in the rheostat, giving a total range, by means of the reversing attachment, of from .001 ohm to 11,110,000 ohms.

The galvanometer is a modified form of the D'Arsonval type, made specially for the purpose, and has proved a superior instrument for testing. It is strongly built, hence not liable to injury, and is perfectly dead-beat, so that readings can be taken very rapidly. Magnetic fields and mechanical vibrations produce no effect whatever, and the instrument will give as accurate indications in the street, on shipboard or in a dynamo room as in a college laboratory. This feature, possessed by no other make of similar apparatus, should not be overlooked.

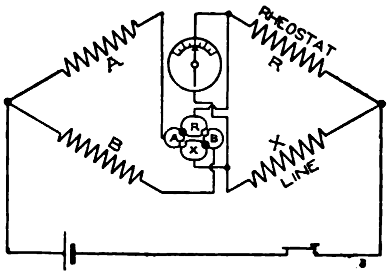
The battery is of the new "Aluminum-Iodine" form with E. M. F of 1 4-10 volts per cell, or equivalent to a total of 17 volts. This is practically 50 per cent. more than the ordinary chloride of silver cells.

The apparatus complete is shown in Fig. 1, while Figs. 2 and 3 indicate the arrangement of working parts. In Fig. 2 A and B represent the two proportional bridge arms, R is the adjustable rheostat, and X the unknown resistance or line. In Fig. 3 the arm A of Fig. 2 is equivalent to the coils 1, 10, 100 on the left hand centre row, and the arm B to the coils 10, 100, 1,000 on the right hand of same row. The rheostat R corresponds to the coils of the top and bottom rows, aggregating 11,110 ohms, and X the unknown quantity is connected between the two binding posts at the lower left hand corner.

In Fig. 3 the blocks marked "A," "R," "B," and "X" are connected to the bridge arms and are the same as shown in the centre of Fig. 2. They constitute the "reversing arrangement" whereby the bridge arms may be interchanged and six coils be made to do the work of eight. By this means it also becomes possible to readily detect inaccuracies in the bridge ratios should any exist, and to eliminate them entirely in work.

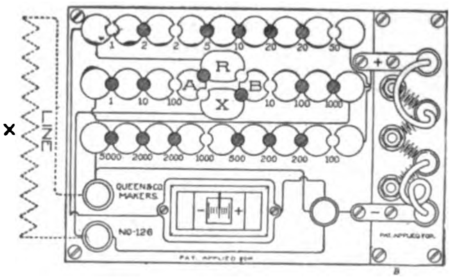
To use the apparatus the terminals of the resistance to be measured should be connected to the binding posts mentioned, and an approximate estimate formed of its value. For example, suppose it is about 400 ohms, the proper method of procedure will then be as follows;

Plug A to R and X to B, and unplug the 100 ohm coil in both A and B and also the 500 ohm coil in the rheostat. Connect one cell of battery and close the key for an instant (it is always best to start with very small battery power as in that case no harm can be done if the unknown resistance is estimated far from its proper value). If the galvanometer needle swings to plus, the resistance unplugged in the rheostat arm is too high; if to minus it is too low. By altering the unplugged resistance of the rheostat arm, and if necessary increasing the battery power, a "balance" can quickly be effected and thus the value of the unknown determined to within 1 ohm. Should the resistance be low, for instance, 10 ohms, the same plan should be followed except that the two 10 ohm coils of the bridge should be used instead of the 100 ohm coil. If the resistance be higher than the total resistance of the rheostat, for example 800,000 ohms, plug A to X and B to R and unplug 10 in A and 1,000 in B; the proportion will then be as 1 is to 100 and a balance will be obtained when 8,000 ohms is unplugged in the rheostat.



ACME PORTABLE TESTING SET. (FIG. 2.)

From the preceding description it will be evident that the apparatus is remarkably simple in operation, so that an inexperienced lineman can learn to use it in a short time. The great value of such an instrument will be evident to those who have used the forms heretofore obtainable, which usually necessitate the handling of two boxes, one for the rheostat, galvanometer and bridge, and a separate one for the battery.



ACME PORTABLE TESTING SEL. (FIG. 3.)

The manufacturers, Queen & Company, Incorporated, Philadelphia, will be pleased to quote prices and furnish further particulars upon application, as also to forward descriptive circular No. 445 to interested parties.

COMMERCIAL PARAGRAPHS.

The Eastern Electric Cable Company, Boston, manufacturers of the famous "Clark" wires and cables, notwithstanding that it has enlarged its factory two or three times the last two years, is still unable to keep up with the orders as they come rolling in. For the last two months they have had to decline any more orders, and though the factory is now running throughout both night and day, the company has business enough in hand to keep going for six months. This state of things has necessitated the erection of another new three story building, 151 feet long. The machinery will be run by a new Fitchburg engine of 150 H. P. Three 50 H. P. boilers will be installed. Clark wires and cables are known everywhere and need no recommendation, they recommend themselves every time.

The Muncie Electric Works, at Muncie, Ind., has orders on hand for a number of their "Iron Clad" machines, among which are two 25 h. p., three 10 h. p., one 15 h. p., three 1 h. p. and one 5 h. p.; they have delivered three 10 h. p. motors since beginning operations, May 1.

INCORPORATIONS.

The Voorhees Electric Company, Boston, Mass.—to manufacture and sell electrical appliances. Capital stock, $5,000. Stockholders: J M. Ladensack, Geo. R. Blinn. Gardner T. Voorhees.

The Essex County Street Railway Company, Newbury, Mass.—to construct a railway in Newbury, Rowley and Ipswich, and operate the same by any motive power except steam. Capital stock, $150,000. Stockholders; F. Cogswell, Chas. A. Sayward, Wm. S. Russell and others.

The Haverhill, Georgetown and Danvers Street Railway Company, Haverhill, Mass.—to construct a railway with switches in Danvers, Topsfield, Boxford, Georgetown and surrounding towns. Capital stock, $300,000. Stockholders: M. Brewster, Sherman Nelson, Jos. B. Poor, Merrill B, Bailey.

The Racket River Railway Company—to construct a standard gauge road about twenty miles in length, to be operated by steam or electric power, from Potsdam, N. Y., to and through the village of Pierpont to the village of Colton, with a branch at or near Hannawa Falls to Parrishville, in St. Lawrence County. Capital $350,000. Directors: W. Wyckham Smith, William Wills, Foster L. Backus, A. L. Chatterton and George R. Crossley, of Brooklyn; Russell L. Kinsay, of Buffalo; Frank E. Bennett, of Topeka, Kansas; J. L. Ludwig and A. R. Dodge, of New York City.

The Hoosic Railway Company—to construct an electric railroad from the Fitchburg Railroad Station in the village of Hoosic Falls, N. Y., through the village streets to Walloomsac. Capital, $60,000. Directors: G. C. Moses and F. H. Twitchell, of Bath, Me.; William Holmes, Joseph Buckley, S. D. Locke and others, of Hoosic Falls.

The Middletown-Goshen Traction Company—to construct a street surface railroad in Middletown, N. Y., about ten miles in length. Capital, $100,000. Directors: B. F. Low and A. D. Seaman, of Middletown; E. G. Wightman, S. W. Roberts, W. B. Rockwell, M. J. Wightman, F. W. Bleckley and B. H. Throop, of Scranton, Pa., and Samuel Harris, of Cleveland, Ohio.

The Lebanon Springs Railroad, which was sold at foreclosure sale in May, 1892, has been incorporated with the Secretary of State at Albany, N. Y., under the name of the Lebanon Springs Railroad, with a capital of $1,427,500.

The Litchfield Electric Light and Power Company of Litchfield, Conn., has been incorporated.

The East End Telephone Company—to construct and maintain a telephone line from East Hampton village to Sag Harbor and neighboring villages in Suffolk County, N. Y. Capital stock, $500. Directors: David J. Gardiner, Jerry Huntting, Edward M. Osborn, of East Hampton, and others.

New Hampton Electric Light and Power Company, New Hampton, Iowa. The company have obtained a franchise for the construction of an electric light plant at New Hampton to cost from $12,000 to $15,000. They also intend to construct and operate plants in other towns.

The Dubuque Light and Traction Company has filed its new articles of incorporation. The new articles provide for the purchase of electric light and electric street railway plants. The capital stock shall be $600,000, divided into 6,000 shares of $100 each. The annual meeting shall be held on the first Tuesday of June each year. Until the first annual meeting James S. Cummins, Walter J. Ballard, Edgar W. Duncan, George K. Wheeler and John L. Martin shall constitute the board of directors. The highest amount of indebtedness to which the company shall subject itself shall not exceed $400,000.

The Citizens' Electric Light Company, of Wayne, Pa. Capital stock, $5,000. Directors: John W. Yeatts, Frank Weckerley, Thomas H. Phillips, Louis Erben, St. Davids; Thomas H. Carter, J. H. Jefferies, Charles H. Barlit, Wayne.

The Mt. Pleasant Electric Light Company, Mt. Pleasant, Sanpete County, Utah. Capital stock, $10,000. President, L. J. Jordan; vice-president, Wm. Zabriske; secretary, W. D. Candland; treasurer, Alif Erickson. These and James Larsen form the board of directors. To furnish light and power.

At a recent meeting of the stockholders of the Schuylkill Traction Company, held at their office in Ashland, Pa., it was decided to increase the capital stock of the corporation from $600.000 to $10,000,000 and the mortgaged indebtedness from $300,000 to $500,000. The increased funds are to be used solely for the betterment and extension of the system.

At Albany, N. Y., on the 9th inst., the Colonial City Electric Railway Company was incorporated with a capital stock of $175,000 for constructing a street surface railroad six miles long in Kingston, N. Y. Directors: Charles W. Deyo, E. G. Lawrence, Elbert G. Loughran, Luke Noone, Alvah S. Newcomb and N. C. Powelson, of Kingston; Hasbrouck Alliger, of Rondout; Wendell Goodwin and Frederick Swift, of New York City.

The Chester Telephone Company, Chester, S. C. Capital stock, $500. Incorporators: A. W. Love, J. N. Cross, J. K. Henry, C. W. Carpenter. S. M. Jones. The purpose of the company is to operate telephone and telegraph wires in the town of Chester.

The Higgins Gravity Motor and Electric Gravity Clock Company, Chicago. Capital, $1,000,000. Incorporators: George C. Higgins, Samuel L. Smith and Joel J. Squier.

The Robertson Southern Electric Railway Company has filed an application for a charter to construct an electric railway from Knoxville, Tenn., to Kingston, Oliver Springs, Poplar Creek Coal Mines, Clinton, Andersonville, Powell's Valley, Luttrell, Maynardsville, Blaine's Cross Roads, Lee's Springs, Strawberry Plains, Dandridge, Sevierville, Allegheny Springs and the Little Tennessee River, in Monroe County, Tenn., with stems from the main lines to many points. The company expects to haul both passengers and freight, and in effect to eventually construct a cheap system of railways through all East Tennessee. The amount of capital stock is not set forth in the application. The incorporators are W. Boright, L. D. Dillon, B. H. Sprankle, J. S. McDonough, J.S. Stewart, J. Luttrell Murphy, Archibald J. Robertson, Henry Curry and J. A. R. Murphy.

Application has been made at Knoxville, Tenn., for a charter for the Paint Rock and Tennessee River Railway Company by J. W. Hudson, B. J. Miller, B. G. Slaughter, G. G. Phillips, Henry Estill and J. Luttrell Murphy, who propose to build an electric railway line from Winchester, Franklin County, Tenn., to McMinnville, by way of Decherd, Viola and Beersheba Springs The line is also to be extended to the head of Estill Fork Creek, of Paint Rock River, thence to Savannah, Mineral Springs, Lynchburg, Pulaski, Lawrenceburg and Waynesboro, in Wayne County.

The Ida Grove Electric Company, Ida Grove, Iowa. Capital stock, $15,000. Incorporators John L. Blakely, Wm. Bender, Alfred Shuter, F. A. Lusk, J. W. Reed, Wm. Bassett, H. M. Whinery, Julius Roher and Chas. Britch, all of Ida Grove. To establish and maintain an electric plant for power and light.

The Chester County Electric Railway Company has been granted a charter by the State Department at Harrisburg, Pa., to build a line of electric railway from Douglassville to Pottstown and Parker Ford. The corporators named are Eli S. Root, Jacob S. Mauger, William Smith, Samuel K. Halteman, David Titlow and William S. Mauger.

The Trenton Electrical Construction Company, Trenton, N. J. Capital stock, $25,000. Incorporators: George F. Applegate, Jeremiah P. Toman, Carl F. Adams, Anton Adams and Paul Suplee, all of Trenton. The object of the company is to manufacture operate and sell all kinds of electrical apparatus for lighting and for power purposes and for acquiring and dealing in patents and franchises.

The People's Street Railway Company, Chester, Pa. Capital stock, $50,000. Incorporators: Jas. R. T. Coates, Chester, Pa.; Samuel L. Kent, Clifton Heights, Pa; W. H. Sayen, Wayne, Pa. To construct and operate an electric railway in Chester, Delaware County, Pa.

The Shenandoah and Mahanoy City Street Railway Company, Ashland, Pa. Capital stock, $100,000, Incorporators: J. F. Bailey, Philadelphia, Pa.; D. D. Phillips, Gordon, Pa.; MacHenry Wilhelm, Ashland, Pa. To construct and operate an electric railway in Schuylkill County, Pa.

The Cleveland Surgical and Electrical Instrument Company, Cleveland, Ohio. Capital stock, $25,000. Incorporators: John R. McQuigg, Joel M. Monroe, Albert G. Langell, Geo. B. Riley, John Colahan. To manufacture and deal in surgical and electrical instruments, materials, etc.

The Hillsboro Water, Light and Power Company, Hillsboro, Texas. Capital stock, $50,000. Incorporators: D. M. Crossthwait, Kyle, Tex.; Walter Tips, Austin, Tex.; T. F. Voight, Dripping Springs, Tex. To supply the public with light and power by electricity.

The Hartman Manufacturing Company, New York, N. Y. Capital stock, $25,000. Incorporators; Edw. R. Vollmer, Brooklyn, N. Y.; Wm. Vollmer, Brooklyn; Julia Hartman, New York City. To manufacture and sell gas and electric fixtures.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JUNE 6, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

498,852. Closed Conduit for Electric Railways. Charles J. Kintner, New York, N. Y., assignor of one-third to Gustav Stahl, Philadelphia, Pa. Filed June 27, 1892.

498,906. Conduit Railway-Trolley. Michael H. Smith, Halifax, England. Filed April 6, 1886.

498,932. Trolley-Stand. James R. Griffiths, Chicago, Ill. Filed July 2, 1892.

498,933. Electric-Railway Trolley. James R. Griffiths, Chicago, Ill. Filed July 6, 1892.

498,985. Mechanism for Transmitting Power from Car-Wheel Axles to Dynamos Within the Cars. Morris Moskowitz and Samuel Young, Newark, N. J., assignors of one-half to Leon D. Adler and Joseph Loewenberg, same place. Filed Dec 6, 1892.

499,095. Trolley-Wire Finder. James Chase, Rochester, N. Y. Filed Jan. 23, 1893.

499,112. Overhead Electric Railway. John C. Henry, New York, N. Y. Filed Sept. 3, 1890.

499,115. Electric-Railway Trolley. George W. Hooper, Rochester N. Y., assignor, by direct and mesne assignments, of three-fourths to John A. Stewart, James S. Baker, and Alfred Green, same place. Filed Aug. 10, 1892.

499,143. Trolley-Wire Support. Carl Peterson, Brooklyn, N. Y. Filed Dec. 16, 1892.

499,167. Trolley-Wire Curve. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company, of Connecticut. Filed Feb. 2, 1893.

ELECTRIC LIGHTS AND APPLIANCES.

498,878. Electric Illuminating Apparatus. Edward A. Colby, Newark, N. J. Filed Feb. 15, 1893.

498,879. Method of Electric Illumination. Edward A. Colby, Newark, N. J. Filed Feb. 15, 1893.

498,901. Incandescent Electric Lamp. Alexander De Lodyguine, Paris, France. Filed March 11, 1892.

498,915. Electrode for Electric-Arc Lamps. Saloman Heimann, New York, N. Y. Filed Oct. 24, 1892.

498,929. Electric Glow-Lamp. Edward A. Colby, Newark, N. J. Filed Feb. 15, 1893.

499,097. Electric Illuminating Apparatus. Edward A. Colby, Newark, N. J. Filed Feb 15, 1893.

499,150. Advertising or Other Illuminating Effect. Horace F. Simon, London, England. Filed Nov. 1, 1892.

DYNAMOS AND MOTORS.

498,763. Electro-Motive Device. Romaine Callender, Brantford, Canada, assignor of two-thirds to Edward Hart and Edward L. Goold, same place. Filed July 14, 1892.

498,969. Dynamo-Electric Machine. William S. F. Dillon, Chicago, Ill. Filed Nov. 21, 1892.

499,099. Electro-Dynamic Machine. Olof Dahl, Paterson, N. J., assignor to the Dahl Electric Company, of New Jersey. Original application filed Oct. 21, 1890. Divided and this application filed April 22, 1893.

499,183. Friction-Clutch for Electric Motors. Olof Dahl, Paterson, N. J., assignor to the Dahl-Electric Company of New Jersey. Filed Oct. 26, 1892.

TELEPHONE AND TELEGRAPH APPARATUS.

498,808. Telephone-Switchboard Annunciator. Frank R. McBerty, Downer's Grove, assignor to the Western Electric Company, Chicago, Ill. Filed Oct. 29, 1892.

498,869. Telephone Handle or Holder. Basil M. Wilkerson, New York. N. Y., assignor of one-half to Shipley Brashers, Washington, D. C. Filed April 14, 1891.

498,911. Copying Telegraphic Apparatus. Sylvester P. Denison, Belleville, N. J., assignor to Herman Broesel, trustee, New York, N. Y. Filed Feb. 1, 1893.

498,919. Telephone. Barton Pickering, Dayton, Ohio. Filed Oct. 4, 1880.

499,108. Telephone. Edward M. Harrison, Fort Smith, Ark. Filed May 31, 1892.

MEASURING INSTRUMENTS, ETC.

498,837. Dynamometer. Hans C. Behr, San Francisco, Cal. Filed Nov. 24, 1891. Renewed March 20, 1893.

498,871. Electrical Transmitter for Telemeter Systems. Charles W. Ayton, New York, N. Y. Filed Feb. 10, 1892.

498,872. Receiver for Telemeter Systems. Charles W. Ayton, New York, N. Y. Filed June 7, 1892.

SIGNALS AND SIGNALING APPARATUS.

498,864. Railway-Signal. James W. Steele, Chicago, Ill. Filed Oct. 5, 1891.

498,865. Railway-Signal. Joseph B. Stewart, Haverstraw, and William G. Wattson, Tappan, N. Y. Filed May 3, 1892.

498,987. Non-Interference Signal-Box. Charles E. Ongley, New York, N. Y., assignor, by direct and mesne assignments, to the Ongley Electric Company, same place. Filed Jan. 19, 1891. Renewed Nov. 16, 1892.

498,988. Electric Signal and Protective System. Charles E. Ongley, New York, N. Y., assignor, by direct and mesne assignments, to the Ongley Electric Company, same place. Filed Jan. 21, 1891. Renewed Nov. 16, 1892.

499,062. Electric Time-Signal. Gerhard W. Van Vlanen, Cologne, Germany. Filed Aug. 2, 1892.

499,125. Electric Signal Apparatus and System. Jacob W. Lattig, Easton, Pa. Filed April 12, 1893.

499,126. Electric Signaling Apparatus and System for Railways. Jacob W. Lattig, Easton, Pa. Filed Feb. 21, 1893.

MISCELLANEOUS.

498,757. Insulated Conductor. Thomas F. Attix, Brooklyn, N. Y., assignor of one-third to Henry C. Hulbert, same place. Filed Dec. 1, 1892.

498,768. Electrolytic Apparatus. Thomas Craney, Bay City, Mich. Filed March 25, 1892.

498,769. Method of Electrolyzing Salts. Thomas Craney, Bay City, Mich. Filed Aug. 10, 1892.

498,770. Electrolytic Apparatus. Thomas Craney, Bay City, Mich. Filed Aug. 18, 1892

498,771. Electrolytic Cell. Thomas Craney, Bay City, Mich. Filed Oct. 10, 1892.

498,776. Clamp for Electric Conductors. Axel H. Englund, Chicago, Ill. Filed June 29, 1891.

498,799. Rheostat. Edward R. Knowles, Middletown, Conn., assignor to the Schuyler Electric Company of Connecticut. Filed Jan. 9, 1893.

498,880. Electrical Switch. James Des Brisay, New York, N. Y. Filed Nov. 23, 1891.

498,907. Electrical Condenser. William Stanly, Jr., and William B. Tobey, Pittsfield, Mass., assignors to the Stanley Laboratory Company, same place. Filed Jan. 9, 1893.

498,973. Method of and Apparatus for Electric Perforating. Dexter M. Garnett, Evanston, and John M. Garnett, Chicago, Ill. Filed Feb. 14, 1893.

499,008. Electrical Call-Box. Walter F. Banks, Milford, Conn. Filed Nov. 25, 1892.

ELECTRICITY.

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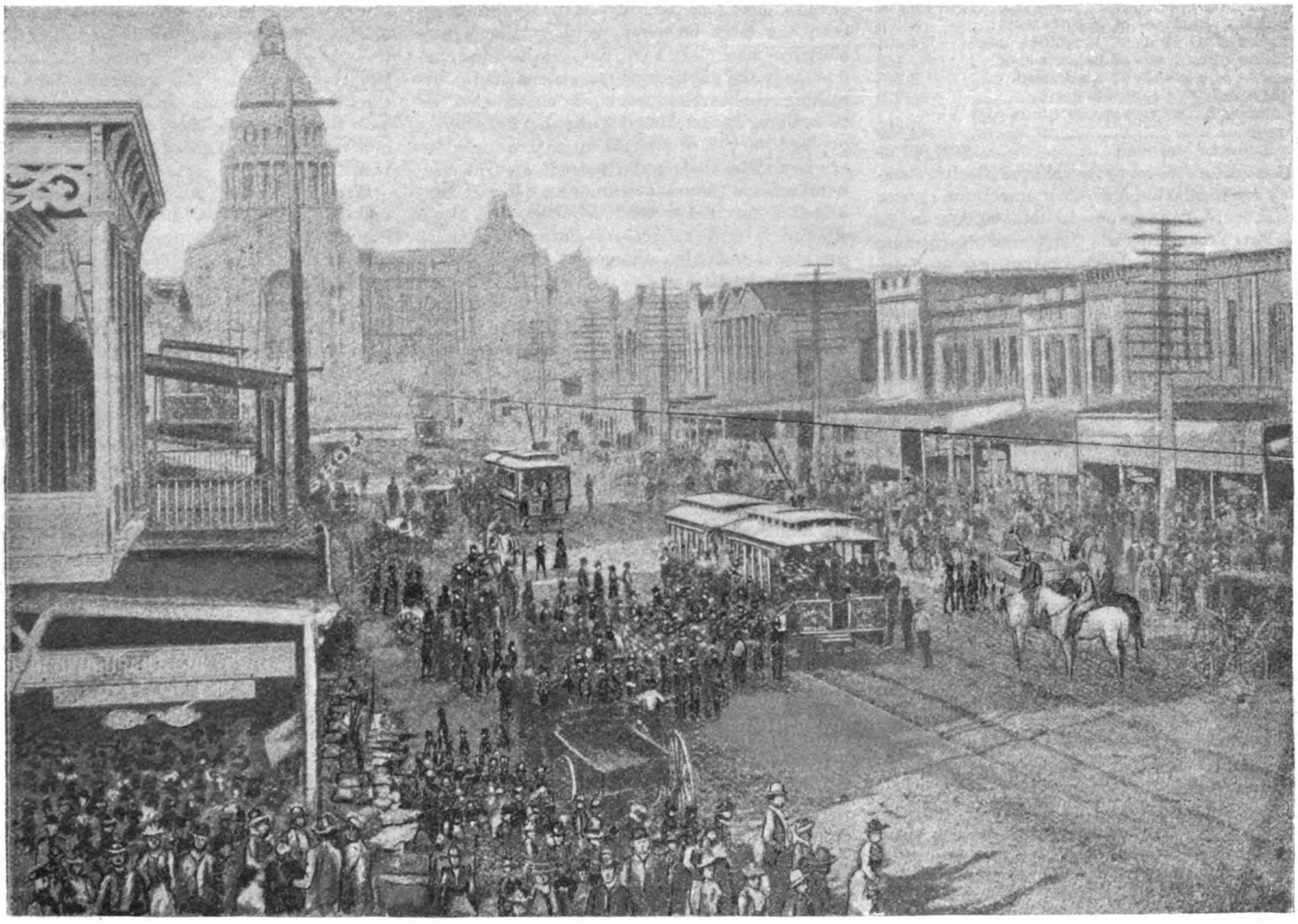

OPENING OF THE ELECTRIC RAILWAY, AUSTIN, TEXAS. (SEE PAGE 314.)

Austin's Water Power.

Electric Lights, Railway Power and Irrigation Supplied by the Colorado River Dam.

The city of Austin, Texas, has just completed a large dam which will utilize the power of the Colorado River for supplying the electric lighting of the city, drive its electric railways as well as furnishing water for irrigation of the farming lands in its vicinity and the city reservoir.

The suggestion of this project was made as early as 1888, since which it has been steadily agitated, but like most extensive works of this character there were many objections to overcome and considerable municipal legislation necessary before the project assumed definite shape. After making preliminary surveys and securing estimates on the work, it was found that the expense of the system as completed would amount to $1,400,000, for which amount city bonds were issued. The actual work was commenced in the latter part of 1890 and the system was put into operation on May 16, 1893. The dimensions and cost of the dam are as follows:

Length of dam, feet	1,150
Maximum height, feet	68
Height above low water, feet	60
Width at base, feet	66
Width at top, feet	16
Granite masonry in the dam, cubic yards	20,648.0
Limestone masonry in the dam, cubic yards	70,651.2
Concrete masonry in the dam, cubic yards	331.4
Total amount of masonry in the dam, cubic feet	91,630.6
Number of carloads of granite used	4,480
Number of carloads of limestone used	14,307
Number of carloads of cement used	456
Number of carloads of sand used	2,736
Total number of carloads used	21,979
Available horse power, 60 hours per week	14,500
Total cost of the dam	$607,927.90

Contracts were let to the General Electric Company for furnishing four 125 H. P. generators with switchboard connections to the stations, and to the Fort Wayne Electric Company for furnishing four 2,500 16 C. P. light alternating current incandescent dynamos, wound for 2,000 volts, and four 1,600 16 C. P. light alternating current incandescent dynamos, wound for 2,000 volts, making a total capacity of 16,400 lights, with all switchboard connections and necessary apparatus inside the station.

Our Frontispiece represents the scene at the opening of the electric railway line, the view being taken on Congress avenue, one of the main thoroughfares of Austin.

The work is of too recent completion to give any data as to its efficiency, but the operation of the system appears to warrant the most sanguine hopes of its projectors.

Electric Motors for Calico Printing.

Probably the manufacturers of Lancashire, Lanarkshire, and the other great centres of calico printing in this country, says the *Electrical Review* (London), will consider that their appliances have been developed sufficiently through years of experimenting into good practical machines, not easily to be improved upon; but they do not yet appear to have entertained to any great extent the possibility of driving their printing-machines by electric motors, although an admirable specimen of such a combination was to be seen in the Manchester Jubilee Exhibition of 1887 amongst the appliances shown by Messrs. Mather & Platt, of Salford Ironworks, Manchester. At the Dunnell Printing Works, of Pawtucket, Rhode Island, a complete arrangement has, however, been put into force, whereby the usual double-cylinder steam-engine employed to drive each machine is replaced by an electric motor, and so far with great success, the results being in advance of any other method used for actual daily work.

Electric Transmission of Power Over Long Distances.

Possibilities and Limitations Affecting its Successful and Economic Employment.

BY W. F. C. HASSON, MEM. TECH. SOC.*

During the past few weeks a number of technical and general papers on this subject have appeared in electrical journals. These articles, though full of interest to those connected with electrical pursuits, have not been of such a nature as to be of much assistance to the practical purchaser.

This latter has little interest in the methods by which the end is attained, the important points to him being the cost of installation, operation and maintenance of the machinery, the efficiency of the transmission, and the distance that it may be successfully accomplished.

Continuous current machinery has been brought to a high state of efficiency and regulation, and furnishes a perfectly satisfactory method of transmitting power to limited distances where low electromotive force can be economically employed. As the relations between electromotive force and strength of current and their connection with the *amount* of power generated becomes better understood, it appeared evident that unless high E. M. F. was employed the cost of copper would practically prohibit the transmission of power to long distances. The continuous current has strong advocates who do not hesitate to say that large amounts of power may be successfully commutated and distributed at an electromotive force of 5,000 or 6,000 volts. However, the large corporations that manufacture electrical machinery have not sustained the confidence of the public in these statements by furnishing commercial machines constructed on these lines. In fact, the company that has actively opposed the use of alternating current machinery now states that, in the present state of electrical science there is a definite limit to safe commutation far below that required, and if an attempt is made to generate heavy continuous currents at such high voltages the machines will inevitably break down.

So broad a statement concerning the final perfection of any electrical system may to-day be accepted with a fair amount of doubt. So firm is the belief of this particular company, however, that during the past year it has brought to a state of commercial perfection an alternating current system.

Notwithstanding the difficulties, certain able enthusiasts, notably Nikola Tesla, have devoted their entire time to the perfecting of commercial alternating current motor systems.

The transmission of power, for lighting purposes only, may be accomplished by means of any of the commercial alternating current systems.

The generators furnish an electromotive force sufficiently high to allow an economic distribution of power over several miles. By means of transformers, an electromotive force of 10,000 volts is easily obtained for transmission long distances to the point of distribution, where reducing transformers supply a safe pressure for local circuits. The success of this system is evidenced at San Antonio, Cal., where a transmission of 28 miles at 10,000 volts is now in operation.

The electrical manufacturing companies of America have been so engrossed in developing and exploiting their lighting and railway systems that they have apparently in the past given little serious attention to the perfection of systems to meet the needs of electric power on the Pacific Coast, and they have given still less consideration to the circumstances which render its employment possible.

During the past year, however, the question of long distance transmission has been extensively discussed, and the best energies of the electrical companies have been devoted to its satisfactory solution.

The result is that three alternating current systems in various stages of commercial perfection are now before the public. These are:

1. The single-phase or popularly called synchronous system.
2. The two-phase or diphase system.
3. The three-phase or triphase system.

The first of these systems has been commercially perfected to meet certain requirements. It is admirably adapted to the transmission of power that is to be used for the continuous operation of motors of not less than thirty horse power. Its success has been exemplified in the machinery that has now been in operation almost two years at Telluride, Colorado. Machinery for the transmission of power thirteen miles to operate the mills of the Standard Consolidated Mining Company is now being installed at Bodie, Cal.

The promoters of these two systems each claim great individual advantages, but, until they have been submitted to the test of commercial operation, the only claims that may be admitted are that the three-phase system requires less copper wire for transmission, and that the two-phase is somewhat more simple and better adapted to meet the possibility of a perfected single-phase motor.

Within three months a three-phase plant for the transmission of 300 horse power will be in operation at Redlands, Cal. Within less than a year one of these systems will be installed for the transmission of three thousand horse power twenty miles, under the guarantee that it will meet the requirements for all varieties of power, and that the efficiency of transmission from generator axle to point of distribution will be at least 79 per cent.

Whatever system is adopted, the cost of generators and motors will not vary greatly, and the important factor in a long distance transmission is the amount of copper necessary for the line.

In determining the feasibility of utilizing water power to operate electrically the industries of any particular town or city, careful consideration must be given of the following points, viz.:

1. The amount of water power permanently available.
2. The cost of developing this power.
3. The interest on this amount.
4. The total demand for power.
5. The amounts and relative locations of the various kinds of power.
6. The cost of steam plants now in operation.
7. The interest on this amount.
8. Cost of fuel for plants now in operation.
9. Cost of operating present plants. Labor.
10. Cost of maintenance of present plants.
11. The amounts and kinds of electric power already in operation.
12. The distance of transmission.
13. The estimated cost of the hydraulic machinery.
14. The guaranteed efficiency and regulation of the hydraulic machinery.
15. Estimated cost of electric machinery.
16. Estimated cost of line construction.
17. Total cost of operating hydraulic and electric machinery.
18. Total cost of maintenance of hydraulic and electric plants.
19. The interest on the total estimated cost of proposed plant.
20. The estimated gross income.

For further information on the many points to be considered in this connection I refer you to the articles by Messrs. C. L. Bradley and L. B. Stillwell, and Doctors Louis Bell and C. E.

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* Abstract of paper read before the Technical Society of the Pacific Coast.

Emery, lately published in the electrical journals.

Undoubtedly, cheap power is essential to the development of the latent industries of California. It is equally true that the reliable electrical manufacturing companies are now prepared to furnish machinery to provide cheap power. The only difficulty in the way of advance appears to be a lack of confidence on the part of possible purchasers. This lack of confidence appears to be due to their inability to reconcile the conflicting claims and statements made by the electrical companies concerning their own machinery and that of competing companies.

Many transmissions that are easily possible are by no means feasible.

No long-distance transmission is absolutely impossible, although it may be thoroughly impracticable.

ON LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.—IV.

BY NIKOLA TESLA.[*]

The streams of light which you have observed issuing from my hand are due to a potential of about 200,000 volts, alternating in rather irregular intervals something like a million times a second. A vibration of the same amplitude, but four times as fast, to maintain which over 3,000,000 volts would be required, would be more than sufficient to envelop my body in a complete sheet of flame. But this flame would not burn me up: quite the contrary, the probability is that I would not be injured in the least. Yet a hundredth part of that energy, otherwise directed, would be amply sufficient to kill a person.

The amount of energy which may thus be passed into the body of a person depends on the frequency and potential of the currents, and by making both of these very great a vast amount of energy may be passed into the body without causing any discomfort, except perhaps in the arm, which is traversed by a true conduction current. The reason why no pain in the body is felt, and no injurious effect noted, is that everywhere, if a current be imagined to flow through the body the direction of its flow would be at right angles to the surface; hence the body of the experimenter offers an enormous section to the current; and the density is very small, with the exception of the arm perhaps, where the density may be considerable. But if only a small fraction of that energy would be applied in such a way that a current would traverse the body in the same manner as a low frequency current, a shock would be received which might be fatal. A direct or low frequency alternating current is fatal, I think, principally because its distribution through the body is not uniform, as it must divide itself in minute streamlets of great density, whereby some organs are vitally injured. That such a process occurs I have not the least doubt, though no evidence might apparently exist, or be found upon examination. The surest to injure and destroy life is a continuous current, but the most painful is an alternating current of very low frequency. The expression of these views, which are the result of long continued experiment and observation, both with steady and varying currents, is elicited by the interest which is at present taken in this subject, and by the manifestly erroneous ideas which are daily propounded in journals on the subject.

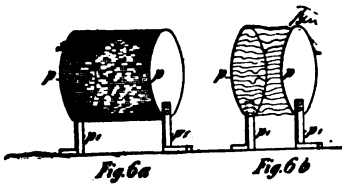


Fig. 6a Fig. 6b

Illustrating the Effects of Rapidly Varying and Steady Electrostatic Force.

I may illustrate an effect of the electrostatic force by another striking experiment, but must first call your attention to one or two facts. I have said before that when the medium between two oppositely electrified bodies is strained beyond a certain limit it gives way, and, stated in popular language, the opposite electric charges unite and neutralize each other. This breaking down of the medium occurs principally when the force acting between the bodies is steady, or varies at a moderate rate. Were the variation sufficiently rapid, such a destructive break would not occur no matter how great the force, for all the energy would be spent in radiation, convection and mechanical and chemical action. Thus the *spark* length, or greatest distance through which a *spark* will jump between the electrified bodies, is the smaller the greater the variation or time rate of change. But this rule may be taken to be true only in a general way when comparing rates which are widely different.

I will show you by an experiment the difference in the effect produced by a rapidly varying and a steady or moderately varying force. I have here two large circular brass plates *p p* (Fig. 6*a* and Fig. 6*b*), supported on movable insulating stands on the table, connected to the ends of the secondary of a similar coil as the one used before. I place the plates ten or twelve inches apart and set the coil to work. You see the whole space between the plate, nearly two cubic feet, filled with uniform light (Fig. 6*a*). This light is due to the streamers you have seen in the first experiment, which are now much more intense. I have already pointed out the importance of these streamers in commercial apparatus and their still greater importance in some purely scientific investigations. Often they are too weak to be visible, but they always exist, consuming energy and modifying the action of the apparatus. When intense, as they are at present, they produce ozone in great quantity, and also, as Professor Crookes has pointed out, nitrous acid. So quick is the chemical action that if a coil such as this one is worked for a very long time it will make the atmosphere of a small room unbearable, for the eyes and throat are attacked. But when moderately produced, the streamers refresh the atmosphere wonderfully, like a thunderstorm, and exercise unquestionably a beneficial effect.

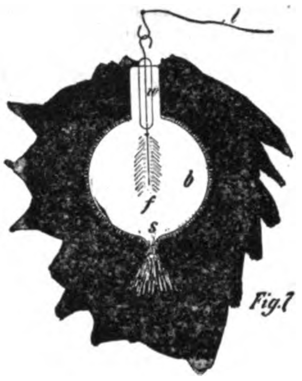


Fig. 7

Breaking a Bulb on Open Circuit.

In this experiment the force acting between the plates changes in intensity and direction at a very rapid rate. I will now make the rate of change per unit time much smaller. This I effect by rendering the discharges through the primary of the induction coil less frequent, and also by diminishing the rapidity of the vibration in the secondary. The former result is conveniently secured by lowering the E. M. F. over the air gap in the primary circuit, the latter by approaching the two brass plates to a distance of about three or four inches. When the coil is set to work you see no streamers or light between the plates, yet the medium between them is under a tremendous strain. I still further augment the strain by raising the E. M. F. in the primary circuit, and soon you see the air give way and the hall illuminated by a shower of brilliant and noisy sparks, 6*b*. These sparks could be produced also with unvarying force; they have been for many years a familiar phenomenon, though they were usually obtained from entirely different apparatus. In describing these two phenomena, so radically different in appearance, I have advisedly spoken of a "force" acting between the plates. It would be in accordance with accepted views to say that there was an "alternating E. M. F." acting between the plates. This term is quite proper and applicable in all cases where there is evidence of at least a possibility of an essential interdependence of the electric state of the plates, or electric action in their neighborhood. But if the plates were removed to an infinite distance, or if at a finite distance, there is no probability or necessity whatever for such dependence. I prefer to use the term "electrostatic force," and to say that such a force is acting around each plate or electrified insulated body in general. There is an inconvenience in using this expression as the term incidentally means a steady electric condition; but a proper nomenclature will eventually settle this difficulty.

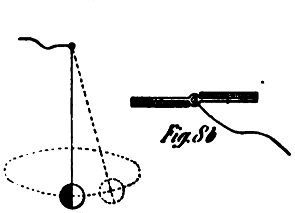
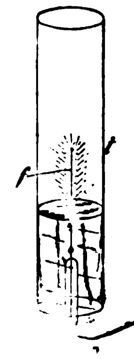


Fig. 8a Fig. 8b

Mechanical Motions Produced by Varying Electrostatic Force in a Gaseous Medium.

I now return to the experiment to which I have already alluded, and with which I desire to illustrate a striking effect produced by a rapidly varying electrostatic force. I attach to the end of the wire *l* (Fig. 7) which is in connection with one of the terminals of the secondary of the induction coil an exhausted bulb *b*. This bulb contains a thin carbon filament *f*, which is fastened to a platinum wire *w* sealed in the glass and leading outside of the bulb, where it connects to the wire *l*. The bulb may be exhausted to any degree attainable with ordinary apparatus. Just a moment before, you have witnessed the breaking down of the air between the charged brass plates. You know that a plate of glass, or any other insulating material, would break down in like manner. Had I therefore a metallic coating attached to the outside of the bulb, or placed near the same, and were this coating connected to the other terminal of the coil, you would be prepared to see the glass give way if the strain were sufficiently increased. Even were the coating not connected to the other terminal, but to an insulated plate, still, if you have followed recent developments, you would naturally expect a rupture of the glass.



Showing the Effect of the Air.

But it will certainly surprise you to note that under the action of the varying electrostatic force the glass gives way when all other bodies are removed from the bulb. In fact, all the surrounding bodies we perceive might be removed to an infinite distance without affecting the result in the slightest. When the coil is set to work, the glass is invariably broken through at the seal, or other narrow channel, and the vacuum is quickly impaired. Such a damaging break would not occur with a steady force, even if the same were many times greater. The break is due to the agitation of the molecules of the gas within the bulb and outside of the same. This agitation, which is generally most violent in the narrow pointed channel near the seal, causes a heating and rupture of the glass. This rupture would, however, not occur, not even with a varying force, if the medium filling the inside of the bulb and that surrounding it were perfectly homogeneous. The break occurs much quicker if the top of the bulb is drawn out into a fine fibre. In bulbs used with these coils such narrow, pointed channels must therefore be avoided.

When a conducting body is immersed in air, or similar insulating medium, consisting of, or containing, small freely movable particles capable of being electrified, and when the electrification of the body is made to undergo a very rapid change—which is equivalent to saying that the electrostatic force acting around the body is varying in intensity—the small particles are attracted and repelled, and their violent impacts against the body may cause a mechanical motion of the latter. Phenomena of this kind are noteworthy inasmuch as they have not been observed before with apparatus such as has been commonly in use. If a very light conducting sphere be suspended on an exceedingly fine wire, and charged to a steady potential, however high, the sphere will remain at rest. Even if the potential would be rapidly varying, provided the small particles of matter, molecules or atoms, are evenly distributed, no motion of the sphere should result. But if one side of the conducting sphere is covered with a thick insulating layer, the impacts of the particles will cause the sphere to move about, generally in irregular curves, Fig. 8*a*. In like manner, as I have shown on a previous occasion, a fan of metal sheet, Fig. 8*b*, covered partially with insulating material as indicated, and placed upon the terminal of the coil so as to turn freely in it, is spun around.

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[*] A lecture delivered before the Franklin Institute at Philadelphia, Feb. 24, 1893, and before the National Electric Light Association at St. Louis, Mo., March 1, 1893.

All these phenomena you have witnessed and others, which will be shown later, are due to the presence of a medium like air, and would not occur in a continuous medium. The action of the air may be illustrated still better by the following experiment. I take a glass tube *t*, Fig. 9, of about an inch in diameter, which has a platinum wire *w* sealed in the lower end, and to which is attached a thin lamp filament *f*. I connect the wire with the terminal of the coil and set the coil to work. The platinum wire is now electrified positively and negatively in rapid succession and the wire and air inside of the tube is rapidly heated by the impacts of the particles, which may be so violent as to render the filament incandescent. But if I pour oil in the tube, just as soon as the wire is covered with the oil all action apparently ceases and there is no marked evidence of heating. The reason of this is that the oil is a practically continuous medium. The displacements in such a continuous medium are, with these frequencies, to all appearance incomparably smaller than in air, hence the work performed in such a medium is insignificant. But oil would behave very differently with frequencies many times as great, for even though the displacements be small, if the frequency were much greater considerable work might be performed in the oil.

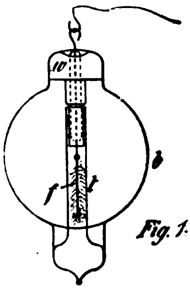

Fig. 10

Showing the Influence of the Conductivity of the Medium upon Electrostatic Actions through Measurable Distance.

The electrostatic attractions and repulsions between bodies of measurable dimensions are, of all the manifestations of this force, the first so-called *electrical* phenomena noted. But though they have been known to us for many centuries, the precise nature of the mechanism concerned in these actions is still unknown to us, and has not been ever quite satisfactorily explained. What kind of mechanism must that be? We cannot help wondering when we observe two magnets attracting and repelling each other with a force of hundreds of pounds with apparently nothing between them. We have in our commercial dynamos magnets capable of sustaining in mid-air tons of weight. But what are even these forces acting between magnets when compared with the tremendous attractions and repulsions produced by electrostatic force, to which there is apparently no limit as to intensity. In lightning discharges bodies are often charged to so high a potential that they are thrown away with inconceivable force and torn asunder or shattered into fragments. Still even such effects cannot compare with the attractions and repulsions which exist between charged molecules or atoms, and which are sufficient to project them with speeds of many kilometers a second so that under their violent impact bodies are rendered highly incandescent and are volatilized. It is of special interest for the thinker who inquires into the nature of these forces to note that whereas the actions between individual molecules or atoms occur seemingly under any condition, the attractions and repulsions of bodies of measurable dimensions imply a medium possessing insulating properties. So, if air, either by being rarefied or heated, is rendered more or less conducting, these actions between two electrified bodies practically cease, while the actions between the individual atoms continue to manifest themselves.

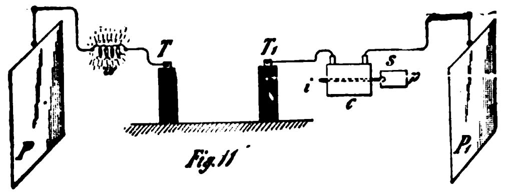

Fig. 11

Showing Effects of Currents flowing through Open Circuits.

An experiment may serve as an illustration and as a means of bringing out other features of interest. Some time ago I showed that a lamp filament or wire mounted in a bulb and connected to one of the terminals of a high tension secondary coil is set spinning, the top of the filament generally describing a circle. This vibration was very energetic when the air in the bulb was at ordinary pressure and became less energetic when the air in the bulb was strongly compressed. It ceased altogether when the air was exhausted so as to become comparatively good conducting. I found at that time that no vibration took place when the bulb was very highly exhausted. But I conjectured that the vibration which I ascribed to the electrostatic action between the walls of the bulb and the filament should take place also in a highly exhausted bulb. To test this under conditions which were more favorable, a bulb like the one in Fig. 10 was constructed. It comprised a globe *b* in the neck of which was sealed a platinum wire *w* carrying a thin lamp filament *f*. In the lower part of the globe a tube *t* was sealed so as to surround the filament. The exhaustion was carried as far as it was practicable with the apparatus employed.

This bulb verified my expectation, for the filament was set spinning when the current was turned on, and became incandescent. It also showed another interesting feature bearing upon the preceding remarks, namely, when the filament had been kept incandescent some time the narrow tube and the space inside were brought to an elevated temperature, and as the gas in the tube then became conducting, the electrostatic attraction between the glass and the filament became very weak or ceased and the filament came to rest. When it came to rest it would glow far more intensely. This was probably due to its assuming the position in the centre of the tube where the molecular bombardment was most intense, and also partly to the fact that the individual impacts were more violent and that no part of the supplied energy was converted into mechanical movement. Since, in accordance with accepted views, in this experiment the incandescence must be attributed to the impacts of the particles, molecules or atoms in the heated space, these particles must therefore, in order to explain such action, be assumed to behave as independent carriers of electric charges immersed in an insulating medium; yet there is no attractive force between the glass tube and the filament, because the space in the tube is, as a whole, conducting.

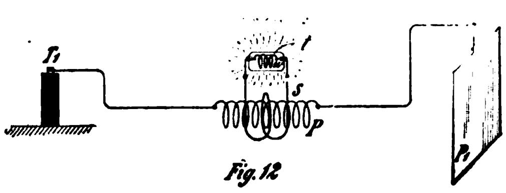

Fig. 12

Conversion on Open Circuit with Coil and Insulated Plate.

It is of some interest to observe in this connection that whereas the attraction between two electrified bodies may cease owing to the impairing of the insulating power of the medium in which they are immersed the repulsion between the bodies may still be observed. This may be explained in a plausible way. When the bodies are placed at some distance in a poorly conducting medium, such as slightly warmed or rarefied air, and are suddenly electrified, opposite electric charges being imparted to them, these charges equalize more or less by leakage through the air. But if the bodies are similarly electrified there is less opportunity afforded for such dissipation; hence the repulsion observed in such case is greater than the attraction. Repulsive actions in a gaseous medium are however, as Prof. Crookes has shown, enhanced by molecular bombardment.

ON CURRENT OR DYNAMIC ELECTRICITY PHENOMENA.

So far, I have considered principally effects produced by a varying electrostatic force in an insulating medium such as air. When such a force is acting upon a conducting body of measurable dimensions, it causes within the same, or on its surface, displacements of the electricity and gives rise to electric currents, and these produce another kind of phenomena, some of which I shall presently endeavor to illustrate. In presenting this second class of electrical effects, I will avail myself principally of such as are producible without any return circuit, hoping to interest you the more by presenting these phenomena in a more or less novel aspect.

It has been for a long time customary, owing to the limited experience with vibratory currents, to consider an electric current as something circulating in a closed conducting path. It was astonishing at first to realize that a current may flow through the conducting path even if the latter be interrupted, and it was still more surprising to learn that sometimes it may be even easier to make a current flow under such conditions than through a closed path. But that old idea is gradually disappearing, even among practical men, and will soon be entirely forgotten.

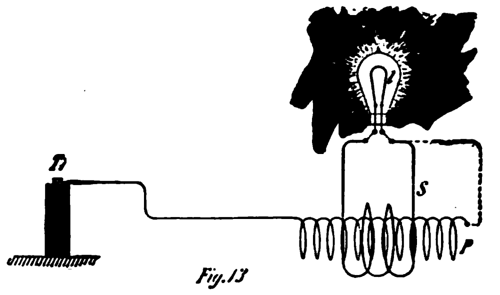

Fig. 13

Conversion on Open Circuit with Coil Alone.

If I connect an insulated metal plate P, Fig. 11, to one of the terminals T of the induction coil by means of a wire, though this plate be very well insulated, a current passes through the wire when the coil is set to work. First I wish to give you evidence that there *is* a current passing through the connecting wire. An obvious way of demonstrating this is to insert between the terminal of the coil and the insulated plate a very thin platinum or German silver wire *w* and bring the latter to incandescence or fusion by the current. This requires a rather large plate or else current impulses of very high potential and frequency. Another way is to take a coil C, Fig. 11, containing many turns of thin insulated wire and to insert the same in the path of the current to the plate. When I connect one of the ends of the coil to the wire leading to another insulated plate P, and its other end to the terminal T_1 of the induction coil, and set the latter to work, a current passes through the inserted coil C and the existence of the current may be made manifest in various ways. For instance, I insert an iron core *i* within the coil. The current being one of very high frequency, if it be of some strength, will soon bring the iron core to a noticeably higher temperature, as the hysteresis and current losses are great with such high frequencies. One might take a core of some size, laminated or not, it would matter little; but ordinary iron wire one-sixteenth or one-eighth of an inch thick is suitable for the purpose. While the induction coil is working a current traverses the inserted coil and only a few moments are sufficient to bring the iron wire *i* to an elevated

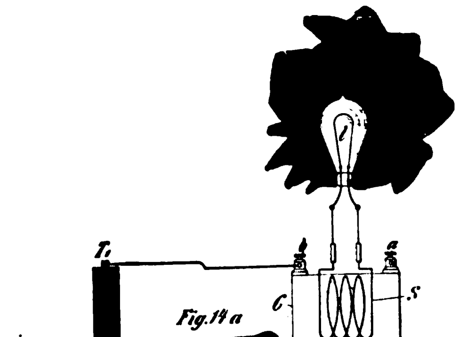

Fig. 14 a

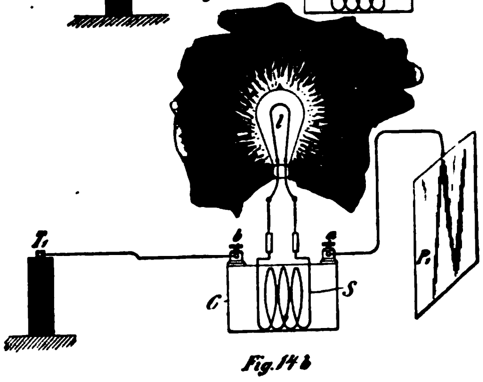

Fig. 14 b

Effect of Attached Plate with Low Frequencies.

temperature sufficient to soften the sealing wax *s* and cause a paper washer *p* fastened by it to the iron wire to fall off. But with the apparatus such as I have here, other much more interesting demonstrations of this kind can be made. I have a secondary S, Fig. 12, of coarse wire, wound upon a coil similar to the first. In the preceding experiment the current through the coil C, Fig. 11, was very small, but there being many turns a strong heating effect was nevertheless produced in the iron wire. Had I passed that current through a conductor in order to show the heating of the latter, the current might have been too small to produce the effect desired. But with this coil provided with a secondary winding, I can now transform the feeble current of high tension which passes through the primary P into a strong secondary current of low tension, and this current will quite certainly do what I expect. In a small glass tube (*t*, Fig. 12,) I have enclosed a coiled platinum wire *w*, this merely in order to protect the wire. On each end of the glass tube is sealed a terminal of stout wire to which one of the ends of the platinum wire *w* is connected. I join the terminals of the secondary coil to these terminals and insert the primary *p* between the insulated plate P_1 and the terminal T_1 of the induction coil as before. The latter being set to work, instantly the platinum wire *w* is rendered incandescent and can be fused even if it be very thick.

Instead of the platinum wire I now take an ordinary 50-volt 16 C. P. lamp. When I set the

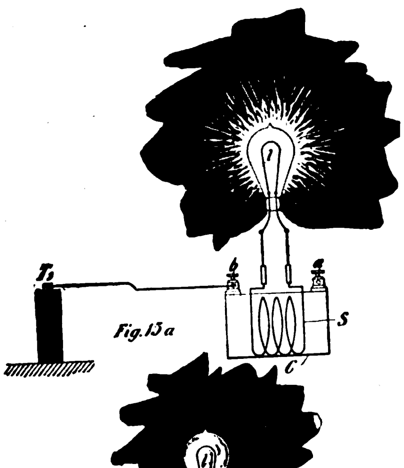

Fig. 15 a

Fig. 15 b

Effect of Attached Plate with High Frequencies.

induction coil in operation the lamp filament is brought to high incandescence. It is, however, not necessary to use the insulated plate, for the lamp (*l*, Fig. 13,) is rendered incandescent even if the plate P_1 be disconnected. The secondary may also be connected to the primary as indicated by the dotted line in Fig. 13, to do away more or less with the electrostatic induction or to modify the action otherwise.

I may here call attention to a number of interesting observations with the lamp. First, I disconnect one of the terminals of the lamp from the secondary S. When the induction coil plays, a glow is noted which fills the whole bulb. This glow is due to electrostatic induction. It increases when the bulb is grasped with the hand and the capacity of the experimenter's body thus added to the secondary circuit. The secondary, in effect, is equivalent to a metallic coating, which would be placed near the primary. If the secondary, or its equivalent, the coating, were placed symmetrically to the primary, the electrostatic induction would be nil under ordinary conditions, that is, when a primary return circuit is used, as both halves would neutralize each other. The secondary *is* in fact placed symmetrically to the primary, but the action of both halves of the latter when only one of its ends is connected to the induction coil is not exactly equal; hence electrostatic induction takes place, and hence the glow in the bulb. I can nearly equalize the action of both halves of the primary by connecting the other free end of the same to the insulated plate, as in the preceding experiment. When the plate is connected the glow disappears. With a smaller plate it would not entirely disappear and then it would contribute to the brightness of the filament when the secondary is closed by warming the air in the bulb.

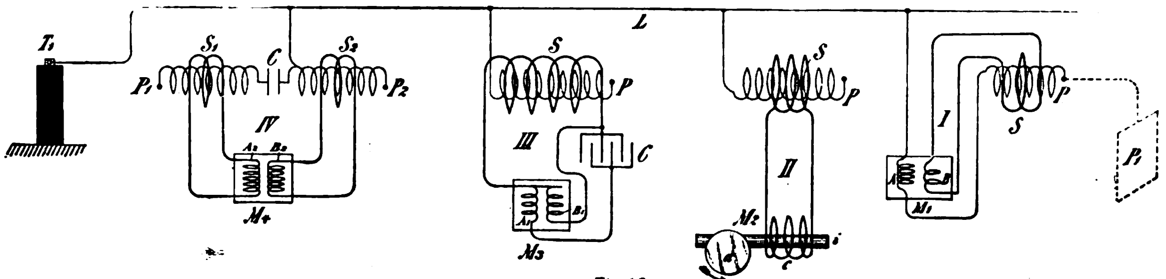

Fig. 16

Ways of Operating Motors with Only One Lead.

To demonstrate another interesting feature, I have adjusted the coils used in a certain way. I first connect both the terminals of the lamp to the secondary, one end of the primary being connected to the terminal T_1 of the induction coil and the other to the insulated plate P_1 as before. When the current is turned on, the lamp glows brightly, as shown in Fig. 14*b*, in which C is a fine wire coil and S a coarse wire secondary wound upon it. If the insulated plate P_1 is disconnected, leaving one of the ends *a* of the primary insulated, the filament becomes dark or generally it diminishes in brightness (Fig. 14*a*). Connecting again the plate P_1 and raising the frequency of the current I make the filament quite dark or barely red, Fig. 15*b*. Once more I will disconnect the plate. One will of course infer that, when the plate is disconnected the current through the primary will be weakened, that therefore the E. M. F. will fall in the secondary S, and that the brightness of the lamp will diminish. This might be the case, and the result can be secured by an easy adjustment of the coils, also by varying the frequency and potential of the currents. But it is perhaps of greater interest to note that the lamp increases in brightness when the plate is disconnected (Fig. 15*a*). In this case all the energy the primary receives is now sunk into it, like the charge of a battery in an ocean cable, but most of that energy is recovered through the secondary and used to light the lamp. The current traversing the primary is strongest at the end *b* which is connected to the terminal T_1 of the induction coil, and diminishes in strength towards the remote end *a*. But the dynamic inductive effect exerted upon the secondary S is now greater than before, when the suspended plate was connected to the primary. These results might have been produced by a number of causes. For instance, the plate P_1 being connected, the reaction from the coil C may be such as to diminish the potential at the terminal T_1 of the induction coil, and therefore weaken the current through the primary of the coil C. Or the disconnecting of the plate may diminish the capacity effect with relation to the primary of the latter coil to such an extent that the current through it is diminished, though the potential at the terminal T_1 of the induction coil may be the same or even higher. Or the result might have been produced by the change of phase of the primary and secondary currents and consequent reaction. But the chief determining factor is the relation of the self-induction and capacity of coil C and plate P_1 and the frequency of the currents. The greater brightness of the filament in Fig. 15*a* is, however, in part due to the heating of the rarefied gas in the lamp by electrostatic induction, which, as before remarked, is greater when the suspended plate is disconnected.

Still another feature of some interest I may here bring to your attention. When the insulated plate is disconnected and the secondary of the coil opened, by approaching a small object to the secondary, but very small sparks can be drawn from it, showing that the electrostatic induction is small in this case. But upon the secondary being closed upon itself or through the lamp, the filament glowing brightly, strong sparks are obtained from the secondary. The electrostatic induction is now much greater, because the closed secondary determines a greater flow of current through the primary and principally through that half of it which is connected to the induction coil. If now the bulb be grasped with the hand, the capacity of the secondary with reference to the primary is augmented by the experimenter's body and the luminosity of the filament is increased, the incandescence now being due partly to the flow of current through the filament and partly to the molecular bombardment of the rarefied gas in the bulb.

The preceding experiments will have prepared one for the next following results of interest, obtained in the course of these investigations. Since I can pass current through an insulated wire merely by connecting one of its ends to the source of electrical energy, since I can induce by it another current, magnetize an iron core, and in short perform all operations as though a return circuit were used, clearly I can also drive a motor by the aid of only one wire. On a former occasion I have described a simple form of motor comprising a single exciting coil, an iron core and disc. Fig. 16 illustrates a modified way of operating such an alternate current motor by currents induced in a transformer connected to one lead, and several other arrangements of circuits for operating a certain class of alternate motors founded on the action of currents of differing phase. In view of the present state of the art it is thought sufficient to describe these arrangements in a few words only. In the diagram, Fig. 16 II shows a primary coil P connected with one of its ends to the line L leading from a high tension transformer terminal T_1. In inductive relation to this primary P is a secondary S of coarse wire in the circuit of which is a coil C. The currents induced in the secondary energize the iron core *i*, which is preferably, but not necessarily, subdivided, and set the metal disc *d* in rotation. Such a motor M_2, as diagrammatically shown in Fig. 16 II, has been called a "magnetic lag motor," but this expression may be objected to by those who attribute the rotation of the disc to eddy currents circulating in minute paths when the core *i* is finally subdivided. In order to operate such a motor effectively on the plan indicated, the frequencies should not be too high, not more than four or five thousand, though the rotation is produced even with ten thousand per second, or more.

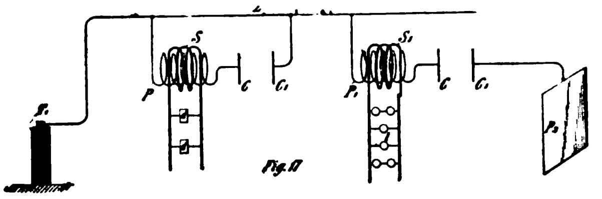

Fig. 17

Single Wire Conversion and Distribution, with Simple Means for Regulating the Effects.

In Fig. 16 I, a motor M_1, having two energizing circuits, A and B, is diagrammatically indicated. The circuit A is connected to the line L and in series with it is a primary P, which may have its free end joined to an insulated plate P_1 such connection being indicated by the dotted lines. The other motor circuit B is connected to the secondary S, which is in inductive relation to

(*Continued on Page* 319.)

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Hawks in the Eagle's Nest.

It would be very interesting to know just what has secured for a number of electrical fakes the privileges of space in the Electricity Building. That these privileges were willingly given by Mr. Hornsby is beyond belief, and yet there are exhibits, more than half a dozen in number, which would not be tolerated even in a respectable country fair.

Some months ago the official announcement went out that a close scrutiny would be made, and that no fakes would be admitted. Hence members of the fraternity generally, and exhibitors in particular, have rested in confidence; and now at the last moment, with the Fair well under way, the fakes omnipresent and presumably protected by permits, redress will be difficult if not impossible.

It would be unjust to characterize all the exhibits of electro-medical apparatus as fakes, as there are several reputable manufacturers represented whose displays must have a wholesome educational effect. But there are as many more of the other kind.

There is little doubt that this subject will be taken up in earnest by the entire electrical press. It is a service due to the public and to the art to make it as plain as possible just where the line should be drawn. That line must be far above "Actina," an "electrical" eye remedy, exhibited by the New York and London Electrical Association, which has a handsome booth at the very head of newspaper row. It is an unqualified fraud.

Directly opposite the booth of the *Electrical World* is a fake of a different nature. It is not medicinal, even in the claims of its boomers. In the opinion of the newspaper men who are compelled to endure its presence, its effect is directly the opposite of medicinal. In fact, it will lead to riot or a more serious offence if it is not speedily removed.

We refer to the abomination of abominations, the "electrical" hand-organ, which is even now, while this is being written, groaning out "Ta-ra-ra-boom-de-ay."

* * *

Water Powers.

The use of electricity is slowly but surely fulfilling the well-known predictions which have been made for it in the direction of power transmission from natural sources to the place of consumption, and this is especially true in the Western part of the country, where water power is often plentiful and the price of coal is invariably high.

Although there is great division of opinion as to the most efficient and practical system of current distribution, there are enough examples of long distance transmission from water powers now in operation to prove its value, and as the requirements which will secure greater efficiency can only be attained by a process of gradual evolution resulting from experience, it promises well for the future that the subject is receiving attention at present with the methods now at hand.

There is a tendency among users of electrical machinery to put off the introduction of a plant of this character until some new and superior method is introduced, and the rapidity of progress in electrical work is perhaps sufficient to account for this feeling, but the experience of the past ten years shows that waiting for the newest electrical device would mean to wait indefinitely as new schemes are proposed almost daily. In these applications of electricity the use of a high potential system is imperative on account of the cost of the lines, and whatever system is used must be capable of converting the current into power as well as light. The simple alternating current has solved the latter case, and current for lighting has been transmitted to considerable distances with good economy for several years.

The transmission of power, however, involves considerable more difficulty and is accomplished with a much lower efficiency. In many cases the single phase alternating current motor or the dynamo reversed will answer the requirements if the machines are not required to start under load, but as this condition is not always avoidable, other systems have been advanced to meet this objection. The use of direct constant potential currents with dynamotors for increasing the pressures at the station end of the line and reducing them at the point of consumption has been found feasible in some places, and the multiphase alternating systems, as well as the continuous direct current, have been introduced for the purpose of employing self-starting motors.

The question of efficiency is not of paramount importance where a sufficient water power exists. It is more often the first cost of construction that decides the question of electric transmission. The many places where water power abounds should be sufficient incentive for vigorous work in this direction, and now that it has been found feasible there will doubtless follow an era of electric power transmission in the same manner that electric lighting and railways were introduced as soon as they had been proved a success.

* * *

Through by Lightning.

The Chicago-St. Louis electric railway, which it was announced would be ready in time for the World's Fair traffic, on which a liberal portion of the road's receipts were based, has not for some time been prominently heard of, and as the contract for the electrical equipment of this road has only just been let it is not probable that many of the visitors to Chicago this summer will be able to enjoy the promised ride at a speed of one hundred miles an hour. From the description of this road and its financial status presented by Dr. Adams, about a year ago, before the New York Electric Club, the loss of patronage which the World's Fair was expected to furnish might be considered a somewhat severe blow to its prospects, as at that time it was estimated that $15,000,000 in fares would be received from visitors to the World's Fair, which would pay for the road two and a half times over. A single power station was at first supposed to be sufficient, but this was afterwards increased to two and recently to four stations, and the idea of utilizing water powers along the route has been abandoned. With a few more modifications in the plans, the road will be robbed of its novel characteristics and will bear a strong resemblance to the less pretentious electric railways now in common use.

Testing Coal by Electricity.

It is not, perhaps, too great a flight of imagination, says the *Electrical Review* (London), to assign this title to a method which W. Hempel has recently devised for use in determining the character of coal. Sulphur is a troublesome constituent which the gas companies would rather have absent from than present in their coals; moreover it seriously impairs the quality of the gas produced. The "monopolists" recognize *now* that they must strain every point in order to produce good gas; this has been forced upon them by competition, hence in this respect, too, electricity has done the public good service. W. Hempel is one of the leading authorities on coal-gas in Germany, and he has recently adapted a method, first devised in more complex form by Berthelot, whereby the sulphur in coals may be estimated, and hence their suitability for gas-making determined before purchase. In doing this he has taken advantage of the cosmopolitan aid which electricity offers. The coal to be tested is powdered and pressed into a little platinum wire cylinder, to which a long platinum wire is attached, and then burned. The combustion is effected in an ordinary glass bottle, which is fitted with a trebly perforated indiarubber stopper. Through this passes a tube with a glass stopcock, and which widens out into a cylinder; also two glass tubes, to the lower ends of which are fused two long thick platinum wires. One of these wires carries the little platinum cylinder or basket already referred to. A little mercury is poured into the tube so as to establish sure contact with wires which lead the electricity. When the current is passed the platinum basket becomes white hot, the combustion of the coal is effected, and the gaseous products containing the sulphur compounds are led off through the stopcock and examined chemically. This method is exceedingly neat, and gives, it is said, very satisfactory results, which enable the character of the coal to be accurately determined.

Lighting Statistics in Switzerland.

Statistics just published by Prof. Dezler of the Zurich Polytechnic School regarding the uses of electricity in Switzerland show that at the close of 1892 there were in operation 562 electric light installations, 53 plants for the transmission of power, 121 batteries of accumulators, and 1,056 dynamos and electromotors. The total capacity in kilowatts was 20,623, the number of incandescent lamps was 115,926 and of arc lamps 1,746. There were thirty-eight firms engaged in electrical works, seven of which were established last year.

Patent Office Exhibits at Chicago.

The Government Building contains a large number of models of early electrical inventions, among which is a model of a magnetic machine invented by Pixii in 1832, an engine by M. H. Jacobis in 1834, magnetic motor by Joseph Henry and an electric motor by Thos. Davenport in 1837. There are also more modern models of Gramme, Sims, Farmer, Fuller, Weston, Brush, Edison, Thomson, Houston and others. Besides these models of motors and dynamos there are others of arc lamps, meters, welding machines, converters, telephone and telegraph apparatus. There are also shown in this building samples of the apparatus used by the U. S. Signal Corps, both the stationary and portable sets.

The Societé Nationale des Sciences et des Arts Industriels, of Paris, are about to open an exhibition of all branches of trade in which electrical goods will form an important group.

(*Continued from Page* 317.)

the primary P. When the transformer terminal T_1 is alternately electrified, currents traverse the open line L and also circuit A and primary P. The currents through the latter induce secondary currents in the circuit S, which pass through the energizing coil B of the motor. The currents through the secondary S and those through the primary P differ in phase 90 degs., or nearly so, and are capable of rotating an armature placed in inductive relation to the circuits A and B.

In Fig. 16 III, a similar motor M_2 with two energizing circuits A_1 and B_1 is illustrated. A primary P connected with one of its ends to the line L has a secondary S, which is preferably wound for a tolerably high E. M. F., and to which the two energizing circuits of the motor are connected, one directly to the ends of the secondary and the other through a condenser C, by the action of which the currents traversing the circuit A_1 and B_1 are made to differ in phase.

In Fig. 16 IV still another arrangement is shown. In this case two primaries P_1 and P_2 are connected to the line L, one through a condenser C of small capacity, and the other directly. The primaries are provided with secondaries S_1 and S_2, which are in series with the energizing circuits A_2 and B_2 and a motor M_2, the condenser C again serving to produce the requisite difference in the phase of the currents traversing the motor circuits. As such phase motors with two or more circuits are now well known in the art, they have been here illustrated diagrammatically. No difficulty whatever is found in operating a motor in the manner indicated or in similar ways, and although such experiments up to this day present only scientific interest, they may at a period not far distant be carried out with practical objects in view.

It is thought useful to devote here a few remarks to the subject of operating devices of all kinds by means of only one leading wire. It is quite obvious that when high-frequency currents are made use of, ground connections are—at least when the E. M. F. of the currents is great—better than a return wire. Such ground connections are objectionable with steady or low frequency currents on account of destructive chemical actions of the former and disturbing influences exerted by both on the neighboring circuits; but with high frequencies these actions practically do not exist. Still, even ground connections become superfluous when the E. M. F. is very high, for soon a condition is reached when the current may be passed more economically through open than through closed conductors. Remote as might seem an industrial application of such single wire transmission of energy to one not experienced in such lines of experiment, it will not seem so to anyone who for some time has carried on investigations of such nature. Indeed I cannot see why such a plan should not be practicable. Nor should it be thought that for carrying out such a plan currents of very high frequency are implicitly required, for just as soon as potentials of say 30,000 volts are used the single wire transmission may be effected with low frequencies, and experiments have been made by me from which these inferences are made.

When the frequencies are very high it has been found in laboratory practice quite easy to regulate the effects in the manner shown in diagram Fig. 17. Here two primaries P and P are shown, each connected with one of its ends to the line L and with the other end to the condenser plates C and C^1, respectively. Near these are placed other condenser plates C_1 and $C^1{}_1$, the former being connected to the line L and the latter to an insulated larger plate P_2. On the primaries are wound secondaries S and S_1 of coarse wire, connected to the devices *m* and *d* respectively. By varying the distance of the condenser plates C and C^1, and C_1 and $C_1{}^1$, the currents through the secondaries S and S_1 are varied in intensity. The curious feature is the great sensitiveness, the slightest change in the distance of the plates producing considerable variations in the intensity or strength of the currents. The sensitiveness may be rendered extreme by making the frequency such that the primary itself without any plate attached to its free end satisfies, in conjunction with the closed secondary, the condition of resonance. In such condition an extremely small change in the capacity of the free terminal produces great variations. For instance, I have been able to adjust the conditions so that the mere approach of a person to the coil produces a considerable change in the brightness of the lamps attached to the secondary. Such observations and experiments possess of course at present chiefly scientific interest, but they may soon become of practical importance.

(*To be continued.*)

Gas Engine Sub-Stations.

We have more than once referred to the likelihood of gas engine sub-stations taking the place of electrical converter sub-stations where circumstances are favorable. The two essentials required are that coal should be abundant, and therefore cheap, and that the lighting should cover an area having compact districts, each of which could be supplied from a sub-generating station. The patchy character of such lighting is one which exists in several of our North country towns. In these, too, the gas monopoly is largely in the hands of the local authorities, which is an important point to consider when a municipal electricity supply is projected. The generating station would then be the gas works, and the high pressure feeders of a converted supply system would give place to gas mains. The Dowson gas plant would, in all probability, be that adopted, if existing works were not under municipal control; and, judging from the examples of this system which are at work, every confidence could be felt in the adoption of such a scheme. The Popp system in Paris would have possessed a much more valuable concession if gas had been taken as the medium for first distribution instead of compressed air. An additional argument in favor of gas engines used in this way has been afforded by the publication of figures as to the cost of lighting a large building by electricity from a private plant. It was there found, by exact experiment extending over two years, that with gas at 2s. 9d. per 1,000 cubic feet, the cost of gas worked out at 1·1 pence per unit generated, the total cost coming to 3d. per unit, including attendance, interest and depreciation of plant, etc. The resultant economy showed a saving of 12½ per cent. per annum in favor of electricity. It is rather a coincidence that Prof. Kennedy's estimate of the engine room cost per unit generated by the Westminster Company for this year should be the same figure, viz., 1·1 pence. We have recently devoted some attention to Liverpool electric lighting, and there the local circumstances have caused the company to go in for four generating stations rather than sub-station converters on a high tension system. The special knowledge of the managing engineer must have been the cause of their taking this course, and they express themselves as convinced of its wisdom. Here, again, is an argument in favor of gas engine sub-stations, for if economy is in favor of several stations rather than a single one of greater size, it seems not unlikely that when greater attention is paid to the gas engine in large sizes, and suitable means are taken to draw attention to the fact that such are to be obtained, some of the numerous supply concerns will find it to their interest to look very closely into the question, and to end by making a practical trial on a sufficiently large scale to prove that electricity can be so generated efficiently and commercially.

Mr. McMullen, who himself is advising a local authority, recently stated that one of the principal objections to gas engines was the varying crank effort. He assumes because a gas engine has a velocity which is susceptible of considerable variation throughout a complete stroke, therefore it must be unsuited to drive alternators. Were it necessary to run alternating machines parallel to obtain commercial success it would be another matter, but the engineer of one of our most successful stations has definitely and distinctly stated that from economic and financial considerations such a method of running is not essential. It may be, in some respects, advantageous and helpful, but need not stand in the way of alternator systems using gas engines as prime movers. If parallel running were so necessary the Metropolitan Company with their Willans alternator direct-coupled sets would be badly off, but the consensus of opinion is gradually, but surely, tending to a calmer and more impartial review of the *pros* and *cons* of what was once a burning question.—*Electrical Review*, London.

World's Fair Notes.

During the past week the electric fountains, located in the grand basin and about which so much has been written, were given their first public trial. The fountains, two in number, are situated on each side of the MacMonnies fountain and on account of their conspicuous position were supposed to be one of the leading evening attractions on the grounds. Owing to a lack of pressure on the water mains the jets of water did not ascend to the height expected and were therefore somewhat disappointing to the large crowd of visitors attracted to the grounds by the notice given out in the daily programmes. The principal trouble seems to arise from the fact that the water mains were not figured to stand the pressure required to force the water to the height specified by the fountain engineers.

In order to introduce an electrical feature into the French piano exhibit, located in the gallery of the Electricity Building, the manager of the exhibit has arranged a piano and a hand organ to run by electric motors. With this accession there is some pretense for having this exhibit located in the Electrical building.

Mr. Geo. Carter, manager of the Ansonia Electrical Company's exhibit at the Fair, reports among the many other sales made through their display a sale of a large variety of electrical heating apparatus.

The large Ferris wheel was given its first complete turn last week. The wheel consists virtually of two wheels mounted on a single axle. The thirty-six cars are supported about the circumference and travel around a circle 250 feet in diameter. The Ferris Wheel Company have installed a small electric light plant in their boiler room with which they intend to illuminate all of the cars and different portions of the wheel with incandescent lights.

A High-Speed Package Railway.

The transportation of mail matter and packages at a speed of 300 miles per hour is the object of a device invented by Albert L. Widdis, of Detroit, a model of which is now on exhibition at the World's Fair. It is an elevated railway with electricity as the motive power, and in appearance the car resembles a long, rectangular box, terminating at one end in a pyramidal projection running to a sharp point. This is the forward end of the car and is intended to reduce the resistance of the air. This car is suspended by iron hangers from four wheels 2 feet 6 inches in diameter, which in turn rest on a single bar of ordinary T-rail stretched on arms projecting from a line of poles. The patent cash carriers in use in many large shops closely resemble the method of suspension from a single rail employed by Mr. Widdis. Below this T-rail is an I beam which serves at once as a guide and a support and which prevents the wheels from leaving the main track. In the centre of the car is a specially designed electric motor of small weight and power that drives the car by means of sprocket wheels and link belts. The current to operate this motor is taken from a wire strung above the track by a trolley wheel much after the manner of the ordinary electric street car. The electric power is to be applied from generating stations at points along the route. Very little power is required. It is estimated that eleven horse-power will propel a 1,000 pound car with its load at the rate of 500 miles an hour.

The stopping of the car is done automatically in the following manner:

A lever projecting from the car comes in contact with a projection or arm from a post near a station which throws the lever backward and it catches in a corrugation. This cuts off the current, sets the brakes, and the car comes to a stop in front of the station. It may be well to explain here that there are both local and through cars. The lever or projection on the through car comes in contact with projections at central or terminal points only, while the lever on the local car comes in contact with the projection at every station, and the device in the local car is so arranged that it automatically throws open a switch, and the car runs in and stops in front of the station.

As the car passes along its route the bags or packages are automatically dropped at the proper place. This is accomplished by means of a lever coming in contact with a projection from a stanchion in front of the station. This lever works on a sprocket chain, on which there is a catch in the form of an acute angle, which as it passes around releases the bag which drops into a net. The storage compartments are bottomless to admit of this being done.

Patents on this system have been taken out by Mr. Widdis, and an experimental line near Detroit is to be constructed in order to put the system to a practical test.

Discharge through Gases.

A paper was read recently before the Royal Society by Prof. J. J. Thomson, F.R.S., on "Electrolysis of Steam," in which the repeated discharge of electricity through gaseous matter, noticed as ribbon flashes in lightning, is thus explained: "When an electric discharge passes through a gas, the properties of the gas in the neighborhood of the line of discharge are modified. Thus, as Hittorf and Schuster have shown, the gas in the neighborhood of the discharge is no longer an insulator, but can transmit a current under a very small potential difference. Faraday's remark, that when once a spark had passed through a gas the passage of another following immediately is very much facilitated, is another example of the same thing. We have thus good reasons for believing that when a spark passes through a gas it produces a supply of a modification of the gas, whose conductivity is enormously greater than that of the original gas. I have shown (*Phil. Mag.*, November, 1891,) that the conductivity of this modified gas is comparable with that of strong solutions of electrolytes. When the discharge stops, this modified gas goes back to its original condition. If now the discharges through the gas follow each other so rapidly that the modified gas produced by one discharge has not time to turn to its original condition before the next discharge passes, the successive discharges will pass through this modified gas. If, on the other hand, the gas has time to revert to its original condition before the next discharge passes, then the discharges pass through the unmodified gas. We regard this as being accomplished by means of successive decompositions and recombinations of its molecules, analogous to those which, on Grotthos's theory of electrolysis, occur when a current passes through an electrolyte."

Electricity to the Rescue.

During the whole of last week Barnum and Bailey's "Greatest Show on Earth" has been exhibiting in Boston along Huntington avenue. The crowds that have patronized the show have exceeded anything in past years, and how they were to be transported from the city to the show grounds was a problem the directors of the West End Railroad had to face and solve. To do this, the company actually put in special switches and turn-outs by means of which they were enabled to put on an extra service of electric cars. This prevented all possibility of interference with the regular traffic along the avenue, which is at all times heavy, so that the quarter million circus goers were accommodated in first-rate style, reflecting credit on the management of the road and demonstrating the value of electric propulsion.

Current Items.

A correspondent of the Philadelphia *Ledger*, writing of the exhibits in the Electricity Building, says: "I was disappointed in finding the business altogether in the hands of big corporations, with the inventors who developed and made possible the whole business so completely suppressed that even their names have almost disappeared. The building, however, remains for the general visitor one of the most interesting of the group."

At San Bernardino, Cal., representatives of the electric light company have been quietly at work on a project designed to supply the city of Los Angeles with electric power for lighting, railway and manufacturing purposes. "High up on the sides of Old Baldy, near the head waters of San Gabriel River," according to a press dispatch, "these men, after long-continued search, found an abandoned ditch and tunnel, used in early days for hydraulic mining, but abandoned over twenty years ago, which develops, according to careful estimates of engineers, 3,000 horse power in a fall of 700 feet. Work was begun last December in cleaning out the old ditch and repairing the tunnel, and is still going on. Lumber for the flumes has been packed on burros. A complete electric light plant has been secured, to be put into position when the other preliminary work has been done."

At the electric scenic theatre on the Midway Plaisance at the World's Fair, the performance is given in a fair-sized auditorium which during the display is dark. In front there is a miniature stage and through this opening the light effects upon the scenic production are given. The display consists of the Bay of Naples and Swiss scenery shown by sunlight and moonlight, the Alps during a thunderstorm and many other beautiful reproductions of scenery. The electric arrangement is such as to bring out the finest effects of the paintings.

Electricity promises to revolutionize the art of brickmaking by greatly reducing the amount of labor required. Instead of laboriously building a kiln, all that is necessary is to fit the clay into sets of iron molds with covers which contain 1,000 bricks each. The covers are fastened on, the current applied, and the work of burning is done in a very short time. The covers detach themselves automatically, and the bricks are ready to be tumbled on the stock for sale.

A new tree insulator has been introduced which greatly simplifies the problem of attaching wires to trees so that they may in no way come in contact with the branches. The insulator proper is on a shaft which works in a ball and socket joint, the cup of which is made fast to the tree. It matters not how much the tree may be swayed by the wind, for the line is kept by this means in its normal position, and is thus effectually prevented from coming in contact with any part of the tree and grounding the circuit.

Space for a fort on a hill near London is being cleared of tree stumps by an electric root grubber or stump puller. The dynamo for supplying the current is about two miles from the hill. The current is taken by overhead wires on telegraph poles to the motor on the grubber carriage. By means of belting and suitable gearing the motor drives a capstan upon which is coiled a few turns of wire rope. A heavy chain is attached to the tree roots, and as the motor is set to work and the rope exerts its force the roots come up quietly one after the other.

In certain iron lamp posts used abroad for arc lights a number of ornamental projections are thrown out by turning a key, enabling the trimmer to climb up without the aid of a ladder. The turning of the key also short-circuits the switch, making the lamp safe to handle.

The telephone has lately been arranged for use of divers. A sheet of copper is used in place of one of the glasses in the helmet, and to this a telephone is fixed so that the diver, when at the bottom of the sea, has only to slightly turn his head in order to report what he sees, or receive instructions from above.

Legal Notes.

The American Bell Telephone Company and E. Berliner have filed their answer to the bill lodged by the Government to annul the Berliner patent in the United States Circuit Court for the District of Massachusetts. The answer is a general denial of all the charges made in the Government complaint, and avers that due diligence was observed in the prosecution of the case in the Patent Office; that as a matter of fact the patent was ready for issue as early as 1882, and that the patent would then have been issued but for the action of Examiner Brown, who rejected all its claims, and raised other objections—all of which could have been done before that date. This action was appealed from to the board of examiners-in-chief, who, in February, 1889, reversed the decision of the examiner. It is also averred in response to the complaint that no new matter was introduced into the amended specification filed in 1880, after the acquisition of the patent by the Bell Company. The Bell Company also aver that in the application for the Berliner patent all due forms of law were observed, and that the Government cannot repudiate the acts of its own agents established by the laws creating the Patent Office.

Two suits for damages are now pending in the Circuit Court at Bay City, Mich., against the West Bay City Street Railway Company. The first is that of Mrs. Hannah Barrett for an accident which happened during a thunder storm. The lady took hold of the handles on the rear end of the car just as she stepped off, and received a shock which rendered her insensible. The company claim that they are not responsible for the accident, any more than they would be responsible for a shock of lightning which struck a person on their premises. The electricity did not come from the car, they aver, but from the air, and this will be their defense. The other case is that of a boy who was playing on the track and went to catch on a car. The car stopped, and he was standing behind it when the motorman reversed the current and the car backed up. The lad did not have time to get out of the way, and was dragged along by the dashboard, and so severely injured that he died. Administrators of the estate, which consisted mainly in the damage claim, were appointed, and as the boy was under age the suit is brought by them. The amount asked is $10,000.

Benjamin F. Peach, of Boston, Mass., has brought suit through Rose, Hemingway & Rose, in the Pulaski Chancery Court as a stockholder in the Little Rock, Ark., City Electric Street Railway Company to the amount of $20,000, to wind up the affairs of the corporation, and divide its assets equally among the creditors. This suit is brought under the recent act of the Arkansas Legislature, which enables any stockholder in an insolvent corporation to file a bill in chancery to wind up its affairs, the laborers and employees alone having the first lien on the property. The bill prays the appointment of a receiver and the enjoining of certain judgment creditors whose judgments were recovered within ninety days before the filing of the suit from executing such judgments.

The Gloversville *Intelligencer* states that the minority stockholders of the Johnstown and Gloversville horse car line will bring a suit enjoining the majority from leasing the road to the Cayadutta Company, on the ground that the lease was the result of sharp practice by stockholders of the latter company in securing a majority of the stock of the horse car line, electing what the minority stockholders call a "dummy" board of directors, and leasing the line to the Cayadutta Company at a figure just about large enough to pay the interest on the bonds, thus making the stock held by the minority stockholders practically valueless.

The temporary injunction preventing the Thomson-Houston Company from taking possession of the machinery at the power-house of the San Francisco and San Mateo Railroad Company, San Francisco, has been removed by Judge Garber; but while the Thomson-Houston Company has obtained legal sanction to take the machinery, Behrend Joost, president of the railroad, says it will not do so, as he and the company have arrived at a satisfactory solution of their differences, and that the electric company is willing to wait a little while for the money which is due.

Messrs. Babbit & Laurence, counsel for Louis Diebold, has applied to the Chancellor in Jersey City for a rule to show cause why a receiver for the American Engineering Company should not be appointed. The American Engineering Company was incorporated under the laws of New Jersey to build and equip electric railways. Diebold claims that the company has suspended all ordinary business, and has been insolvent for six months. The Chancellor reserved his decision.

The New Haven (Conn.) *Journal* says the case of the Edison Electric Company against the Perkins Electric Lamp Company and that of the Edison Electric Company against the Mather Electric Company, infringement of patents being the basis of both actions, which were to have been heard in the United States Court last week, by agreement of counsel were postponed subject to future assignment.

The Detroit Electrical Works plant was sold on the 12th inst. on a foreclosure suit for $100,000. W. H. Wells bid that amount for Hugh McMillan, and it was the only offer made. Mr. McMillan held mortgages to the amount of $200,000, and Judge Reilly ordered the sale because of default in the payment of certain promissory notes given to Mr. McMillan for money which he had advanced.

The application of the several steam railroad companies at Norristown, Pa., for injunctions to restrain the trolley companies from crossing their tracks at grade has been denied by the Court, who holds that a change of motive power to electricity cannot increase the danger at the crossings, and therefore refuses to interfere.

The Edison Phonograph Company of New York has filed in the United States Circuit Court several bills of complaint against Thomas H. McDonald, of Bridgeport, Conn. It is claimed that the defendant has infringed the complainant's patents for phonographs.

A company has been formed, with works at Providence, R. I., for the manufacture of the Field electric car fender, a new invention. The fender extends in front of the car 24 inches, and is formed of a series of steel wires that curve from the platform in a gentle swell to the bar in the front of the fender which is a few inches above the track. A rod with a ratchet attachment runs from the back of the fender to the inside of the dasher terminating with a padded end which is placed at just the height of the motorman's knee, so that, in case of any obstruction on the track, the motorman, by pressing with his knee on the pad, which he can do without moving out of his position, causes the front of the fender to drop to the track and a series of rollers prevents it from binding on the rough pavement. The steel wires are very elastic and a body striking the fender is scooped up on to the wires owing to their elasticity, the weight bending the wires so as to prevent its rolling off in front of the car.

Personal.

It gave us much pleasure to receive a visit of Saturday from Mr. Morgan Brooks, President of the Electrical Engineering and Supply Company of St. Paul, Minn., who has come East on business connected with his company. Mr. Brooks informs us that his company intends removing their plant from St. Paul to Minneapolis early in July. They have secured a site there and will erect capacious buildings to accommodate the different branches of their manufacture, one of these being the well known Packard incandescent lamp, a great trade in which the company has secured.

Mr. H. M. Haines, the railroad representative who has accompanied a great many of the special trains carrying the delegates of the National Electric Light Association to the various conventions, has just accepted the office of treasurer of the American Traveller and Tourist Company, a concern which conducts a general railroad, steamship and steamboat business at 849 Broadway, New York City.

Electricity and National Economy.

So much nonsense has been talked about electricity and its capabilities that we are glad to note the signs of a healthy revival of thought and an increasing desire to shake loose of the fetters of the imagination so often permitted to run riot when matters electric are mentioned. To romance is one thing, to talk drivel another, and it is a pity that avowedly respectable papers of the American technical press should lend themselves to strengthen what tutored minds regard as mere vaporings of an enthusiastic and ultra-sanguine mind.

Mr. E. Tremlett Carter, who is well known as having been one of the pillars of the now defunct Hanover Square School of Electrical Engineering, has a smartly written article in a recent number of a London electrical contemporary, under the above title, and we commend its perusal as a wholesome antidote to the cloying and nerve-shaking results which follow from an extended dose of the American view of electric possibilities. The average American writer, when freed from the recital of facts and the calming influence of the almighty dollar, "would, as it were, take us to the summit of Olympus, from which deific height we may survey all the kingdoms of the future of the world and the glory thereof. From such a lofty pinnacle it may be an unpleasant fall to the plain level earth, and to the facts and figures of political economy; but we must make it."

Certainly electricity is far from being a "cure-all" when applied to the boils and sores of our unhealthy modern body political. If we may judge of its probable influences in this country in years to come from what we see in the United States, it rather seems to be an all-important factor in intensifying and multiplying those evils of which some would have us believe it is the sovereign remedy. The remedy *may* prove worse than the disease, and the Yankees are already crying out bitterly enough to be saved from their reputed savior.—*Industries.*

An Electric Riding Whip.

The following description has been given of an electric whip for the use of riders. In the handle, which is made of celuloid, is placed a coil of fine wire with a small battery attached to it. The wire is over 2,000 yards in length. The circuit is closed by means of a spring and the ends of the wire are led to the end of the whip and terminate in two points sharpened so as to pierce the skin of the horse without wounding it. The whole weight of the whip is less than one pound.

Mr. Harness and the "British Medical Journal."

In November last the *British Medical Journal* published the following paragraph: "We have good grounds for stating that the *Times* has recently refused a four-column advertisement from the Harness Electropathic Belt Establishment, of the value of £80, a course worthy of the high and honorable traditions of that journal." "This paragraph," says the *British Medical Journal*, "was, in fact, inserted in the *Journal* with the sole object of raising boldly between ourselves and Mr. Harness the question whether the business carried on by him was a legitimate and honest one, or the very reverse; and we were prepared, at any cost and trouble, to have this question fully and fairly tried by a jury, and to abide by their decision on the issue presented to them. Accordingly, on the action being commenced, we admitted that we had published the paragraph complained of, and justified what we had written. Our readers will perhaps not be altogether surprised to learn that Mr. Harness, after we put in our defense to his action, took no further steps in the matter. Determined to bring him to book, after waiting a reasonable time, we applied for an order that Mr. Harness should be compelled either to go on or to discontinue this action, and an order was accordingly made that unless he proceeded to give notice of trial and to enter his action for trial within twenty-one days, it should be dismissed with costs. After what we have already stated, our readers will doubtless anticipate the sequel. The twenty-one days elapsed. Mr. Harness abandoned his action, and the same was dismissed with costs, since paid by him. These costs, being what are termed party-and-party costs, necessarily do not represent the expenses which the association has been put to in preparing to meet and justify the paragraph which Mr. Harness has allowed to go against him unrefuted. That, however, is a very small matter. The result of this abortive action is a convincing proof that Mr. Harness was not prepared to meet the charges brought against him by the *Journal* in open court, and is conclusive that all we have said on the subject of Mr. Harness and his so-called electric belts has been fully justified."

In some country towns the first running of electric cars causes as lively a commotion as the entry of a circus, and even the usually self-possessed editor of the local sheet is not unmoved by the occurrence, but is apt to spread himself in an elaborate report of the "trial trip," mingling descriptions of the scenery by the wayside, the vibrations and oscillations of the car and other incidentals of the trip with analytical notes of the sensations produced in the editorial *corpus* by "electrical propulsion." In a late number of a country paper, over a lengthy report, we find the following heading: "Trip over the Electric Road—Ovation at County Capital—Crowds of Men, Women, Children and Barking Dogs Greet the First Cars—A Delightful and Easy Trip Run Over a Well Constructed Road—Two Journeys Made, One in the Afternoon and the Other in the Evening." After which follows a full column of narrative, interspersed with complimentary references to the projectors and builders of the road, the conductor, the motorman, the car, the trolley and the track, with a truly rural account of the convivial proceedings that took place after the trolley was off.

Boston Notes.

The subject of placing electric wires underground in the city of Lynn is engrossing more and more public attention. A special committee of the city council to investigate the matter has been appointed and gone to work. As the New England Telephone and Telegraph Company owns and operates about eighty per cent. of all the overhead wires in the shoe city, that company has made a proposition to the city council that, if acted upon and certain very reasonable concessions be made, will result in nearly all wires going underground in a short time. The New England Telephone Company has placed nearly all its wires underground in Boston with very satisfactory results to themselves, their customers and the public generally.

An electric fountain is to be erected on the common in Lynn. After the exact design has been selected the fountain will be erected in the centre of the pond and it is intended to have it one of the most attractive pieces of work in New England.

About every business man in Boston is complaining that after a large expenditure of time and money by the special commission appointed for the purpose, the bill for securing rapid transit in and around Boston, that has just become law, is of such a visionary character as to make it seem improbable that anything will ever be attempted under it, hence the number of men who are formulating plans to be submitted to the State Legislature when that august body reassembles in the autumn. Meantime the crowded streets and congested traffic on the West End Railroad continue, and no one can predict within say ten years when any change will be attempted, to say nothing about its being consummated.

The Thomson European Electric Welding Company, whose offices are in Boston, on Thursday last re-elected the directors--Oliver Ames, S. Endicott Peabody, N. Smith, B. F. Spinney, Prentiss Cummings, G. P. Messervy, Henry D. Hyde and Francis Peabody, Jr. The sale of the European patents has not yet been effected, but the agent has still five months' option remaining, during which period it is hoped he may close a deal. The English company is in abeyance for the present. The stock in this enterprise has not been subscribed for nearly so freely as was anticipated, hence the comparatively slow progress the company has thus far made.

A somewhat amusing incident occurred in the State Militia camp at Framingham, Mass., a few days ago as the result of a mistake made by a signalman, who to save his legs essayed to transmit an order or command by flag signal rather than by telephone. By this mistake a whole troop of cavalry mounted their steeds and started off at a flying gait for brigade headquarters. It happened thus: A telephone message was received at the station near press headquarters asking for Lieut. Shaw, of Troop F. Now, Troop F was located a good half mile from the "phone," and the receiver, being anxious to save a walk, bethought himself of a brilliant scheme. The signal corps was working in front of headquarters and they undertook to transmit the message. In a minute the flags were waving and thrashing, and with some degree of pride the signal officer watched his subordinates doing their duty. When the message was ended, he exclaimed, "It is done; it's all right." Directly at the point where the message had been received there was a great commotion in the cavalry quarters; the bugle sounded the assembly, and with a rush and a dash the entire troop swept across the plain, nearly creating a panic in the ranks of the infantry, then in the field for drill. Drawing up his troops in front of brigade headquarters the captain of cavalry reported to the General in command as ready for duty. The General was as much astonished as anybody at the sudden appearance of the cavalry, but he had no duty for them to do and knew not why they had been called for. Explanations followed. It turned out that only the lieutenant of Troop F had been called for and not his men. The signal officer at once returned to his devotions while the cavalry rode back to their quarters, silently blessing (?) that signalman.

Mr. John Heinze, a talented young electrical inventor, who is at the head of the Heinze Electric Company, Lynn, has prepared a set of plans and drawings for an electrical fountain that is about to be erected on the common in that city. The plans are at present under consideration by a committee specially appointed by the City Council to select plans and carry out the work.

The Bell Telephone Company has just declared a dividend of 3 per cent. and an extra dividend of $3.00 per share as usual.

General News.

What is Going on in the Electrical World.

Saginaw, Mich.—A company has been organized here for the construction of a new telephone line.

Elmira, N. Y.—The new electric power station is nearly finished and is expected to be in running order July 1.

Waterford, N. Y.—The electors of this town have voted in favor of having electric lights. The Green Island Electric Works will furnish the light.

Berkeley, Cal.—The Berkeley Improvement Company, having gained possession of the electric light plant, will apply for the renewal of the lease.

Camden, N. J.--The Camden Horse Railroad Company has received permission from the board of public works to use electric motors on its tracks.

Martinsville, Ind.—The Martinsville Electric Light and Power Company have assigned to J. K. Scott. The liabilities amount to about $10,000, assets stated to be $17,000.

Humboldt, Tenn.—An electric lighting plant will be in operation here before the summer ends, the council having just closed a contract with a company to light the streets.

Youngstown, Ohio.—The route of the Youngstown and Canfield electric railway as decided upon runs past Lauterman's Falls to Cornersburg, thence via the Tippecanoe shaft to Canfield.

Shenandoah, Pa.—The Lake Side Electric Railway Company has been granted the right of way through this town in order to make connection with Lake Side Park, a local summer resort.

New York.—The board of directors of the Western Union Telegraph Company have declared a quarterly dividend of 1¼ per cent. for the three months ending June 30, payable at the office of the treasurer on and after July 15.

Pittsburg, Pa.—A travelling crane operated by electricity, to be erected in the ladle house of the converting mill of the Edgar Thomson Steel Works, was tested a few days ago and raised 100 tons. It will operate ladles exclusively.

Winchester, Tenn.—A St. Louis firm has the contract for building and equipping the Decherd branch of the Winchester system of electric railroads; also for putting in and equipping a large electric light plant for Winchester and Decherd.

Colorado Springs, Col.—The Colorado City Glass Company is making arrangements for putting in an electric light plant. The town board has agreed to contract with the company for the lighting of the city for a term of five years at $13 a month for each arc light.

Oneida, N. Y.—An electric road from Oneida to Silver Beach has many advocates, and a charter for that purpose will probably be applied for as soon as the plan is decided upon. Mr. Warner, the owner of the electric light plant here, is reported to be interested in the project.

Muncie, Ind.—A new electric railway scheme taking shape here is the building of a line twelve miles long from this city to Eaton, to be known as the Muncie and Eaton Electric Railway. George Reed and James Pixley are reported to be the leading promoters of the project.

Noblesville, Ind.—Dr. Gessner, the general manager of the Chicago and Central Indiana Electric Railway Company, is quoted as saying that the company has decided to extend its line from Lafayette to Chicago, thus making one of the finest systems of electric railway in the world.

Bellows Falls, Vt.—The construction of the electric road from this place to Saxton River, hindered on account of the death of one of the projectors, is likely to go on, as nearly all of the stock has been subscribed for. A number of good water powers will be made accessible by the line.

Brooklyn, N. Y.—The operating of the Fulton street cars by the trolley system has increased the amount of travel over that route fifty per cent. although it has been run less than a fortnight.—A trial of a new underground electrical system was made at Coney Island a few days ago. The patent is owned by the Universal Electric Company.

Frederick, Md.—A project under consideration here is the construction of an electric road from

Gettysburg, Pa., by way of Emmitsburg, Mechanicstown and Frederick to Washington. A road over this route, it is believed, would be largely patronized and could be made to pay handsomely.

Worcester, Mass.—The city council has authorized the making of a three year contract with the Worcester Electric Light Company for furnishing arc lights for the streets at the rate of 35 cents per light per night, a reduction of 5 cents from the price which has prevailed for the last three years.

Detroit, Mich.—The Standard Electric Company, which owns and manufactures the Logan storage battery, has lately been reorganized, and will carry on a more extensive business than hitherto. Its new officers are: President, R. E. Turner, of St. Joseph, Mo.; vice-president, W. T. Anderson, of St. Louis; secretary and treasurer, W. H. Little, of St. Louis.

Bayonne, N. J.—The Bayonne City Rapid Transit Company, a new corporation applying for a franchise to operate nine miles of electric railroad, will have a public hearing on the evening of June 26 at the City Hall. At the same time the old established Jersey City and Bergen Railroad Company will be heard with reference to its application to use electrical power.

Albany, N. Y.—As the time approaches for the electrical experiments on the Erie Canal interest in canal boat propulsion increases among the boatmen and others who are engaged in canal commerce. Superintendent Hannan states that he has received letters from about a dozen inventors who are convinced that they have motors that need only to be tested to show that they have solved the problem that is engaging so much attention.

Syracuse, N. Y—The men said to be most deeply interested in the projected electric railway between Syracuse and Manlius are Howell Smith, Miller A. Smith, Fred K. Fitch and E. W. Emmons, composing the New York Electrical Works, and William T. Corliss, of the Gillette Electric Works of Red Bank, N. J. The capital stock of the company is set at $250,000, and the name of the corporation will be the Syracuse, Fayetteville and Manlius Railway Company.

Minneapolis, Minn.—The Minneapolis *Tribune* says: "The Electrical Engineering and Supply Company of St. Paul, wholesale and retail dealers in and manufacturers of electrical machinery and supplies, have decided to change their base of operations from St. Paul to Minneapolis, and to materially increase their plant. The company expect to have the transfer of stock completed by July 1. In connection with their extensive wholesale business, the company will add a valuable addition to the manufacturing department for the purpose of manufacturing incandescent lamps."

St. Joseph, Mo.—The settlement of the affairs of the People's Street Railway is at hand, and the receiver is preparing to turn over the railway property to the St. Joseph Traction and Lighting Company, of which James T. Gardiner, of Albany, N. Y., is president. The new company will expend several thousands of dollars in improvements during the summer. The first step in this direction will be the purchase of new summer cars. These will be distributed on the various lines as needed. The next thing will be to replace the motors on all the cars now in use with new ones of an improved pattern.

New Haven, Conn.—The board of public works has granted permission to the Whitney Avenue line to use electricity as a motive power. —The *Journal* says: "The advent of the electric railway in the annex has given a great impetus to the prosperity of the east shore. All along its route new houses are springing up, especially on Woodward avenue, where a dozen new houses have been erected, all neat, comfortable-looking, attractive little homes. All the land on the avenue for a long distance has been sold in building lots, there never having been before in the history of the section any such call for land for building purposes."

Amsterdam, N. Y.—A new electric road to connect Amsterdam, Johnstown and Gloversville is under consideration. John H. McClement, president of the Amsterdam Street Railroad, and J. Seaver Page, a capitalist of New York City, having recently gone over the route, were very much impressed with the feasibility of building a road by which Gloversville can be reached from Amsterdam by a distance of only twelve miles. The present route over the Central and Fonda, Johnstown and Gloversville, is twenty-one miles. If the new line is built the distance will be reduced nine miles and the fare will be proportionally reduced.

Chicago.—The system of electric light buoys running from Chicago harbor to the Exposition grounds is nearly ready for operation. The work was done under the direction of Commander John J. Brice, U. S. N., inspector of the Ninth Light House District, and is said to be the greatest undertaking of the kind in the world. The system will consist of thirteen buoys, half a mile apart, each one surmounted by an incandescent light of great power, and visible eight miles in clear weather. In times of heavy weather and fog no difficulty will be experienced by pilots in picking out the next buoy when he has reached the first one, and each succeeding one in turn.

Hartford, Conn.—Open cars fitted with motors are to be put on the Glastonbury and East Hartford lines. The cars are expected to arrive daily. —The adoption of the storage battery system for running street cars in this city as against the trolley system has been under consideration in both branches of the common council for some time, but the question is still undecided. The councilmen, however, have requested the Wethersfield Horse Railroad Company to accept the proposition made to it by the Milford Company to equip three storage battery cars and run them on the Main street lines for six months as a test of the efficiency of the Milford system, the Hartford Company to receive 40 per cent. of all the receipts.

Newark, N. J.—The Consolidated Traction Company has secured control of the Newark Passenger Railway Company, a majority of the stockholders having agreed to sell their stock to the Consolidated Company (known as the Crimmins syndicate) on the basis of an exchange of the first mortgage 5 per cent. gold bonds of the Consolidated Company at par for railway company stock at $35 per share, with the express provision that the same terms of sale should be extended to all stockowners. The amount involved was $6,000,000. The Consolidated Company intends to spend $2,500,000 in building new lines in Newark streets, for which franchises have already been applied for, and in the improvement of existing lines.

A Mile in Thirty-two Seconds.

The question of relative speed of English and American railway trains has been, during the past two or three years, a standing theme of debate; the rival claims of the Scotch Express and the Flying Dutchman on the one hand, and the New York Central's famous Empire State Express on the other, each having staunch supporters, but now the New York Central comes to the front again with a record of 112½ miles an hour, which is surely the most marvellous performance of any railroad train past or present, demonstrating conclusively that this line possesses road-bed, rolling stock and motive power of the very best and highest type.

This remarkable run was made on May 11th by the new mammoth "Empire State Express" engine No. 999, hauling a heavily laden train, consisting of Wagner Palace Drawing-room and Combination Buffet, Smoking and Library Cars and two standard passenger coaches. Total weight, 241 American tons, or 482,000 pounds.

Commenting on this remarkable run the New York *Herald* says editorially: "The purpose of one line (the New York Central) to run a train to Chicago in 20 hours meets with no little objection from competing lines. The latter say the train won't pay; that it is not wanted, and they even intimate that it is not altogether safe. This opposition is obviously prompted by business considerations, though it seems to be a striking exception to the spirit of progress so often shown by American railway managers in promptly matching any improvement in speed or train service introduced by a competitor. In this matter public sympathy must be on the side of progress. With Americans time is money. They want the fastest trains attainable with safety, and are willing to pay for them. The same spirit which has prompted and demanded this advanced railway service has prompted and demanded progress in ocean travel. The crack steamers of to-day are floating palaces compared with those of years ago, while the time of the trip has been reduced season by season. As for railway travel, there is no reason why the progress of the future should not eclipse that of the past. Achievement has demonstrated that, so far as motive power is concerned, a speed of over 100 miles an hour is practicable. With safe rolling stock, safe road-bed and efficient management, security is assured."

The New York Central is a model road in every important particular. It has a magnificent road-bed, heavy steel rails, block signals, finest rolling stock procurable, and, to cap all, possesses four complete tracks throughout nearly its entire length. No. 999 and the Empire State Express will form a part of the New York Central's exhibit at the World's Fair.

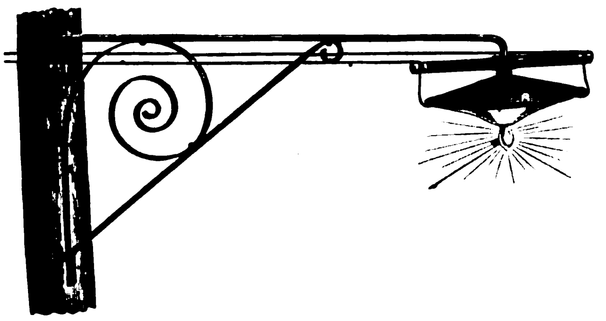
The New Stanley Transformer.

The complete and pronounced success attained by the new Stanley Transformer with its solid moisture proof insulation must be gratifying to its manufacturers, who aver that for regulation, efficiency, ease of handling, convenience of replacing primary fuses and ability to withstand lightning it has no competitor. The Ansonia Electric Company, Randolph street and Michigan avenue, Chicago, will promptly fill all orders for the new Transformer, and also for the new W.-W. Lightning Arrester, which is meeting with great success on account of its effectiveness, simplicity of construction and low cost. It will doubtless save many an armature.

Cutter's "Boulevard" Streethoods.

The streethoods designed and built by George Cutter are now in use throughout the country and so well known as to need no further comment. However there are cases where the goose-neck type of bracket arm is not ornamental enough to suit some tastes. This lack is met by the "Boulevard Streethood," illustrated herewith, which is aleady beautifying many streets in Western cities.

The various details of the hood and insulating arm are worked out the same as in the now standard form of hoods made by Mr. Cutter, the departure lying in the design of the supporting bracket, which is as strong and well braced as it is neat. The maker is exploiting them from his headquarters at the Rookery, Chicago.



CUTTER'S "BOULEVARD" STREETHOOD.

Ornamental Iron Work.

The Winslow Bros. Company, Carroll avenue and Fulton street, Chicago, have issued a trade-book for the current year to which the adjective superb might be appropriately applied, giving in the best style of art a large collection of photogravure plates, showing specimens of ornamental iron produced by the company. The number of plates in the collection is 141, of which 23 are of stairways and balconies, 17 of railings, 39 of elevator enclosures, 2 showing twelve designs of elevator cabs, 2 with eighteen designs of panels, medallions, etc., in Galvano-plastic, the remaining 68 being devoted to counter railings, entrances, canopies, grilles, lamps, frames, brackets, screens, skylights, etc.

The book is in every respect highly creditable to the company and all concerned in its preparation.

The Winslow Bros. Company have also published a lithograph edition, giving 88 plates, 11 x 14 inches, showing over 400 designs of ornamental iron work, and they intend issuing a monthly journal devoted to art metal work and embellished with numerous photogravures and half-tone illustrations.

The Page Belting Company has an extensive exhibit at the World's Fair, to the investigation of which they cordially invite all persons interested in belting.

A Flourishing Company.

The Interior Conduit and Insulation Company shows a constant and steady growth in its business which for the last three months has exceeded that of any similar period in its history. The interior conduit has now become the rule with all the first-class electrical installations, and there are but few large buildings of recent construction in New York City which are not equipped with this system of wiring.

The motors and electrical supplies manufactured by this company have also acquired a wide reputation among electrical men for their excellence of design and for the workmanship which is a characteristic of these goods.

The company has been obliged to constantly increase its manufacturing facilities from the start in order to meet the increase in its business, and results of the past three months have been ample justification of the large outlay of capital which its business has called for.

The General Incandescent Arc, Light Company's Catalogue.

Catalogue No. 1, just published by the General Incandescent Arc Light Company, 572-578 First Avenue, New York, is a handsome trade book, with a novel and attractive cover page containing a list of the lamps manufactured and dealt in by the company. The Catalogue is intended to supersede Circulars Nos. 1 and 2, which heretofore served to introduce the "General" Arc Lamps to the notice of electric light companies, contractors, architects, etc., and is of course much more comprehensive than the circulars. It contains illustrations and descriptions of the several kinds of lamps manufactured by the company, and of others added to their regular manufacture, together with brackets and other fixtures. Many of the examples given are beautiful in form and decoration and all of them are apparently well adapted for their various purposes. Prices are given with the descriptive notes.

Accompanying the catalogue are price lists of the high grade carbons of the company, who are sole agents for the United States and Canada of the Fabrik Elektrischer Belenchtungs Kohlen, of Nurnberg, Germany.

COMMERCIAL PARAGRAPHS.

Queen & Company, Incorporated, Philadelphia, report a large stock of "Magnetic Vane" Ammeters and Voltmeters which they can ship promptly and are pushing with great vigor. These instruments combine qualities highly essential for switchboard use, and which render them specially valuable for isolated plants.

A number have been supplied to exhibiting companies for installation at the World's Fair, and the makers have a handsome collection in their own display.

The "Acme" Portable Testing Set, described in detail last week, has met with favor wherever shown and is sure to become the standard instrument for general testing. Queen & Company have already received orders for more than twenty sets. Circulars 420 and 445, describing these specialties, can be had for the asking.

"The best mail yet," was an expression which dropped from the lips of Mr. Price, of the Pettingell-Andrews Company, Boston, a few mornings ago. This was a significant remark when it is known that this firm, the largest electric supply house in the East, is doing quite a phenomenal business—the increase in volume for the present year being over 40 per cent. better than last year.

A prompt and satisfactory piece of business was transacted by Mr. C. A. White, manager of the Eco Magneto Watchman's Clock Company, Boston, on Wednesday of this week. Just after 9 A. M., he received an enquiry by wire from Chicago as to price of two of their high-grade watchman's register. He replied by wire, which called forth an order for two—a 30 station and a 25 station equipment—before 12 noon, and within a couple of days the entire order was shipped West. These devices are being installed everywhere.

Mr. W. W. Jones, Eastern agent for W. R. Fleming & Company, makers of the Ide and Ideal Engines, is about completing installations as follows: A steam plant of 1,000 H. P. for the New Britain, Conn., Electric Street Railway Company, a 500 H. P. steam plant for the Taunto, Mass., Electric Light Company, a complete steam and electric lighting plant of 300 lamps at Martha's Vineyard, Mass. The "Ideal" engine was installed in each of these plants.

Though illustrated descriptions and advertisements in the electrical journals of a new revolving fan motor made by the W. S. Hill Electric Company, of Boston, appeared for the first time the last week, that company has had the pleasure of receiving enquiries in response for nearly 100 of these unique machines in three days. Who can say advertisements don't pay?

"Imitation is the sincerest form of flattery," says an old proverb which may be applied to Insullac, the excellent insulating material which the Massachusetts Chemical Company of Boston placed on the market a few months ago. So unprecedented has been the success "Insullac" has achieved that several imitations are being pushed, but not to the detriment of "Insullac," for the company after doubling its manufacturing capacity, working night and day forces, cannot keep up with the demand, and is at the present time shipping it in large quantities to Europe. "Once used, always used," is the universal verdict.

Mr. Brown, the live salesman of the Westinghouse Electric Company's Boston office, reports a continually increasing demand for railway equipment. During the past few days he has closed several good contracts and has several more under way.

The Ansonia Electric Company have recently gotten out a little circular describing the Wirt Dimming Switch, which switch is a great convenience and luxury in a bedroom or nursery for dimming the light. They also report an enormous sale in the last month of Habirshaw wire, and have just closed a contract for upwards of forty miles of Shield Brand Wire for lighting and power work.

INCORPORATIONS.

Articles of incorporation of the "C. & C." Electric Company were filed at Newark, N. J., on the 14th inst., by Joseph Wilkie, of Flushing, L. I.; G. D. Mumford, of New York, and Lloyd McKim Garrison, of Orange, N. J. Capital stock, $1,400 000: $400,000 preferred, $1,000,000 common. The object is to manufacture electric motors and appliances.

Citizens' Mutual Telephone Company, at Decatur, Ill. Capital stock, $100,000. Incorporators: W. J. Kurtz, R. Tobey, O. E. Harris, J. G. Harvey and O. T. Kirk.

City Illuminating Company, Chicago—to produce and furnish light for illuminating buildings, streets, etc., and to generate and distribute electrical currents for operation of motors, etc. Capital stock, $6,000. Incorporators: M. B. Austin, R. H. Watson and H. W. Ames.

The Novelty Electric Company, Chicago. Capital stock, $10,000. Incorporators: Howard M. Carter, Charles B. Carter and Edwin G. Lancaster.

The East St. Louis Electric Street Railroad Company has increased its capital stock to $500,000.

A charter has been granted at Harrisburg, Pa., to the Easton and Bangor Electric Railway Company, to build a road sixteen miles long. Capital stock, $100,000. Directors: Marshall Young, president; T. M. Lesher, J. P. Correll and D. W. Nevin, of Easton, and George Geaston of Mt. Pleasant, Pa.

The Niagara Electric Railway Company, with principal offices in Buffalo—to construct a street railroad between and in the villages of Pekin and Lewiston, Niagara County, N. Y. Capital, $50,000. Incorporators: Harvey Hoag, M. L. Failing, J. G. Charles, J. A. Kuck, of Buffalo, and others.

Rogue River Water, Light and Power Company, Grants Pass, Oregon—to construct, equip, maintain and operate water works and electric light system in the city of Grants Pass, Oregon. Capital stock, $50,000. Promoters: Geo. A. Pease, W. H. Pope, A. L. Pease, all of Portland, Oregon.

The Miamisburg Electric Company, Miamisburg, Ohio—to manufacture and deal in all kinds of electrical and other machinery and appliances, etc. Capital stock, $100,000. Promoters: T. V. Lyons, Wm. Gamble, Christian Weber, Elwood Allen, A. L. Daniels, Wm. A. Mays, Wm. Burnley.

The Portsmouth Street Railroad and Light Company, Portsmouth, Ohio—to operate street railroad and furnish light and power, etc. Capital stock, $125,000. Promoters: Samuel B. Timmonds, Jno. F. Brushart, George Davis, Anselm T. Holcomb, Floyd L. Smith.

Jackson Electric Railway, Light and Power Company, Jackson, Miss.—to carry on a general electric railway and power business in the city of Jackson. Capital stock, $250,000. Promoters: J. B. Harris, W. E. Hayne, J. B. Ross, all of Jackson, Miss.

The Continental Gas Company, Chicago, Ill.—to manufacture and deal in gas, electricity, erect, maintain and manufacture plants, appliances, etc., for operation of same. Capital stock, $10,000,000. Promoters: Chas. Springer, Ernest B. Stuart, Charles S. Corning.

Sloss-Stein Electric Company, Chicago, Ill.—to manufacture and sell electric appliances, metal products and specialties. Capital stock, $50,000. Promoters: Sydney Stein, Aaron M. Sloss, Louis Stein.

Tri-City Power and Light Company, Rock Island, Ill.—to manufacture appliances for and furnish light, heat and power to inhabitants of Moline and Rock Island and vicinity, gas, steam, air or electricity. Capital stock, $300,000. Promoters: R. H. MacMullan, Wm. Mullen, Jas. F. Hughes.

The Independent Electric Company, Chicago, Ill.—general electrical manufacturing and machine shop business. Capital stock, $25,000. Promoters: Wm. F. Hall, S. G. Hicks, N. D. Levin.

The Fairmount Railway Company, Denver, Col.—to build an electric railway from Fairmount Cemetery to Montclair in Arapahoe County. Capital stock, $10,000. Promoters: Willard Teller, Wm. H. Bush, Thos. H. Porter, Robt. H. McMann, Frank C. Young, all of Denver, Col.

The Riverside Electric Company, Riverside, Cal.—to generate electricity for all purposes and operate street railroads. Capital stock, $100,000. Promoters: Geo. L. Bush, Frederick Carter, Jno. T. Jarvis, B. B. Bush, Obed Patty, Riverside, Cal.

The Arizona Electric Company, Phœnix, Ariz.—to furnish light, heat and power and buy and sell all kinds of electrical machinery. Capital stock, $400,000. Incorporators: William Pickrell, W. F. White and Henry Kemp.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JUNE 13, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

499,270. Safety Support for Trolley Wires. Hiram K. Whitney, Chicago, Ill. Filed Feb. 6, 1893.

499,374. Conduit Electric Railway. William R. DeVoe, Shreveport, La. Filed Oct. 28, 1892.

499,461. Overhead Trolley Wire Switch. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Feb. 2, 1893.

499,633. Gearing for Electric Railway Cars. John C. Henry, New York, N. Y. Filed April 29, 1892.

499,662. Trolley-Wire Hanger. Charles B. Elliott, Boston, Mass., assignor to the Revere Rubber Company, same place. Filed Aug. 8, 1892.

ELECTRIC LIGHTS AND APPLIANCES.

499,297. Electric Gas Lighting Apparatus. Thomas W. Lane, Boston, Mass., and Charles E. Lee, Chicago, Ill., assignors to the Electric Gas Lighting Company, Portland, Me. Filed Feb 8, 1892.

499,298. Electric Gas Lighting Apparatus. Thomas W. Lane, Boston, Mass., assignor to the Electric Gas Lighting Company, Portland, Me. Filed Feb. 15, 1892.

499,470. Shade Holder for Electric Lamps. Charles Remhof, Brooklyn, N. Y. Filed Feb. 13, 1891.

499,478. Electric Light. Gaston Sautter, Paris, France, assignor to Sautter, Harle & Company, same place. Filed Jan. 5, 1892.

499,676. Electric-Arc Lamp. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company of Connecticut. Filed March 28, 1893.

DYNAMOS, MOTORS, ETC.

499,350. Commutator for Dynamo-Electric Machines. Horace F. Parshall, Lynn, Mass., assignor to the General Electric Company of New York. Filed Jan. 13, 1893.

499,446. Alternating-Current Generator. William Stanly, Jr., and John F. Kelly, Pittsfield, Mass., assignors to the Stanley Laboratory Company, same place. Filed Jan. 9, 1893.

99,544. Regulator for Electric Machines. John C. Henry, Westfield, N. J. Filed Sept. 3, 1892.

MEASURING INSTRUMENTS.

499,318. Electrical Measuring Instrument. Edward Weston, Newark, N. J. Filed Oct. 3, 1892.

SIGNALS AND SIGNALING APPARATUS.

499 411. Electric Signaling Apparatus for Elevators. Charles G. Armstrong, Chicago, Ill., assignor of one-half to Dankmar Adler, same place. Filed Jan. 23, 1893.

MISCELLANEOUS.

499,253. Process of Magnetic Separation and Apparatus Therefor. Richard H. Sanders and Charles T. Thompson, Philadelphia, Pa. Filed Dec. 27, 1892.

499,254. Electric Hose Coupling. Howard Sargent, Cambridge, Mass. Filed Feb. 21, 1893.

499,261. Burglar-Alarm System. Alfred Stromberg, Chicago, Ill. Filed Feb. 11, 1893.

499,275. Safety Device for Systems of Distribution. Herbert C. Wirt, Boston, Mass. Filed March 16, 1892.

499 305. Electric Bell. John L. Moore, New York, N. Y. Filed June 6, 1892.

499 321. System of Propelling Canal-Boats by Electricity. Samuel W. Gear, Buffalo, assignor of one-half to John F. Alden, Rochester, N. Y. Filed Jan. 26, 1893

499.363. Electric Switch. James F. McElroy, Albany, N. Y., assignor to the Consolidated Car-Heating Company, Wheeling, W. Va. Filed Nov 16, 1892.

499,425. Strong-Current Protector. Charles D. Haskins, Brooklyn, N. Y., assignor to the Western Electric Company, Chicago, Ill. Filed Sept. 9, 1890.

499,428. Electric Hinge. William S. Hull, Sheffield, Ala. Filed Nov. 16, 1892.

499,497. Cut-Out. Patrick J. Barrett, Boston, Mass., assignor of one-half to John J. Frawley as President of the Boston Society of Redemptorist Fathers, same place. Filed April 3 1893

499,518. Method of Electrically Welding Metals. Charles L. Coffin, Detroit, Mich. Filed Sept. 25, 1890.

499,543. Electro-Magnetic Car-Brake. John C. Henry, Westfield, N. J. Filed Aug. 8, 1892.

499,572. Apparatus for the Production and Inhalation of Ozone. Marie P. Oudin, Paris, France, assignor to Jules Ehlis, Liege, Belgium. Filed Dec. 10, 1891.

499,596. Electric Igniting Device. William H. Russell and George E. Russell, Jersey City, N. J. Filed Mar. 9, 1893.

499,610. Recorder. John T. Todd, Newman, assignor, by direct and mesne assignments, to the Todd Applegate Company, Chicago, Ill. Filed May 24, 1892.

499,614. Multiple-Fuse Block. Gardner T. Voorhees, Boston, assignor to James E. Maynadier, Taunton, Mass. Filed Sept. 1, 1892.

499,646. Switch. George W. Russell, Jr., Denver, Col. Filed April 7, 1893.

499,657. Method of and Apparatus for Electrically Welding Sheet Metal. Charles L. Coffin, Detroit, Mich. Filed Oct. 18, 1892.

499,664. Electric-Fuse Block. Thomas J. Fay, New York, N. Y., assignor to James L. Doolittle, Brunswick, Me. Filed Feb. 11, 1891. Renewed May 2, 1893.

499,681. Electro-Magnetic Blanket. Nils A. Renstrom, Omaha, Nebr., assignor of one-half to James S. Stone, same place. Filed April 15, 1893.

499,693. System of Wiring Multiple Switchboards. Charles H. Wilson, Chicago, Ill., assignor to the Western Electrical Company, of Illinois. Filed Oct. 8, 1888.

ELECTRICITY.

VOL. IV. NEW YORK. JUNE 28, 1893. CHICAGO. No. 24

THE FERRIS WHEEL AT THE WORLD'S FAIR. (SEE PAGE 326.)

The Ferris Wheel.

The Ferris Wheel, the crowning engineering feature of the Columbian Exposition, was thrown open to the public last Wednesday before a large audience of invited and distinguished guests. Over five thousand people were present to see the enormous body of iron make its formal turn for the public pleasure and comfort.

The wheel is certainly one of the most remarkable structures that have ever been designed or erected. As the Brooklyn Bridge and the Eiffel Tower have been as milestones to mark the progress made in engineering in the past, so will the Ferris Wheel be added to mark another advancing step. The Ferris Wheel is to the Columbian Exposition what the Crystal Palace Hall was to the Crystal Palace Exposition, or the Eiffel Tower was to the Paris Exposition. Although the electrical features of the wheel are of a secondary nature, the wheel itself is deemed of sufficient importance to warrant a short description in these columns.

The highest point is 265 feet above the surface of the earth. The diameter is 250 feet and the circumference 825, the entire thing being raised 15 feet above the ground.

In reality there are two wheels thirty feet apart. These twins are connected by iron rods and struts which do not approach nearer than twenty feet to the periphery. Outside of these rods the cars are hung and supported by steel bars of about five inches in thickness extending from one wheel to the other. Each wheel has for its outline a curved iron beam 25½ by 19 inches. Forty feet inside is another beam, forming a smaller circle. From these beams or circles extends the massive iron truss-work which holds them together.

The axle on which the great wheel turns is a steel bar 32 inches thick and 45 feet long. It is fastened to each of the twin wheels in a steel hub 16 feet in diameter. All of this great mass, the hubs and the two circles, is held together by 2½-inch steel rods arranged to run in pairs from the axle to spread 13 feet apart at the circumference.

There are thirty-six cars on the wheel, each capable of comfortably seating forty people. The cars are 27 feet long, 13 feet wide and 9 feet high, and each one weighs 13 tons.

The wheel, with its passengers, weighs 1,200 tons. The whole thing rests on two pyramidal towers at the axis. The towers are 140 feet high, forty by fifty feet at the base and six feet square at the top. Each tower has four feet resting on twenty-foot cube concrete foundations. Underneath these are crossbars of steel. The motive power comes from a 1,000 horse power steam engine under the wheel. It will find no difficulty in revolving the wheel and the passengers as fast as the latter want to go. There is an automatic air brake on, however, to regulate the speed and stop everything in case of danger. The wheel is moved by cogs on the periphery passing over a chain that looks like a mammoth bicycle chain. In the construction every precaution has been taken against accident.

The illumination of the wheel will be effected by arranging 300 incandescent lamps around the periphery on each side, and 360 lights on the cross beams. One hundred or more lamps will be placed in the form of rosettes on the axle. The legs and foundations will be wired for 500 lamps. A space of eighteen inches on the shaft has been reserved between the bearing and the hub for the collector rings, which will be similar to those used on alternating dynamos.

Current is to be furnished from a small plant in the boiler house, located about 400 feet from the wheel. The lighting plant will consist of a 150 horse-power Ball engine and an Edison dynamo.

In order to prevent accidents by starting the car before the gates or doors are closed a very novel electrical arrangement has been introduced. A six-point annunciator is mounted on the engine in full view of the engineer. Each drop is wired to one of the gates in such a manner that as soon as it is opened the pointer will indicate its position and the engineer will understand that the wheel cannot be put in motion.

The company has a plan under consideration for introducing a telephone system so that each car will be in direct communication with the engineer.

Ayrton and Mather's Electrostatic Voltmeter.

For the last three or four years Prof. Ayrton, in conjunction with Mr. Mather, has been experimenting with a view to the construction of a trustworthy and accurate electrostatic voltmeter for the measurement of high pressure. There can be no question about the great advantage of placing an electrostatic voltmeter directon high pressure mains, over the clumsy expedient frequently employed of wasting power in transforming down the pressure to suit the range of a low pressure hot wire voltmeter, which can only give a reading by wasting a good deal more power.

An increasing need is, therefore, felt for an electrostatic instrument prompt and accurate in its indications, and safe both from liability to internal injury caused by the pressure it measures and from risks of causing dangerous shocks to persons handling the instrument when in use. To fulfil the requirements of the engineer it should also have a bold scale, be suitable in form for fixing on a switchboard, and be quite unaffected by the cleaning of the glass or the proximity of other bodies, whether electrified or not.

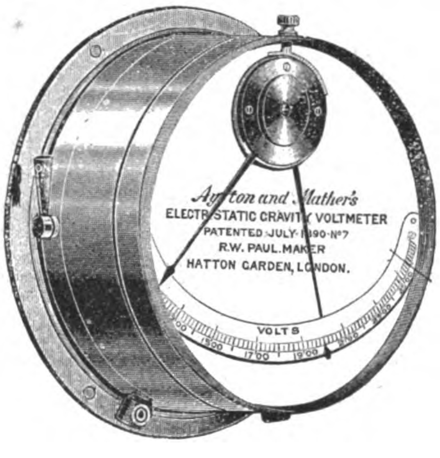


Fig. 1.

Many instruments were constructed by the inventors, some with spring or torsional control, others controlled by gravity; after exhaustive tests the style of instrument which fulfilled the conditions best was selected, and in its final form it is shown in Fig. 1, of which the following description is given by the *Electrical Review* (London):

The working parts of the instrument are shown diagrammatically in Fig. 2, in which the parts A, B, C are the fixed inductors, corresponding to the quadrant of an electrometer. These inductors are curved brass plates whose edges and corners are carefully rounded to prevent sparking. They are connected together by the plate D, and fixed in an inner case, from which they are highly insulated. The needle, E, F, consists of two thin curved aluminium plates concentric with the staff G, which carries them. These plates are drawn into the space between the inductors by the electrostatic attraction between them. Being curved, they have the advantage over flat plates in strength and lightness, their moment of inertia is small, so that the needle takes its position of equilibrium rapidly, and as the peripheries and spokes of the needle are made out of one piece of aluminium the electric conductivity is perfect, and the voltmeter accurately measures direct or alternating the pressures of any frequency. The needle is counterpoised by the hand and controlled by a weight attached to an arm on the staff so as to bring the hand to zero; it is finely pivoted in jewels, and works in a frame attached to the circular brass plate seen near the top of the dial. The working parts can thus be easily removed bodily. The needle is in connection with the dial, which carries the inner case containing the inductors, the latter being highly insulated. From the inductors an insulated spring reaches downwards alongside a similar spring attached to the inner case; these springs make contact with the terminals.

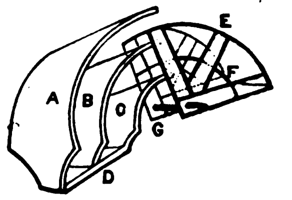


Fig. 2.

The dial is supported on ebonite pillars and surrounded by a bezil ring of ebonite, which prevents contact with the outer case, the latter is therefore entirely insulated from the circuit.

Each terminal, of which a section is shown in Fig. 3, is cased in ebonite, so that a person connecting up cannot receive shock from it. The hollow ebonite portion A, A, contains a brass block E, imbedded near its outer end and covered by an ebonite nipple; the block is tapped for the set screw F, which holds the wire in place. The part of A which projects into the case, into which it screws at B, contains a fuse of platinum silver, .001 inches in diameter, enclosed in a glass tube with metal caps to which it is connected. They make contact with the block E at one end and the spring cap D at the other. The cap D makes contact in turn with the connecting spring mentioned above. The fuses are therefore very easily replaced.

To enable the instrument to be easily disconnected from the mains when necessary, a switch is provided; the handle seen on the left side of the instrument is attached to a cam-shaft and turning it down raises the springs from the caps D of the terminals, and so disconnects the instrument from the mains; it then short-circuits the inductors and needle, bringing them to the same potential.

A spark gap is arranged inside the voltmeter; before the instrument is sent out it is tested at considerably above the working pressure for sparking between the needle and inductors, the gap is then adjusted, so that, in case of abnormal rise of pressure, sparking will occur at the gap and produce no damage.

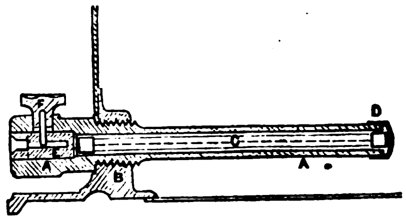


Fig. 3.

A device is provided whereby the engineer may see at a glance whether the working pressure is being maintained; it consists of an index below the scale (seen to the right of Fig. 1) adjustable by a crown wheel and pinion at the top of the instrument. It can be thus seen at a distance whether the pressure is right, that is, whether the hand and index coincide. When the index is turned as far as it will go to the left it clamps the needle for traveling.

The scale has a radius of 6 inches and a length of 10 inches, thus giving a bold open scale whose clearness is enhanced by the dead white silver of the dial. The external diameter of the instrument is 12 inches.

The instruments at present made are suitable for circuits at 500, 1,000, 2,000 and 2,400 volts, the range being very open near the working pressure. By differently shaping the inductors an equally divided scale may be obtained when desired.

The instruments are made by Mr. Paul, 44 Hatton Garden, and Leather Lane, London, E. C.

ON LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.—V.

BY NIKOLA TESLA.*

Very high frequencies are of course not practicable with motors on account of the necessity of employing iron cores. But one may use sudden discharges of low frequency and thus obtain certain advantages of high frequency currents without rendering the iron core entirely incapable of following the changes and without entailing a very great expenditure of energy in the core. I have found it quite practicable to operate with such low frequency disruptive discharges of condenser alternating-current motors. A certain class of such motors which I advanced a few years ago, which contain closed secondary circuits, will rotate quite vigorously when the discharges are directed through the exciting coils. One reason that such a motor operates so well with these discharges is that the difference of phase between the primary and secondary currents is 90 degrees, which is generally not the case with harmonically rising and falling currents of low frequency. It might not be without interest to show an experiment with a single motor of the kind, inasmuch as it is commonly thought that disruptive discharges are unsuitable for such purposes. The motor is illustrated in Fig. 18. It comprises a rather large iron core *i* with slots on the top into which are imbedded thick copper washers *c c*. In proximity to the core is a freely movable metal disc D. The core is provided with a primary exciting coil C the ends *a* and *b* of which are connected to the terminals of the secondary S of an ordinary transformer, the primary P of the latter being connected to an alternating distribution circuit or generator G of low or moderate frequency. The terminals of the secondary S are attached to a condenser C which discharges through an air gap *d d* which may be placed in series or shunt to the coil C. When the conditions are properly chosen the disc D rotates with considerable effort and the iron core *i* does not get very perceptibly hot. With currents from a high frequency alternator, on the contrary, the core gets rapidly hot and the disc rotates with a much smaller effort. To perform the experiment properly it should be first ascertained that the disc D is not set in rotation when the discharge is not occurring at *d d*. It is preferable to use a large iron core and a condenser of large capacity so as to bring the superimposed quicker oscillation to a very low pitch or to do away with it entirely. By observing certain elementary rules I have also found it practicable to operate ordinary series or shunt direct-current motors with such disruptive discharges, and this can be done with or without a return wire.

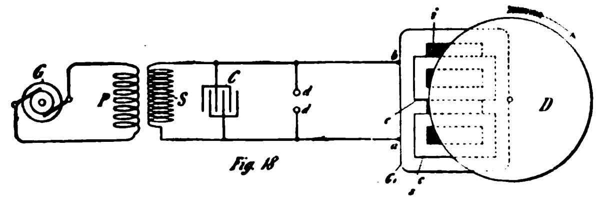


Fig. 18

OPERATING A MOTOR BY DISRUPTIVE DISCHARGES.

Among the various current phenomena observed perhaps the most interesting are those of impedence presented by conductors to currents varying at a rapid rate. In my first paper before the American Institute of Electrical Engineers, I described a few striking observations of this kind. Thus I showed that when such currents or sudden discharges are passed through a thick metal bar there may be points at the bar only a few inches apart which have a sufficient potential difference between them to maintain at bright incandescence an ordinary filament lamp. I have also described the curious behavior of rarefied gas surrounding a conductor to such sudden rushes of current. These phenomena have been since more carefully studied and one or two novel experiments of this kind are deemed of sufficient interest to be described here.

With reference to Fig. 19*a*, B and B_1 are very stout copper bars connected at their lower ends to plates C and C_1 respectively, of a condenser, the opposite plates of the latter being connected to the terminals of the secondary S of a high tension transformer, the primary P of which is supplied with alternating currents from an ordinary low frequency dynamo G or distribution circuit. The condenser discharges through an adjustable gap *d d* as usual. By establishing a rapid vibration it was found quite easy to perform the following curious experiment. The bars B and B_1 were joined at the top by a low voltage lamp l_3; a little lower was placed, by means of clamps *c c*, a 50-volt lamp l_2 and still lower another 100-volt lamp l_1, and finally at a certain distance below the latter lamp an exhausted tube T. By carefully determining the positions of these devices it was found practicable to maintain them all at their proper illuminating power. Yet they were all connected in multiple arc to the two stout copper bars and required widely different pressures. This experiment requires, of course, some time for adjustment but is quite easily performed.

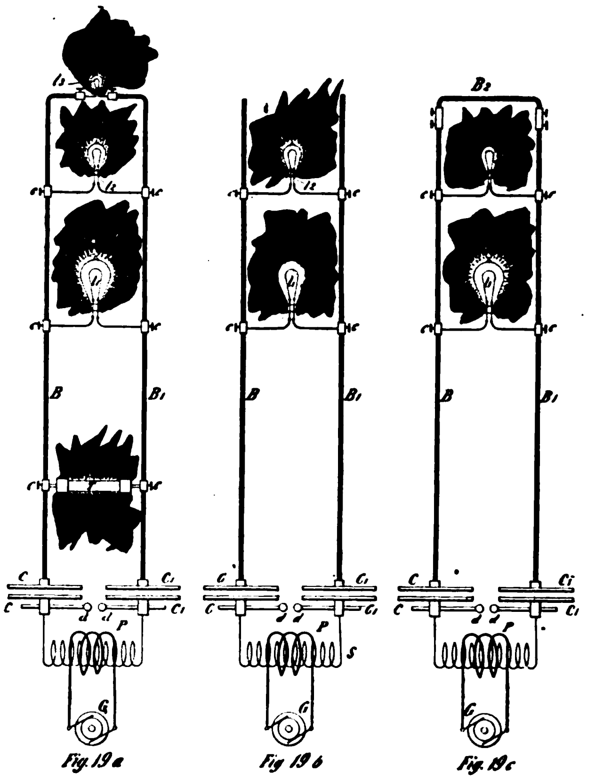


Fig. 19a Fig. 19b Fig. 19c

IMPEDENCE PHENOMENA.

In Figs. 19*b* and 19*c*, two other experiments are illustrated which, unlike the previous experiment, do not require very careful adjustments. In Fig. 20*b*, two lamps l_1 and l_2, the former a 100-volt and the latter a 50-volt, are placed in certain positions as indicated, the 100-volt lamp being below the 50-volt lamp. When the arc is playing at *d d* and the sudden discharges passed through the bars B B the 50-volt lamp will as a rule burn brightly, or at least this result is easily secured, while the 100-volt lamp will burn very low or remain quite dark, Fig. 19*b*. Now the bars B B may be joined at the top by a thick cross bar B_2 and it is quite easy to maintain the 100-volt lamp at full candle power while the 50-volt lamp remains dark, Fig. 19*c*. These results, as I have pointed out previously, should not be considered to be due exactly to frequency but rather to the rate of change, which may be great even with low frequencies. A great many other results of the same kind equally interesting, especially to those who are only used to manipulate steady currents, may be obtained, and they afford precious clues in investigating the nature of electric currents.

In the preceding experiments I have already had occasion to show some light phenomena, and it would be now proper to study these in particular; but to make this investigation more complete I think it necessary to first make a few remarks on the subject of electrical resonance which has to be always observed in carrying out these experiments.

ON ELECTRICAL RESONANCE.

The effects of resonance are being more and more noted by engineers and are becoming of great importance in the practical operation of apparatus of all kinds with alternating currents. A few general remarks may therefore be made concerning these effects. It is clear that if we succeed in employing the effects of resonance practically in the operation of electric devices the return wire will, as a matter of course, become unnecessary, for the electric vibration may be conveyed with one wire just as well, and sometimes even better, than with two. The question first to answer is, then, whether pure resonance effects are producible. Theory and experiment both show that such is impossible in nature, for as the oscillation becomes more and more vigorous the losses in the vibrating bodies and environing media rapidly increase and necessarily check the vibration which otherwise would go on increasing forever. It is a fortunate circumstance that pure resonance is not producible, for if it were there is no telling what dangers might not lie in wait for the innocent experimenter. But to a certain degree resonance is producible, the magnitude of the effects being limited by the imperfect conductivity and imperfect elasticity of the media or, generally stated, by frictional losses. The smaller these losses, the more striking are the effects. The same is the case in mechanical vibration. A stout steel bar may be set in vibration by drops of water falling upon it at proper intervals, and with glass, which is more perfectly elastic, the resonance effect is still more remarkable, for a goblet may be burst by singing into it a note of the proper pitch. The electrical resonance is the more perfectly attained the smaller the resistance or the impedence of the conducting path and the more perfect the dielectric. In a Leyden jar discharging through a short stranded cable of thin wires these requirements are probably best fulfilled, and the resonance effects are therefore very prominent. Such

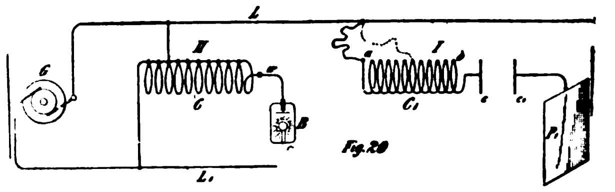


Fig. 20

PLAN FOLLOWED IN OBSERVING THE EFFECTS OF RESONANCE.

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* A lecture delivered before the Franklin Institute at Philadelphia, Feb. 24, 1893, and before the National Electric Light Association at St. Louis, Mo., March 1, 1893.

is not the case with dynamo machines, transformers and their circuits, or with commercial apparatus in general in which the presence of iron cores complicates or renders impossible the action. In regard to Leyden jars, with which resonance effects are frequently demonstrated, I would say that the effects observed are often *attributed* but are seldom *due* to true resonance, for an error is quite easily made in this respect. This may be undoubtedly demonstrated by the following experiment. Take, for instance, two large insulated metallic plates or spheres, which I shall designate A and B, place them at a certain small distance apart and charge them from a frictional or influence machine to a potential so high that just a slight increase of the difference of potential between them will cause the small air or insulating space to break down. This is easily reached by making a few preliminary trials. If now another plate—fastened on an insulating handle and connected by a wire to one of the terminals of a high tension secondary of an induction coil, which is maintained in action by an alternator (preferably high frequency)—is approached to one of the charged bodies A or B, so as to be nearer to either one of them, the discharge will invariably occur between them; at least it will if the potential of the coil in connection with the plate is sufficiently high. But the explanation of this will soon be found in the fact that the approached plate acts inductively upon the bodies A and B, and causes a spark to pass between them. When this spark occurs, the charges, which were previously imparted to these bodies from the influence machine, must needs be lost, since the bodies are brought in electrical connection through the arc formed. Now this arc is formed whether there be resonance or not. But even if the spark would not be produced, still there is an alternating E. M. F. set up between the bodies when the plate is brought near one of them; therefore the approach of the plate, if it *does* not always actually, will at any rate, *tend*, to break down the air space by inductive action. Instead of the spheres or plates A and B we may take the coatings of a Leyden jar with the same result, and in place of the machine, which is a high frequency alternator preferably, because it is more suitable for the experiment and also for the argument, we may take another Leyden jar or battery of jars. When such jars are discharging through a circuit of low resistance the same is traversed by currents of very high frequency. The plate may now be connected to one of the coatings of the second jar, and when it is brought near to the first jar, just previously charged to a high potential from an influence machine, the result is the same as before, and the first jar will discharge through a small air space upon the second being caused to discharge. But both jars and their circuits need not be tuned any closer than a basso profundo is to the note produced by a mosquito, as small sparks will be produced through the air space, or at least the latter will be considerably more strained owing to the setting up of an alternating E. M. F. by induction, which takes place when one of the jars begins to discharge. Again another error of a similar nature is quite easily made. If the circuits of the two jars are run parallel and close together, and the experiment has been performed of discharging one by the other, and now a coil of wire be added to one of the circuits, whereupon the experiment does not succeed, the conclusion that this is due to the fact that the circuits are now not tuned would be far from being safe. For the two circuits act as a condenser coatings, and the addition of the coil to one of them is equivalent to bridging them, at the point where the coil is placed, by a small condenser, and the effect of the latter might be to prevent the spark from jumping through the discharge space by diminishing the alternating E. M. F. acting across the same. All these remarks, and many more which might be added but for fear of wandering too far from the subject, are made with the pardonable intention of cautioning the unsuspecting student, who might gain an entirely unwarranted opinion of his skill when seeing every experiment succeed; but they are in no way thrust upon the experienced as novel observations.

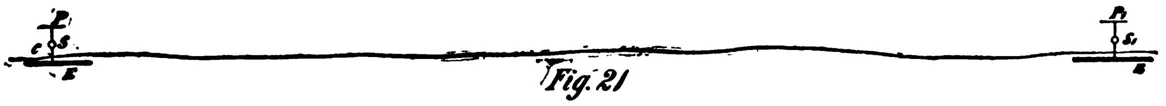

Fig. 21

ENERGY TRANSMISSION TO ANY DISTANCE WITHOUT WIRES.

In order to make reliable observations of electric resonance effects it is very desirable, if not necessary, to employ an alternator giving currents which rise and fall harmonically, as in working with make and break currents the observations are not always trustworthy, since many phenomena which depend on the rate of change may be produced with frequencies widely different. Even when making such observations with an alternator one is apt to be mistaken. When a circuit is connected to an alternator there are an infinite number of values for capacity and self-induction which, in conjunction, will satisfy the condition of resonance. So there are in mechanics an infinite number of tuning forks which will respond to a note of a certain pitch, or loaded springs which have a definite period of vibration. But the resonance will be most perfectly attained in that case in which the motion is effected with the greatest freedom. Now in mechanics, considering the vibration in the common medium—that is, air—it is of comparatively little importance whether one tuning fork be somewhat larger than another, because the losses in the air are not very considerable. One may of course enclose a tuning fork in an exhausted vessel and by thus reducing the air resistance to a minimum obtain better resonant action. Still the difference would not be very great. But it would make a great difference if the tuning fork were immersed in mercury. In the electrical vibration it is of enormous importance to arrange the conditions so that the vibration is effected with the greatest freedom. The magnitude of the resonance effect depends, under otherwise equal conditions, on the quantity of electricity set in motion or on the strength of the current driven through the circuit. But the circuit opposes the passage of the currents by reason of its impedence and therefore, to secure the best action it is necessary to reduce the impedence to a minimum. It is impossible to overcome it entirely, but merely in part, for ohmic resistance cannot be overcome. But when the frequency of the impulses is very great, the flow of the current is practically determined by self-induction. Now self-induction can be overcome by combining it with capacity. If the relation between these is such that at the frequency used they annul each other, that is, have such values as to satisfy the condition of resonance and the greatest quantity of electricity is made to flow through the external circuit, then the best result is obtained. It is simpler and safer to join the condenser in series with the self-induction. It is clear that in such combinations there will be, for a given frequency, and considering only the fundamental vibration, values which will give the best result with the condenser in shunt to the self-induction coil—of course more such values than with the condenser in series. But practical conditions determine the selection. In the latter case in performing the experiments one may take a small self-induction and a large capacity or a small capacity and a large self-induction, but the latter is preferable, because it is inconvenient to adjust a large capacity by small steps. By taking a coil with a very large self-induction the critical capacity is reduced to a very small value, and the capacity of the coil itself may be sufficient. It is easy, especially by observing certain artifices, to wind a coil through which the impedence will be reduced to the value of the ohmic resistance only, and for any coil there is, of course, a frequency at which the maximum current will be made to pass through the coil. The observation of the relation between self-induction, capacity and frequency is becoming important in the operation of alternate current apparatus, such as transformers or motors, because by a judicious determination of the elements the employment of an expensive condenser becomes unnecessary. Thus it is possible to pass through the coils of an alternating current motor under the normal working conditions the required current with a low E. M. F. and do away entirely with the false current, and the larger the motor the easier such a plan becomes practicable; but it is necessary for this to employ currents of very high potential or high frequency.

In Fig. 20 I is shown a plan which has been followed in the study of the resonance effects by means of a high frequency alternator. C is a coil of many turns, which is divided in small separate sections for the purposes of adjustment. The final adjustment was made sometimes with a few thin iron wires (though this is not always advisable), or with a closed secondary. The coil C is connected with one of its ends to the line L from the alternator G and with the other end to one of the plates *c* of a condenser $c\ c_1$, the plate (c_1) of the latter being connected to a much larger plate P_1. In this manner both capacity and self-induction were adjusted to suit the dynamo frequency.

As regards the rise of potential through resonant action, of course theoretically it may amount to anything since it depends on self-induction and resistance and since these may have any value. But in practice one is limited in the selection of these values, and besides these there are other limiting causes. One may start with, say, 1,000 volts and raise the E. M. F. to fifty times that value, but one cannot start with 100,000 and raise it to ten times that value because of the losses in the media, which are great, especially if the frequency is high. It should be possible to start with, for instance, two volts from a high or low frequency circuit of a dynamo and raise the E. M. F. to many hundred times that value. Thus coils of the proper dimensions might be connected each with only one of its ends to the mains from a machine of low E. M. F., and though the circuit of the machine would not be closed in the ordinary acceptance of the term, yet the machine might be burned out if a proper resonance effect would be obtained. I have not been able to produce, nor have I observed with current from the dynamo machine, such great rises of potential. It is possible, if not probable, that with currents obtained from apparatus containing iron the disturbing influence of the latter is the cause that these theoretical possibilities cannot be realized. But if such is the case I attribute it solely to the hysteresis and Foucault current losses in the core. Generally it was necessary to transform upward, when the E. M. F. was very low, and usually an ordinary form of induction coil was employed, but sometimes the arrangement illustrated in Fig. 20 II has been found to be convenient. In this case a coil C is made in a great many sections, a few of these being used as the primary. In this manner both primary and secondary are adjustable. One end of the coil is connected to the line L_1 from the alternator, and the other line L is connected to the intermediate point of the coil. Such a coil with adjustable primary and secondary will be found also convenient in experiments with the disruptive discharge. When true resonance is obtained the top of the wave must, of course, be on the free end of the coil as, for instance, at the terminal of the phosphorescence bulb B. This is easily recognized by observing the potential of a point on the wire *w* nearer to the coil.

In connection with resonance effects and the problem of transmission of energy over a single conductor, which was previously considered, I would say a few words on a subject which constantly fills my thoughts and which concerns the welfare of all. I mean the transmission of intelligible signals, or perhaps even power, to any distance without the use of wires. I am becoming daily more convinced of the practicability of the scheme; and though I know full well that the great majority of scientific men will not believe that such results can be practically and immediately realized, yet I think that all consider the developments in recent years by a number of workers to have been such as to encourage thought and experiment in this direction. My conviction has grown so strong that I no longer look upon this plan of energy or intelligence transmission as a mere theoretical possibility, but as a serious problem in electrical engineering, which must be carried out some day. The idea of transmitting intelligence without wires is the natural outcome of the most recent results of electrical investigations. Some enthusiasts have expressed their belief that telephony to any distance by induction through the air is possible. I cannot stretch my imagination so far, but I do firmly believe that it is practicable to disturb by means of powerful machines the electrostatic condition of the earth and thus transmit intelligible signals and perhaps power. In fact, what is there against the carrying out of such a scheme ? We now know that electric vibration may be transmitted through a single conductor. Why then not try to avail ourselves of the earth for this purpose? We need not be frightened by the idea of distance. To the weary wanderer counting the mile posts the earth may appear very large, but to that happiest of all men, the astronomer, who gazes at the heavens and by their standard judges the magnitude of our globe, it appears very small.

And so I think it must seem to the electrician, for when he considers the speed with which an electric disturbance is propagated through the earth all his ideas of distance must completely vanish.

A point of great importance would be first to know what is the capacity of the earth? and what charge does it contain if electrified? Though we have no positive evidence of a charged body existing in space without other oppositely electrified bodies being near, there is a fair probability that the earth is such a body, for by whatever process it was separated from other bodies—and this is the accepted view of its origin—it must have retained a charge, as occurs in all processes of mechanical separation. If it be a charged body insulated in space its capacity should be extremely small, less than one-thousandth of a farad. But the upper strata of the air are conducting, and so, perhaps, is the medium in free space beyond the atmosphere, and these may contain an opposite charge. Then the capacity might be incomparably greater. In any case it is of the greatest importance to get an idea of what quantity of electricity the earth contains. It is difficult to say whether we shall ever acquire this necessary knowledge, but there is hope that we may, and that is, by means of electrical resonance. If ever we can ascertain at what period the earth's charge, when disturbed, oscillates with respect to an oppositely electrified system or known circuit, we shall know a fact possibly of the greatest importance to the welfare of the human race. I propose to seek for the period by means of an electrical oscillator, or a source of alternating electric currents. One of the terminals of the source would be connected to earth as, for instance, to the city water mains, the other to an insulated body of large surface. It is possible that the outer conducting air strata or free space contains an opposite charge and that, together with the earth, they form a condenser of very large capacity. In such case the period of vibration may be very low and an alternating dynamo machine might serve for the purpose of the experiment. I would then transform the current to a potential as high as it would be found possible and connect the ends of the high tension secondary to the ground and to the insulated body. By varying the frequency of the currents and carefully observing the potential of the insulated body, and watching for the disturbance at various neighboring points of the earth's surface, resonance might be detected. Should, as the majority of scientific men in all probability believe, the period be extremely small, then a dynamo machine would not do and a proper electrical oscillator would have to be produced, and perhaps it might not be possible to obtain such rapid vibrations. But whether this be possible or not, and whether the earth contains a charge or not, and whatever may be its period of vibration, it certainly is possible—for of this we have daily evidence—to produce some electrical disturbance sufficiently powerful to be perceptible by suitable instruments at any point of the earth's surface.

Assume that a source of alternating currents s be connected, as in Fig. 21, with one of its terminals to earth (conveniently to the water mains) and with the other to a body of large surface P. When the electric oscillation is set up there will be a movement of electricity in and out of P, and alternating currents will pass through the earth, converging to, or diverging from, the point C where the ground connection is made. In this manner neighboring points on the earth's surface within a certain radius will be disturbed. But the disturbance will diminish with the distance, and the distance at which the effect will still be perceptible will depend on the quantity of electricity set in motion. Since the body P is insulated, in order to displace a considerable quantity the potential of the source must be excessive, since there would be limitations as to the surface of P. The conditions might be adjusted so that the generator or source s will set up the same electrical movement as though its circuit were closed. Thus it is certainly practicable to impress an electric vibration at least of a certain low period upon the earth by means of proper machinery. At what distance such a vibration might be made perceptible can only be conjectured. I have on another occasion considered the question how the earth might behave to electric disturbances. There is no doubt that, since in such an experiment the electrical density at the surface could be but extremely small considering the size of the earth, the air would not act as a very disturbing factor and there would be not much energy lost through the action of the air which would be the case if the density were great. Theoretically, then, it could not require a great amount of energy to produce a disturbance perceptible at great distance, or even all over the surface of the globe. Now it is quite certain that at any point within a certain radius of the source s a properly adjusted self induction and capacity device can be set in action by resonance. But not only can this be done, but another source s_1 Fig. 21, similar to s, or any number of such sources can be set to work in synchronism with the latter and the vibration thus intensified and spread over a large area, or a flow of electricity produced to or from the source s_1 if the same be of opposite phase to the source s. I think that beyond doubt it is possible to operate electrical devices in a city through the ground or pipe system by resonance from an electrical oscillator located at a central point. But the practical solution of this problem would be of incomparably smaller benefit to man than the realization of the scheme of transmitting intelligence or perhaps power to any distance through the earth or environing medium. If this is at all possible, distance does not mean anything. Proper apparatus must first be produced by means of which the problem can be attacked and I have devoted much thought to this subject. I am firmly convinced that it can be done and hope that we shall live to see it done.

(To be continued.)

The Electrically Lighted Fountains at the Exposition.

A correspondent of the Buffalo *Times* writes enthusiastically of the electrically illuminated fountains that form such an attractive feature of the spectacular attractions at the Columbian Exposition. He says:

"Of all the contrivances of man for the creation of beautiful effects this electric fountain is the most wonderful. It is impossible for me or any one else to describe the glorious spectacle. It is something that must be seen to be appreciated. But imagine, if you can, a bouquet of gorgeous water flowers rising to a height of 150 feet and changing their colors as they rise and fall; showers of rubies, pearls and amethysts; great sheaves of golden wheat; ferns in columns and sprays of water greener than moss in the woods. But how do they introduce the color effects? This operation is simple. By each search light stands a six-leafed fan arrangement attached to an upright spindle. Each leaf, which is of glass, has a different color. One is red, another green, a third blue, a fourth orange, a fifth sea-green, a sixth ruby. The operator may throw on any one of these colors, which is instantly reflected through the stream and in every drop of spray or particle of mist overhead. He may cause the fan to revolve and thus change the colors with kaleidoscopic rapidity. He may paint one set of streams in red and another in ruby. He may surround a red and vivid central palm with a circlet of a dozen golden wheat sheaves. He may cause a column of water to rise in a sea-green pillar and then to burst into a shower of rubies and so on."

The water for this display is forced through pipes from the pumping station near Machinery Hall. There are four huge pumps in operation there, but the leviathan of the lot is used for the fountain. The daily capacity of the four pumps is forty millions of gallons. The fountain pump, says the writer, "rises before the eye like a six-story house. By actual measurement it is fifty-one feet high. It is what is known as a vertical compound low duty pumping engine. The high pressure cylinder is two and a half and the low pressure cylinder five feet in diameter. The stroke, fifty-two to the minute, is five feet long. . . . In the eastern end of Machinery Hall is the generating plant for the electric light part of this magical fountain. This consists of four big dynamos, set in a row. They are painted white, the fields of their generating cylinders are wound with white cord, and the switchboard from which they are controlled is of white marble. These four dynamos generate the current which throws a fierce light from the reflectors upon the rising columns of water. A thousand horse power is converted into light for the illumination of the fountains. There are two engines in this plant, and one of them of the cross compound type, cylinders 20 inches and 38 inches, running at 224 revolutions per minute, develops 600 horse power and is said to be the largest high speed engine in the country. This pair of engines, painted white like the remainder of the plant, are as graceful and perfect in their operation as if they were built for beauty and not for power. While not in use for the fountains the engines charge the batteries of the fleet of electric launches which run about the lagoons."

Dead-Weight.

A great deal of the expense of electric traction is due to the effect of the dead-weight of carriage that it is supposed to be necessary to carry. There is first the actual material itself perhaps uselessly expended, there is the added strength and weight of motor required, and the added size of locomotive by reason of these two. Then the added cost of capital for plant, and added expense in maintenance. Now let us put it to the electrical engineers who build electrical railways: Is it really necessary to have all this dead-weight besides the passengers? We must remember that questions of extreme efficiency have only lately had their full play. Hitherto, anything that would stand well and do its work, even if inefficient, was enough. The old coach, with its paraphernalia of springs, trappings and gilt, was not designed for special lightness nor on the best scientific principles. The railway wagons were but modified coaches, and to-day the influence of the coachbuilders is paramount; and in trams and electric cars the same old fashion of building cars is followed with but little variation. The Pullman car, a marvel of convenience, is also extremely heavy. It is not so with one other carriage now greatly used—the bicycle. Here every endeavor of scientific ingenuity has been expended to obtain lightness of rolling-stock, and 25 lbs. or 30 lbs. dead weight per person is not uncommon. The speeds, moreover, that this apparently frail structure will stand are often nearly 20 miles an hour, and not over smooth rails, but over the usual broad roads. The question may be suggestively asked: If we are going to have electric cars, can we not do away with much of the dead-weight? And possibly the answer might be more satisfactorily solved—we give the suggestion tentatively—if the cars were designed not by coachbuilders, but by those, like the bicycle builders, who have devoted their lives to the reduction in scientific principles of the dead-weight. A structure, as is well known, need not be less stiff, less strong, if the material is saved where it is not required; and the fact that cars for bearing the weight of so many persons could, if desired, be designed of far less weight should lead those who are considering the electric railways of the future to consider not only the efficiency of their dynamos and engines, not only the equalization of loads, but the reduction to the lowest limit compatible with safety of the dead-weight to be hauled. We think the question is worthy of study.—*Electrical Engineer*, London.

The Illinois Lamp Company and Mr. Schaefer.

The troubles of the Illinois Lamp Company and Mr. John F. Schaefer, the former superintendent, have been settled through the intervention of Mr. B. E. Sunny of the General Electric Company.

The latter company has bought out the stock, good will, patents, etc., of the Illinois Lamp Company for about $1,500. The Illinois company discontinues its proceedings against Mr. Schaefer, who enters the employ of Mr. Sunny for one year at a good salary.

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The Battle Royal at Detroit.

The success or failure of the present plan of the city of Detroit to erect and operate a lighting plant of its own, and to do it economically, is a matter of more than ordinary interest to electrical business men throughout the country.

The general question of the desirability of municipal plants is a broad one, and ELECTRICITY has already given its opinion on the subject. But for a town situated as Detroit is there can be but one opinion among unprejudiced men. The town buys light; it pays out a large sum of money for it; it is entitled to competition, and failing to get the benefits of competition, the only thing it can do in justice to its taxpayers is to erect a city plant and operate it.

As in other matters where the feelings of the General Electric Company are likely to be hurt, our discreet contemporaries have ignored the battle royal which has been in progress in Detroit, and which is not yet finally decided. But the regular readers of ELECTRICITY have been kept posted.

It will be remembered that some months ago the matter of a new contract for the city lighting came up. The Detroit Electric Light and Power Company has had the field to itself, and its present contract expires July 1. The price has been high and the service very bad.

A year or two ago the Michigan Legislature passed a law enabling towns to own lighting plants, but Detroit was barred out through the efforts of Messrs. Fitzgerald and McDonald.

This year Mayor Pingree, after becoming convinced that there would be no competition for the city contract, went before the Legislature and after a hard struggle got the limitations removed. Then followed a bitter fight in the Council, the bribery of several aldermen, the arrest of Manager Fitzgerald, and finally the complete victory of the Mayor.

Manager Fitzgerald made the effort of his life, and finding the tide turning against him, sent for those old campaigners, Mr. Richard McDonald and Mr. Ellery Garfield, who came promptly and took personal charge of the army of special agents. Boodle was plenty, and it is said some of the aldermen got as much as $800 apiece. And although Mayor Pingree is an able fighter, he would surely have been beaten by McDonald and Garfield had not a stroke of good luck come his way. An alderman who had been "approached" by Fitzgerald came voluntarily to the Mayor and surrendered the boodle which Fitzgerald had given him "on account" the day before the question came up in the board for action. Mayor Pingree waved this boodle before the aldermen just previous to the vote, and with wholesome effect—they were afraid to deliver the goods which they had sold.

The appointment of a Lighting Commission followed, and it is expected that bids will be called for within a few weeks for a plant to cost all told about $600,000. Contrary to general expectations, Mr. Frank B. Rae was not appointed as engineer by the Lighting Commission, the place having been given to Mr. Alexander Dow, of Chicago, who has been for years prominently identified with a large manufacturing company.

The next question to be settled in Detroit is "How shall the city be lighted pending the completion of the city plant?" The contract expires July 1, and it has been intimated that the Detroit Electric Light and Power Company will demand a price large enough to pay for their entire plant for four months' service.

Mayor Pingree does not look with approval upon any such scheme, and has several plans by which the city may make its power felt.

Our readers will be promptly informed of further developments.

* * *

An Error at the Start.

We trust that the future official acts of the Detroit Lighting Commission will be a good deal further beyond criticism than the appointment of their electrical engineer; and this without any reflection whatever upon Mr. Dow. His appointment was just as surely an improper one as would have been the placing of a manufacturer of apparatus on the commission itself.

The proper man for that position would be some one who has never been interested in the sale of the apparatus of any company which is to be a competitor for the plant.

There are dozens of such men to be had, men of ability and experience equal at least to Mr. Dow's.

If the commission desires to place itself beyond criticism at once, it will secure the services of two consulting engineers, who shall pass upon Mr. Dow's work; and no one should be more anxious for such an arrangement than Mr. Dow himself.

The State of Michigan is not barren of electrical talent, and we beg to suggest to the commission the name of a gentleman who is eminently qualified, both by ability and by his freedom from entangling business alliances, to fill such a position creditably—Prof. H. S. Carhart, of Ann Arbor University.

The appointment of Prof. Carhart and Mr. Rae would clear the atmosphere at once.

* * *

Electric Heating Applications.

The subject of electric heating has been vigorously pursued recently, as the latest application of this system will show. This is a method of burning brick by electricity and dispensing with the ordinary kiln. The process, which has been put to a practical test, is extremely simple and the bricks so produced are pronounced harder and better than those of the usual manufacture, and they are also produced more cheaply and in a much shorter time.

The apparatus consists of a number of electrically connected iron molds in which the clay is placed and on which covers are securely fastened. The molds and their contents are then heated by a current which completes the burning in about three hours, after which the covers are automatically removed and the finished bricks are dumped out to cool.

This system of heating permits an intense degree of heat to be applied which is unattainable in a kiln and reduces the time necessary for burning to a fraction of the time formerly necessary. This process in some respects seems well adapted to burning all kinds of clay wares, as besides the intensity of the heat it also permits of accurate regulation, which is an essential condition for most earthenware manufacture, as the least defect in any flue of a kiln will ruin all the goods in the vicinity of that flue.

In burning many wares it is also a matter of extreme care to reduce the heat very gradually and evenly after the burning is finished in order to avoid cracking the goods, and in this respect an electric heater would have a great advantage over the kiln. There is, of course, no pressure exerted on the molds by the clay as it shrinks in volume during the burning.

* * *

Safe Medical Apparatus. The question of the safety of utilizing the currents from central stations in connection with electro-medical apparatus has been raised for discussion frequently, and the general opinion is that any danger attending this practice is not probable, but it must be admitted that although remote it is not impossible for the patient, in case of certain accidents, to receive a considerable overdose of current. The danger lies chiefly in the direction of imperfect insulation and the possibility of contact with other lines carrying much higher voltages. The mains should certainly not be used for medical use, unless the very best systems of automatic cut-outs are employed so that any disturbance on the line will cut off the current altogether.

There is no doubt but that patients generally would prefer to avoid the possibility of electrocution however remote, and with the very best of apparatus the treatment by electricity should only be administered by a physician thoroughly familiar with its use.

* * *

IT IS doubtful if the visit of Mr. E. I. Garfield to Detroit in the interest of his friends Fitzgerald and McDonald was productive of much good. There are a great many respectable business men in that city who would condemn, without further consideration, anything in which Mr. Garfield is interested.

* * *

WE WONDER why it is that Mr. E. I. Garfield, at one time Controller of the city of Detroit and now secretary of the General Electric Company, fails to register at any hotel when he visits that city, but sneaks in and out of town like a fugitive from justice. Can any one tell?

* * *

THERE can be no impropriety in our reminding Mr. Alexander Dow, electrical engineer for the Detroit Lighting Commission and some time agent for the Brush Electric Company, that we are looking at him.

An inventor in Lynn proposes to sprinkle the streets of that city with an apparatus built on an electric car, the sprinkler itself being in many respects similar to those with which the ordinary water cask on wheels is equipped.

Lieut. Spencer and the Westinghouse Exhibit.

Exhibitors in the Electricity Building of the World's Fair are having a good deal of quiet fun over the frantic efforts made by Lieut. E. J. Spencer, who has charge of the General Electric Company's exhibit, to have a portion of the Westinghouse exhibit abolished as a common nuisance.

It appears that after space had been allotted to the various companies it was discovered that no provision had been made for filling the large space on the south wall of the building over the gallery, and that without decoration of some kind it would not be at all in keeping with the rest of the building. This wall space was accordingly offered to the General Electric Company, who declined to use it, as did three or four others afterwards. Finally it was offered to the Westinghouse Company, who accepted it promptly.

Workmen have been busy for some days arranging the display, which will consist of a figure of Columbus and some scroll-work in incandescent lamps, and an illuminated sign of the Westinghouse Company of mammoth proportions. It was evidently feared that the chance visitor would consider the entire building as an exhibit of the Westinghouse Company and the General Electric Company merely a dependency of the former.

At any rate, Lieut. Spencer objected. Petitions were circulated among exhibitors asking for the removal of the sign, but they got few signatures—not over a dozen all told. Then Mr. Spencer wrote to Prof. Barrett, as the story goes, and threatened to withdraw the exhibit of the General Company. He received a vigorous reply, stating that if any such thing were attempted the management would cancel all the passes of Mr. Spencer and his employees, and would run the exhibit themselves.

The sign remains, and exhibitors, particularly those in the gallery, consider it a welcome addition to the show in the building.

Observations.

Chicago and the World's Fair.

A representative of ELECTRICITY who recently spent a few days in Chicago observed—

That the town is being run wide open.

That the police interpose no objection to the enjoyment of the multitude, whatever direction the enjoyment may take.

That the show in its entirety is the grandest exhibition the world has ever seen, and that Chicago has eminent reason to be satisfied with herself.

That the Bowery is tameness itself compared with the Midway Plaisance, and that even the babes of the exhibiting tribes know enough to reach for American coin.

That the Western Electric Company's exhibit is the most attractive one in the Electricity Building; that the Westinghouse exhibit comes next, and the General Electric Company is in third place.

That the curtains in front of Newspaper Row will dissolve in a damp atmosphere.

That the masses will leave the most instructive exhibits, like Prof. Gray's telautograph, and crowd each other to get near the "fake" electrical hand organ, which is driving exhibitors in the west gallery to insanity.

That that hand organ has got to go.

That Dr. Owen, who sells "electric" belts, is very much in evidence, whiskers and all; and that his exhibit should not have been allowed within one mile of the Electricity Building.

That by allotting space to various "electro-medical" exhibits of a questionable nature, the management has assisted in the humbugging of the public.

That the Ferris Wheel is the biggest thing at the Fair, and that when it finally lands at Coney Island, where it naturally belongs, New Yorkers who have not already seen it in the Midway will be amazed.

That the statement of a New York paper that there is nothing new in the conception of this wheel is nonsense; that the wheel is a notable triumph of engineering skill, and ought to make a fortune for its inventor.

That the hotels in Chicago are trying to pay off all their mortgages out of the profits of this season's business.

That the new hotels that failed to advertise are not turning many guests away.

That the restaurants throughout the city have maintained their regular rates, which have never been high.

That intending visitors who select the Hotel Ingram, kept by Warren Leland, will make no mistake.

That Chicago's surface cars, for the purpose of getting about in the business part of the town, are about as useful to a stranger as so many ox teams.

That the huts of the African and South Sea Island tribes on the Midway, illuminated by incandescent lights, must cause even their inhabitants to smile.

That the entertainment provided at the Trocadero is the best thing of the kind ever heard in this country; that New York has never yet been able to maintain anything of the kind, and that the audiences are far more respectable than those which gather at a mixed entertainment in New York—even at the Vaudeville Club.

That the grand show is now complete, open every day in the week from 7 A. M. to 11 P. M., and that every citizen who can raise the money, even if he has to borrow it, should go and see it and stay as long as possible.

World's Fair Notes.

The exhibit of the Bryant Electric Company, which is illustrated in this issue, is one of the most artistic exhibits in the gallery of the Electricity Building. It is composed of a number of their well-known switches mounted on a dark background and very artistically arranged to form an outline for a smaller board on which are mounted very neat designs for fuse blocks and sockets. As will be noticed, the railing is composed of different parts of their appliances. The display was designed and constructed by the Grier brothers, who are the Western agents for the Bryant Company.

The Belknap Motor Company's exhibit occupies a prominent position on the east side of the main floor of the Electricity Building. The exhibit is exceedingly novel and attractive, especially to the ordinary visitor. The practical application of the electric motor as shown in the display appeals to their nature, as is proven by the quaint remarks dropped within hearing of the attendants. The company have twenty-six motors in operation. Some of them are used in running coffee mills, while others are utilized to run dynamos and exhaust fans. A very neat electrical sign has been erected on one side of the booth which is attracting considerable attention. Their electric drill with magnetic grip is very interesting.

The electrical exhibit of the British Government has arrived and is being placed in position in the Electricity Building. It consists principally of a number of historical instruments and includes the original telegraph machines made by Wheatstone and Cooke. The intention of the display of instruments is to convey to the mind the course pursued in developing the telegraph to its present state. A large number of sections of cable are exhibited which show the action of different climates and currents of water on insulation. The exhibit as a whole is a very creditable one for the Government sending it.

The Western Electric Company's large display continues to be one of the leading attractions in the Electricity Building. The electric scenic theatre was opened this week and commanded the attention of a portion of the large crowd that congregates around the company's space.

The decision of the directors to keep the Fair open every evening instead of only three evenings in the week has been favorably received by both exhibitors and visitors. A number of the displays, especially those in the Electricity Building, can only be shown to advantage after dark. Since the order went into effect the construction department has been overwhelmed with orders for more incandescent lights, showing that the exhibitors expect a largely increased attendance at night.

The electric buoys which are to light the water way between the Park and the city pier have all been anchored in position and connected up by a double cable. It is expected that current will be turned on during the coming week. With the lamps illuminating the water there will be little danger of the many boats plying between the city and the Exposition grounds colliding with each other.

The Action of Compound Dynamos When Run in Parallel.

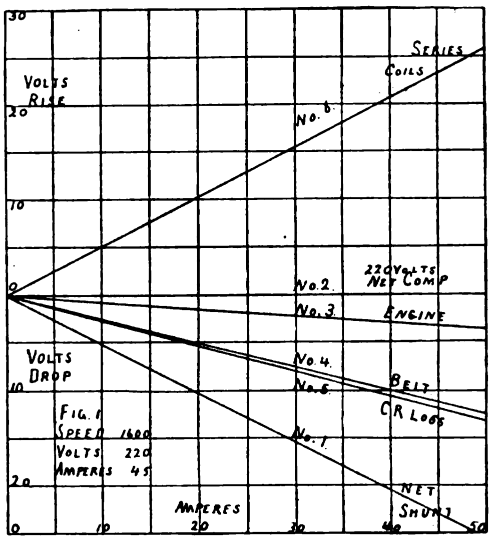
BY WILLIAM L. PUFFER, S. B.*

While arranging some details of the wiring plan for connecting up two compounded railroad generators so that they could be tested for commercial efficiency, while under the conditions of full load, by one of the purely electrical methods, my attention was drawn to the fact that the usual method of adjusting such dynamos so that they would give a constant potential at their terminals irrespective of the current flowing could not be a correct one unless the machines were exactly alike in all respects.

The general practice is to over-compound such generators, and then to experimentally shunt the series coils with a German silver ribbon until the desired "0 per cent. rise" is obtained; this is well enough for a single dynamo, but when two or more are in parallel, with their series coils also in parallel, the German silver shunts do not in any way aid the different dynamos in equalizing their load, and any original structural difference will cause the load to divide unequally. I found that in all of the power plants that I could then visit (winter of 1890-91) there was very decided evidence of this tendency to unequal division of the load, and it could readily be seen that some machines were always taking more than their share of an increase of load and tending to do too little when the load fell off. There seemed to be a very common knowledge of the trouble in making the dynamos work well together, but there seemed to be no attempt to help the matter, or, as far as I could find, any knowledge of where the fault was.

A year ago the Thomson-Houston Electric Company was so kind as to loan the Institute a pair of similar over-compounded motor-type dynamos which had been adjusted for "0 per cent. rise"; these dynamos were similar to the power generators of that company, and enabled me to make a study of the action of compound generators connected in parallel. The dynamos were belt driven from the main shaft in the dynamo room of the Physical Department and were under good average running conditions. A short piece of shafting was arranged so that by slipping the pulleys slightly the two armature shafts could be mechanically connected, and therefore must at all times be at the same speed. Suitable water resistances connected to each machine were used for varying the output of the armatures. Double-pole jack-knife switches of the type generally used were provided for connecting the two dynamos in parallel. A dead-beat ammeter was placed in each armature circuit, and an Ayrton & Perry spring ammeter in the equalizing wire; a Weston voltmeter was used in connection with pressure wires to measure the voltage of either armature.

Considering first the action of a single shunt dynamo driven by a belt from an engine doing no other work, if now the load be gradually increased to the maximum amount that can be safely carried, and if from time to time simultaneous values of the current and voltage be taken and plotted as in Fig. 1, Curve 1—for want of a better name let us call this the *net* characteristic curve of the combination—this curve would be a horizontal line (Curve 2) if it were not for the sum of a number of actions all of which tend to lower the electromotive force. Beginning at the engine there is the usual fall of speed as the load increases, due simply to the action of the governor (Curve 3); the dynamo pulley lags behind more and more on account of the increasing slip of the belt as the transmitted power becomes greater (these two changes are plotted in Curve 4); in the dynamo armature there are the usual demagnetizing reactions which lower the electromotive force; and finally there is the fall of potential in the armature wires as well as all the necessary leads, fuses, ammeters and connections up to the distribution point or bus bar where the voltmeter was connected (Curve 5). These separate losses may be plotted separately, and their sum will equal the amount that the net characteristic will fall below a horizontal line.

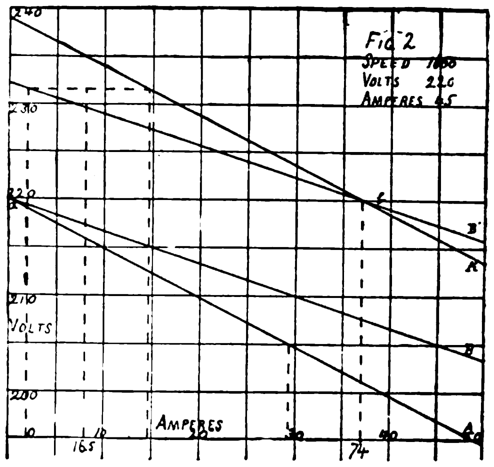


Inasmuch as the net characteristic in this combination is a very drooping one, it would be necessary to use hand or automatic means of adjusting the voltage as the current changes so as to keep the mains at the normal value—the effect of this regulation can be considered to be a raising or lowering of the net characteristic bodily without any material change in the inclination. Such regulation is always too late by at least the time necessary to produce a change of the indicating device, yet if this amount is small and the demand for current is not very variable such a combination is perfectly satisfactory, and even desirable, on account of the sudden fall of voltage on a short circuit which lessens very materially the shock to all parts of the system.

A second similar combination can be connected in parallel to this first one and the load divided between them—all that is necessary is to have the voltage of the incoming system very nearly equal to that of the bus bar or common point and then to close the switches. Evidently if the voltage of the new dynamo were just right no current could pass in either way, but if it were somewhat too high then a part of the total current would change from the old dynamo to the new one. If, for example, the new dynamo were x volts higher than the old, then the current through it would be of such value as would cause a fall of $\frac{1}{2}x$ on the net characteristic, and the current from the old dynamo would be smaller by the same amount. When the net characteristic is quite drooping, as is always the case with shunt dynamos, there is little or no danger of even overloading an armature when connecting it to the mains, in fact it is common practice in central stations to judge of the voltage of the new dynamo by the looks of its pilot lamp. If the two units (dynamo with its engine) have similar net characteristics, any change of load, sudden or not, will divide equally between them; but if, as usual, the characteristics are not similar this will not be the case, and we shall find that the unit with the steepest characteristic will not take its share of the work if the load increases, and will take more than its share with a decrease of load.

Let the lines A and B in Figure 2 represent the net characteristics of the two units; when the armatures are in parallel and delivering no current, let the voltage be brought to 220 volts, then the two lines are common, as at a. A sudden current of 74 amperes will cause the voltage to drop to 205, and B will deliver 45 and A 29 amperes. If now the load is equalized with 37 amperes in each armature, and the voltage brought up to 220 by the use of the regulating rheostats, the lines A and B are raised to A^1 and B^1 respectively, being common at b; now let the total current be diminished from 74 amperes to 16.5 amperes, a similar construction shows that the voltage will rise to 231.6 volts, and that A will deliver 14.5 amperes, and B 2 amperes.

When two dynamos with net characteristics like these are subject to a rapidly changing load, it is impossible to evenly divide the current, and a balance has to be struck between the limits on the one hand of the dynamo A driving B as a motor—which will, of course, do no especial harm other than to waste energy in heating and sparking—and on the other hand of melting the fuses of dynamo B during an unusually heavy call for power, which might have been safely carried by the fuses if equally divided. It is plain that in this case the combination of the two dynamos is not double the capacity of either one, and the commercial efficiency is considerably lessened by the want of similarity of the net characteristics.



It is very desirable on many accounts to have a dynamo which will automatically maintain an approximately constant potential at the switchboard irrespective of the amount of current flowing. We may add a series winding to the dynamo of just sufficient number of turns to give such a magnetizing effect as will produce a voltage which shall be at all times exactly equal and opposite to the combined effects of the change in engine speed, belt slip, armature reactions, and the drop of voltage due to the resistance of the armatures, lead wires, ammeter, safety devices, and the like, up to the bus bar (Figure 1, Curve 6). The net characteristics will now be made up of the sum of the individual effects, as shown in Figure 1, Curve 2, and the voltage at the switchboard would be constant at all times were it not for the hysteresis of the iron in the magnets, which will very slightly prevent the instantaneous rising and falling of the effect of the series coils, and any change in resistance due to temperature change. The temperature change will be slow, and is corrected by an occasional change of the rheostat in the shunt coil circuit and can be neglected for the present.

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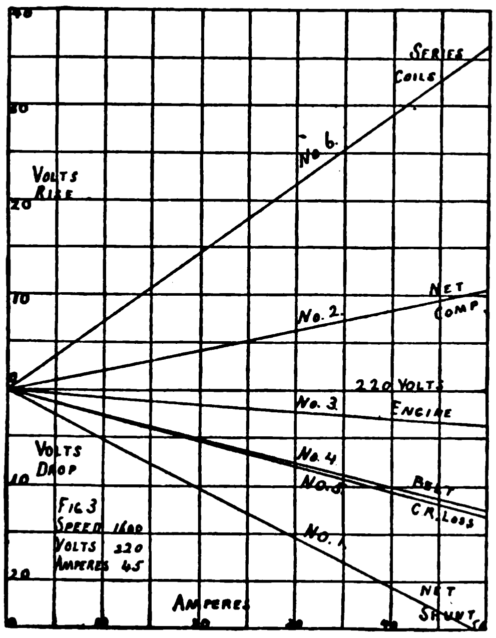
*Abstract from "Technology Quarterly," Vol. V, No. 4, read March 23, 1893.

Should it be necessary to use a second dynamo of exactly similar design, we cannot proceed as in the case of simple shunt dynamos, for this reason: if the new dynamo is at exactly the same voltage as the mains at the switchboard when connected in parallel, the combination will be unstable, because if for any cause the voltage of either dynamo varies a little, so that the new machine becomes ever so slightly a motor, the effect of the reverse current in its series coil will be to weaken still more the electromotive force, which will allow an increasing current to flow until something burns out.



If, however, there is a third connection made so that the brushes as well as the terminals of the two dynamos are connected, it becomes impossible for this reversal to happen, and the machines will run perfectly under all changes of load.

An examination of the components of the net characteristics (Figure 1, Curve 2,) shows us that if the incoming dynamo be brought up to the voltage of the switchboard and the switch closed, the load will instantly divide between the two dynamos with no disturbance or shock of any kind. Suppose, for instance, that the loaded machine is giving out 40 amperes, we see from the net shunt characteristic (Figure 1, Curve 1) that there is a drop of 20.5 volts, which is made up by the effect of the series coil (Curve 6), giving a terminal potential of 220 volts. When the new machine at 220 volts is switched in parallel we may first consider that one-half the total current of 40 amperes passes through each of the parallel series coils, and from Curve 6 we see that the volts-rise is cut down from 20.5 to 10.2 in the first dynamo and raised from zero to 10.2 in the new one; from Curve 1 we see that for each dynamo this change of 10.2 volts just compensates for a current of 20 amperes through the armature circuits, and that the total load of 40 amperes at 220 volts will be equally divided between the dynamos.

The action of compound constant potential dynamos in parallel is generally misunderstood, and the equalizing connection is credited with a remarkable power of control over the output of such dynamos which it does not and cannot have, as can be seen by watching the dynamos while at work as well as by examination of the makeup of the net characteristic (Figure 1). The common idea is that the equalizer has the property of compelling a lagging dynamo to take its share of the work, and we hear of the wonderful power of control which it has even over dynamos of different types and sizes running under somewhat different conditions. Now the real effect of the equalizer is to put the series coils in parallel, so that the total flow of current from the plant will divide between them inversely as their resistance without any regard as to whether this current comes from one armature alone or is divided among many, and hence it follows that it cannot in any way exercise even the slightest regulating effect on any one dynamo that it does not have over all the rest. The armatures themselves are running in parallel under the usual conditions of ordinary shunt dynamos, and the total current will divide between them under the same laws that would hold if there were no series coils at all and the current were taken from the two main wires to which the brushes are connected.

The net characteristic of the plant is then a falling one as far as the armatures are concerned, to which has been added the automatic regulation of the parallel series coils which act together in proportion to the total flow of current from the station; and if these series coils are all alike in effect, each dynamo will have its voltage altered by an equal amount in proportion to the output of the station, but each armature will not do its share of the work unless all the net falling characteristics are exactly similar.

(*To be continued.*)

South American Indians Instructed.

The Washington *Star* credits Amos J. Thomas with relating the following: "The Bolivian Government," said Mr. Thomas, "recently attempted to establish a telephone line between Lapas and Lake Titicaca, forty-five miles apart. It was torn down and destroyed so frequently by the Indians that the Government was compelled to abandon it. The electric light plant in Lapas was preserved by adopting an ingenious method of overawing the natives. After the plant had been in operation but a few nights it happened that there was an eclipse of the moon. The superstitious Indians believed that the electric light was absorbing or swallowing the moon. They gathered in a large body at one quarter of the town and moved upon the plant to destroy it. It was saved only by the intervention of the troops. The Government the next day selected representative Indians, took them to the power house, shocked them severely, then took them out along the line and shocked them again with the wires, and informed them that the electric light was an evil spirit and that they had better leave it alone. Since then they have had no trouble on that score."

Current Items.

The combined length of the world's telegraph lines is 881,000 miles, or enough to encircle the earth about thirty-three times.

Prof. Bell thinks the time occupied by inventors in working out the problem of aerial navigation by the usual inflated gas-bags and methods of steering them is wasted. He thinks a feasible means of propelling and directing an air ship would be by a kind of trolley system where the rod would hang down from the car to the stretched wire, instead of extending upward. He recommends this idea to inventors.

The selectmen of Brookline, Mass., are considering whether they ought to prohibit the running of an electric carriage in the streets, complaint having been made that it frightened a horse. Mr. Fiske Warren, the owner of the vehicle, cites in defence of such use of it the case of the bicycle, against which similar objections were raised when it first appeared, but are heard no more.

In a paragraph going the rounds it is stated that a New England firm has introduced a new resistance metal in wire, sheet or castings, which is regarded as a very important contribution to this class of material in electrical engineering. The wire resembles ordinary copper wire on the outside, has a pinkish white tinge at the surface of fracture, and is very strong, without losing much ductility. Combined with these favorable mechanical qualities, it is claimed that the wire has the remarkable resistance of thirty-five times that of copper, with a temperature co-efficient of less than one-tenth that of German silver.

One of the most curious displays in the Electrical Building at Chicago is the magic pencil. Large script letters made of different colored electric lamps form the initials of the Western Electrical Company, and behind them is a pole or stick supported by small wires and resembling a huge pencil. This pencil is all the time in motion, its movements being automatically controlled. It starts at the top of the "W," and follows the lines of that letter two down strokes and two up strokes. Then it jumps over to the "E," and finally traces the "Co." Wherever it touches, or appears to touch, it leaves a trail of fire behind it. The first thing it does is to illuminate the topmost lamp of the "W," and then the next lamp below burns brightly, and the third and all the others in turn.

E. T. Evans, a jeweler in Golden, Col., has invented a clock which has electricity for its motive power. The clock in question has neither weight nor spring, but consists only of three wheels, a pendulum, two electric magnets and a battery. The motive power is transmitted to the pendulum and only enough power is required to overcome the lost motion of the pendulum. The two electromagnets are arranged similar to a motor. In starting the pendulum connection is formed on one side and at a certain angle is automatically cut off again, the pendulum swinging back of its own gravity, and as it passes the centre of gravity it makes connection again on the other side, and when it reaches the same angle the current is cut off. The line of contact at each swing of the pendulum is just long enough to give sufficient force to overcome the lost motion. One tooth marks the revolutions every minute and by a very simple device this wheel is connected with the dial wheels. The advantages of this clock are that it never needs winding but will run as long as the battery lasts, which is from twelve to thirty-four months.

Neglect on the part of hotel guests to turn off the gas or electric lights in their rooms when leaving them is an evil for which hotel managers have long been seeking a remedy. A recent invention will probably supply it. A switch has been invented which compels the guest to turn off his light upon leaving his room whether it occurs to him to do so or not. In the modern hotel it is the practice to fit the doors of all guest chambers with "secret" or double bolt locks, one bolt being operated from the inside and the other from the outside, and it is by taking advantage of this arrangement that the new switch is made to carry out its work so successfully. To provide means whereby the occupant of the room may turn the light off from the inside when desired, an auxiliary switch is placed on the inside of the room, in circuit between the controlling door lock and the lamps, in such manner that while the door remains unlocked upon the outside the lamps may be turned on or off at will in the usual manner; but whatever the position of this auxiliary switch may be, as to whether the current is "off" or "on," when the occupant locks his door from the outside upon leaving the room the lights are invariably turned off.

Personal.

Mr. George Walker, of the firm of Claflin & Kimball, Boston, accompanied by his wife, has gone to the World's Fair, and will not be back before July 4.

Mr. Cyrus O. Baker, Jr., of Newark, N. J., whom to know is to esteem, paid a visit to Boston last week. Mr. Baker is entitled to be known as the Ubiquitous Peripatetic, for while he was in Massachusetts only a few days ago, we heard of him only a week or two ago scampering over Europe accompanied by his estimable wife, and ere this he may have reached the Pacific Coast, or be temporarily ensconced in his own office at Newark. Be where he may, he is sure to be among friends.

Mr. W. Burnham, Assistant Manager of the Electric Gas Lighting Company, Boston, has recently suffered from an attack of sickness which necessitated his abrupt return from an unusually successful trip down South.

Mr. Fred Swan, Constructing Electrical Engineer, Boston, has just closed several large contracts for electric lighting plants and apparatus in the State of Maine. Mr. Swan has a very fortunate way of capturing a contract whenever he goes after one.

Mr. Louis Nahm, secretary and treasurer of the American Electrical Manufacturing Company of St. Louis, Mo., was in New York last week. His visit was principally on the business of the company, placing agencies in New York for the lamps they manufacture, which, he said, are meeting with a large demand.

Legal Notes.

The Cowles Electric Smelting and Aluminum Company have had their appeal dismissed by request in the case of the Pittsburg Reduction Company against the former company before the United States Circuit Court of Appeals at Detroit. The patent at issue was the Hall patent, which covers the only commercial method at present used for manufacturing aluminum.

Mrs. Elizabeth Baker has brought suit in Boston against the West End Street Railroad Company for serious bodily injuries which she alleges were received while a passenger on one of its cars that collided with another car through careless management. She claims $20,000 damages and her husband has put in an additional claim of $2,000 for loss of services.

The Court of Common Pleas at Toledo, Ohio, has granted an injunction restraining the Consolidated Street Railway Company, the Metropolitan Street Railway Company and A. E. Lang from proceeding with the construction of the electric railway between Toledo and Maumee. The injunction proceedings were brought by Wm. B. Taylor, who maintains that the building of the road would constitute a breach of contract by the defendants, who before they procured the franchise had made an agreement not to enter into competition with the plaintiff in the construction and operation of a railroad between Toledo and Maumee.

The Erie Telegraph and Telephone Company has filed notice of reduction in the number of directors of that company from twenty-one to twelve. The officers of the company are to consist of a president, secretary and treasurer and twelve directors, all to be chosen by votes of stockholders. But two of the directors are now required to be residents of the State of New York instead of a majority, as was required when the number of the board was increased in 1891.

Chicago Notes.

The first reception at the Ansonia Electric Company's club rooms was given last Thursday. A large number of invited guests were present and included most of the prominent electrical people in the city. The reception was entirely informal, but more enjoyable on that account. A number of vocal and instrumental selections were rendered by the members of the club. Mr. M. M. Wood, of the company, operated a phonograph, affording much pleasure to the guests.

At one of the sessions of the Fire Insurance Congress held in Chicago this week, C. J. H. Woodbury read a paper on "Electricity as a Fire Hazard." Mr. W. J. Jenks also read one on a similar subject.

In an injunction suit brought by one of the residents on the Twenty-second street line against the Chicago City Railway Company to prevent the completion of the electric road, the presiding judge held that the State law limited the rights of the property-owner to his particular mile of the road, and did not extend over the whole line.

The electric fountain in Lincoln Park was started up last Wednesday, and although the Fair was open the fountain proved as attractive as in former years.

Among the visitors noticed in the city last week were James H. Mason, of the Simplex Wire Company of Boston, Mr. C. P. Mackie, of the Electric Selector and Signal Company of New York. Mr. C. B. Fairchild, of the *Street Railway Journal*, is stopping over a week to see the Fair on his trip back from the Coast to New York.

Boston Notes.

The town of Winchester, Mass., entertains a unanimous opinion apparently on the subject of a municipal gas and electric lighting plant. At a recent meeting of citizens there were thirty-seven votes cast in favor and not a single one against accepting the provisions of the Municipal Lighting Act of 1891. A committee was appointed some time ago and will continue its work in the direction indicated by the vote as above. This is the second vote taken on the subject, and it is confidently expected that ere long such a project will be undertaken by the town.

For some time past a change of location for some of its electric car tracks has been contemplated by the Lynn Street Railway Company, which would prove an inconvenience to many of the employees of the General Electric Company engaged in the factories. In consequence, petitions to the company against the proposed change are being got up in the factories and are securing so many signatures, the president, Mr. C. A. Coffin, and nearly all the other officials signing, that the chances are the changes will not be made as the petitioners constitute an entire host of daily patrons over the road.

Notwithstanding the inconvenience caused by a serious fire in the insulated department of the Stanley Electric Manufacturing Company's factory at Pittsfield, Mass., lately, the company, with its ample resources, has been able to keep everything moving, shipping orders daily. The resuscitated department, larger and better equipped than ever, will soon be running full blast again. To enable it to keep up with the extraordinary and increasing demand for its high grade specialties the company is to double its capital, making it $200,000 in future.

A new board of management has been appointed for the Danvers and Beverly Street Railway. This road was operated for a time by storage batteries, the use of which was discontinued and traffic entirely suspended. As the road has recently passed into the hands of the Boston and Lynn Railway Company, there is a prospect of its soon being put into operation again.

The Electric Heat Alarm Company of Boston, whose valuable device is receiving such rapid popularity as a most efficient and reliable piece of apparatus for the prevention of fire, has just issued a handsome little pamphlet describing and illustrating its entire system, which is being called for from everywhere. The representative who is in charge of this company's exhibit at the World's Fair has already closed many excellent contracts for the installation of this device, property-owners alike in the East and West having promptly caught on to its merits and appreciated the solid and useful fact that in buildings where this system is in use insurance premiums are reduced.

The fleet of steamers running between Nantucket Beach and Boston are now equipped with the new Westinghouse incandescent lamp, several hundred of them being used. They give excellent satisfaction.

A party of capitalists from Hartford, Conn., recently visited Milford, Mass., to inspect and investigate the merits of the storage battery system which is there in use with a view to its adoption in Hartford.

General News.

What is Going on in the Electrical World.

Camden, N. J.—The Camden Horse Railroad Company has obtained permission to equip its lines with electricity.

Lockport, N. Y.—The Lock City Electric Railway Company has ordered its new cars from the St. Louis Car Company.

Seattle, Wash.—The city council is considering the supplanting of the incandescent street lighting by a complete arc system.

Columbia, S. C.—The Electric Street Railway Company intend at an early day to extend their new line, forming a belt system.

Richmond, Ind.—The Richmond Light, Heat and Power Company has purchased James M. Starr's entire gas and electric light plant.

Hot Springs, Ark.—The electric cars are now running and give great satisfaction. It is now proposed to build an electric line to the Ouachita River.

Elmira, N. Y.—The electric railroad is to be extended to the village of Horseheads. The Horseheads motor line cars are being converted into electric cars.

St. Louis, Mo.—Charles Stagle has made a general assignment of the Stagle Electric Engineering Company to Gustav F. Decker in trust for the benefit of creditors. Assets, $3,000.

Saratoga, N. Y.—The double-deck cars on the electric road are proving very popular vehicles, and are crowded every trip. Cars run to the Geyser every half hour and to the lake every hour.

Riverside, Cal.—A company has been formed here and a franchise asked for the construction of an electric railway in the principal streets. The scheme is backed by the strongest financial men in the city.

Waterford, N. Y.—The village trustees have closed a contract with the Union Electric Light and Power Company of Lansingburgh and Waterford for twenty electric lights of 1,200 candle power.

Brooklyn, N. Y.—The board of aldermen has granted franchises to the Nassau Electric Railroad Company and to the Kings County Electric Railway Company to run lines in certain specified streets within the city limits.

Toledo, Ohio.—Hon. T. P. Brown proposes to have an electric railway between Toledo and Maumee at an early day if he has to build it himself. He is tired of the legal squabbles in which the project has become involved.

Philadelphia.—Should nothing occur to cause a hitch in the present arrangements, the proposed lease of the Frankford and Southwark Passenger Railway system to the new Electric Traction Company will go into effect July 1.

Hagerstown, Md.—The street commissioners have signed a contract with the Schuyler Electric Light Company of Middletown, Conn., for the lighting of the streets, avenues and highways of Hagerstown for five years from July 1.

Salida, Col.—The local Edison Electric Light Company have decided to use water instead of steam power, and are having a huge ditch made to bring the water to their works, a mile from the source. The stream will supply about 500 H. P.

New Orleans.—The Electric Traction Company, Limited, has come to an agreement with the Crescent City Railroad Company under which the Traction Company will make electric systems of the Crescent City and the Judah Hart lines.

Paterson, N. J.—An agreement having been reached by the Newark and Paterson Electric Railway Company and the Franklin Township Committee, the electric line between Paterson and Newark will be completed as soon as possible.

Jersey City, N. J.—The Passaic Elevated Transit Company have negotiated a loan of $2,000,000 and will construct a double-tracked elevated railway line from West Side avenue, Jersey City, to Broad street, Newark. Either electric or steam power may be used.

Rome, N. Y.—The present contract with the Rome Gas Light Company for lighting the city with electricity will expire next fall, and a special committee has been appointed by the mayor to consider whether it would be advisable for the city to purchase a plant and do its own lighting.

Queretaro, Mex.—Governor Casio, who has lately visited a number of cities in the United States, investigated the subject of municipal lighting by electricity while there, with a view to establishing an electric lighting plant at Queretaro, the capital of the State, in which he has been a ruling power for years.

Manitou, Col.—A franchise to construct an electric railway on Ruxton and Manitou avenues has been granted to M. A. Leddy. The road will cost about $50,000, and $200,000 additional will be applied to the erection of a mammoth casino near the Iron Springs which is expected to increase travel on the road by its attractive features.

Americus, Ga.—The Thomson-Houston Company, owners of the defunct street railway in this city, are making preparations to remove the rails, wires and other appurtenances from the streets under a recent order of the city council requirits removal within thirty days. The road is five miles long and cost somewhere between $25,000 and $30,000.

Hartford, Conn.—E. P. Usher, the general manager of the Milford and Hopedale Electric Company, says he hopes and expects to be able to reach an agreement with the Hartford and Wethersfield Horse Railroad Company by which the Hopedale storage battery system may be put in actual operation here; probably on the Parkville line.

Kansas City, Mo.—The Interstate Water and Electric Power Company expect to begin work in a short time in building a dam across the Kaw River near Muncie and locating a big electric power plant there. From this plant the projectors propose to furnish electric power to operate mills, street railways and to furnish the two Kansas Citys with cheap lights.

Cleveland, Ohio.—A company, to be known as the Eastern Electrical Equipment Company, has been organized here for the purpose of promoting a new electric car which is constructed with a view to economy in room and protection to the motorman, who is to have an elevated compartment to himself, where he can give undivided attention to his duties without any obstruction or interference from passengers.

San Diego, Cal.—The Electric Railway Company, it is said, propose to lay out a park in the suburbs at an expense of $75,000. The park is to be modeled after a famous park in Honolulu, and a landscape gardener is now there copying the plans. These are to be brought here and are to be closely followed. The park will contain about 160 acres, and will be used as picnic grounds and as a source of attraction to induce people to travel over the electric railway.

Newark, N. J.—The plant, leasehold interests, etc., of the defunct Schuyler Electric Light and Power Company have been purchased by the Central Power Company, a Newark concern of some years' standing. It having been stated that the Consolidated Traction Company and the Newark Electric Light and Power Company were interested in the above purchase, representatives of those companies deny that they had any part or interest in the transaction.

Miamisburg, Ohio.—The Miamisburg Electric Company has begun here what promises to expand into an extensive business. The company is capitalized at $100,000, and will manufacture the Burnley cartridge batteries, the Imperial dry batteries, commutator segments, commutator brushes, copper brushes and various attachments for dynamos and electric machines in which copper is used. The officers of the company are: T. V. Lyons, president; W. A. Mays, vice-president; Wm. Gamble, treasurer; D. H. Allen, secretary.

Buffalo, N. Y.—Dr. Hill, city chemist, recently tested the lights furnished the city by the General Electric Company, and found them of much less C. P. than the contract called for. The electric company then had a test made in a darkened room, by Profs. Whitthaus, Vanderbergh and Randall, who found the light furnished even stronger than that specified in the contract (2,000 C. P.) Dr. Hill's tests were made in the street. He still believes his tests the more accurate.

New York.—Several of the new trolley cars of the Westinghouse system have been received at the shops of the Union Railway Company at 170th street and Third avenue. They differ from the present cars in that the reserve battery, which is intended for use in cases of emergency, is located in an iron cylinder in front of the dashboard, instead of under the car.—An electric drill, the invention of Wesley Webber, of Pittsburg, Pa., is to be tested in a day or two in boring an artesian well 1,500 feet deep at the power-house of the Broadway Railway.

Elizabeth, N. J.—The Suburban Electric Light Company's plant, which furnished light to Elizabeth and its suburbs, was destroyed by fire on the night of the 19th inst. The loss is estimated at over $100,000. The building destroyed contained a new triple-compound 600 horse-power Corliss engine, two 300 horse-power engines, two dynamos, each of 500 volts, six alternating and two 220 volt machines, two arc power, two small high speed engines and a lot of other valuable machinery. Most of the machinery to operate the Elizabeth and Plainfield Electric Railway was stored in the building.—The Elizabeth and Plainfield Electric Railway Company, being unwilling to assume the burdens that the city council were inclined to impose, have withdrawn their application for a franchise for the projected road.

"Queen" Apparatus at the World's Fair.

The standard electrical instruments exhibited by this company are attracting increased attention each day, and prove of considerable interest to all who appreciate strictly high class workmanship.

The Armour Institute of Chicago is equipping an electrical laboratory in good style, and has already reserved some $3,000 worth of the instruments exhibited by Queen & Company. These are to be delivered in November after the Exposition has closed. The manufacturers consider this as a happy compliment to their product, as Mr. Armour spares no money in making his equipment the best in the country.

The De Mott Electric Motors.

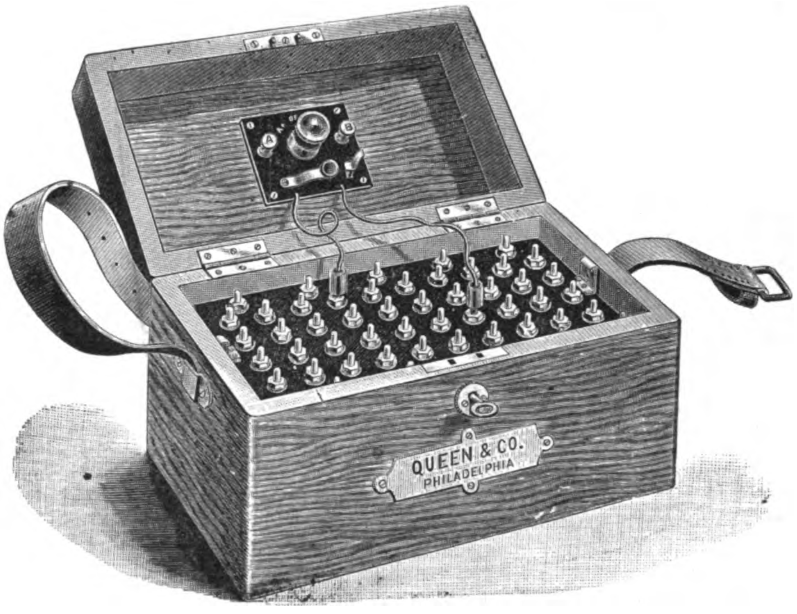
Messrs. J. Jones & Son, 39 Vesey street, New York, report a very satisfactory demand for the De Mott Motors and De Mott Improved Bluestone Battery, for which they are agents. The motors embody several improvements not found in other motors on the market, and no expense has been spared by the manufacturers to enable them to give to the trade an article which they say is an "ideal in miniature motors." They claim for it "symmetry in appearance, no dead centre, practically noiseless while in operation, and more work with the same amount of current than any other motor." The motors are designed to operate mechanical toys, model machinery, turn tables, toy launches, music boxes and miniature machinery of all kinds and for ventilation purposes, and they can be run on the ordinary bluestone battery, or with the De Mott Improved Bluestone Battery. The prices range from $4 to $15 for the motor, and the improved battery is sold at $1.75 to $2.00 according to size; fans from 50 cts. to $1.50.

The "Aluminum-Iodine" Portable Testing Battery.

The Testing Battery illustrated herewith is a new form that has been thoroughly developed in the experimental department of Queen & Company, Incorporated, Philadelphia, and is now placed on the market by this company with expectation of a large demand.

In chemical composition the "Aluminum-Iodine" cell is quite different from anything heretofore known, and possesses important features the most essential of which is high electromotive force. Each one develops a voltage of 1 4-10 volts, which is fully 50 per cent. more than the output of an ordinary "Chloride of Silver" cell. The effect, as will be seen, is that 50 aluminum silver cells have the same efficiency as 75 of the other type, so that great economy in first cost results.

The cells are prepared with great care, and those used in the laboratory of Queen & Company for months past have shown remarkable constancy and long life. There is no danger of explosion or leakage, and local action is practically eliminated, so that when not in use there is no injurious waste.



The "Aluminum-Iodine" Portable Testing Battery.

The cells are mounted in handsome polished mahogany cases in sets of 50, more or less as desired. A battery of 50 cells gives 70 volts E. M. F., which is quite sufficient for all ordinary work. Electrical engineers in testing the insulation of submarine or underground cables often require 200 or 300 volts to secure proper sensibility in results, and a battery of as many cells can readily be prepared if desired.

The "Acme" Portable Testing Set, also manufactured by Queen & Company, contains twelve "Aluminum-Iodine" cells, which they propose to use entirely in place of the regular "Chloride of Silver" form.

The makers are prepared to meet a large demand for this new specialty, and interested parties should write them for a copy of descriptive circular No. 445.

The Carpenter Enamel Rheostat Company.

The catalogue of the Carpenter Enamel Rheostat Company, of Bridgeport, Conn., issued the present month, contains a number of illustrations showing various forms of rheostats, theatre dimmers, arc lamp resistances, feeder equalizers and regulators for fan motors, with brief but explicit descriptions of the machines and appliances manufactured by the company, also tables giving sizes, capacities and prices of the various articles. A large number of letters from electrical companies, theatre managers and others, attesting the satisfaction the rheostats, etc., have given to all who have dealt in or used them, are appended to the catalogue, and the general tenor of these is indicative of a very high efficiency in the machines and their thorough adaptability to the services required of them. The Catalogue can be obtained by applying to Chas. D. Shain, general selling agent, 136 Liberty street, New York, or to the company, as above.

The Joseph Dixon Company's World's Fair Exhibit.

The Joseph Dixon Crucible Company is the only concern in the world which manufactures every article of which graphite is a component part. With the invention by Joseph Dixon in 1827 of the plumbago crucible, the crucible business was revolutionized. At that date began also the manufacture of Dixon's stove polish, foundry facings, and the development of an industry now grown to enormous proportions and fittingly represented by the Joseph Dixon Crucible Company.

This company has two exhibits at the Fair. One is of Dixon's American Graphite Pencils, in the northeast gallery of the Manufactures Building, and the other, covering all the other articles manufactured by them, in the northeast gallery of the Mines and Mining Building. The Pencil exhibit occupies a space 10 by 14 feet. In the centre of this space stands a low mahogany table surmounted by a pyramid of velvet which is covered with pencils arranged in graceful and beautiful designs by an artist employed specially for that purpose. Over this pyramid stands a rosewood and plate-glass case. Two ornamental facades of turned and carved mahogany front the space, which is separated from neighboring spaces by means of Japanese bead curtains suspended from carved grilles.

The space is lighted at night by means of two gilt electroliers of six 16 candle power lights each.

The company's exhibit of general and special graphite products in the Mines and Mining Building occupies a space 25 by 28 feet. A very handsome cherry facade fronts the space while the sides are hung with tastefully arranged portieres. Crucibles, retorts, ladles, stopper-heads and nozzles, graphite boxes, phosphorus chargers, resistance rods and devices, incandescent filament forms and other special goods made of graphite are shown in upright cabinets. In another case is shown the development of an electrotype plate, in which process the use of graphite is an essential. In still another case are shown over fifty varieties of graphite, for as many different uses and under as many different names, such as graphite for lubricating, stove polish, foundry facings; for green, dry or loam castings; core wash, ingot mold wash, shot and power glazing; for electrotypers, gilders' use, hatters' use; rubber packings, piano and organ actions; "pot-leading" yachts; for crucibles, lead pencils, paint pigment, lubricants, etc., etc.

There are also shown samples of graphite from all the principal sources from which that article is obtained. One very fine sample from the Island of Ceylon weighs nearly 300 pounds. Comfortable chairs, with writing desks and stationery for the free use of those who may desire it, give to the exhibit an air of genial comfort and ease.

The Dixon Company were the first to complete their exhibit and their promptness brought forth the following letter from the Chief of the Department:

World's Columbian Commission.
Office of the Director-General of the Exposition.
Chicago, Ill., U. S. A., May 20, 1893.

MR. JOHN A. WALKER, Vice-President,
Joseph Dixon Crucible Co., Jersey City, N. J.

Dear Sir: I am in receipt of your esteemed favor of the 17th instant, and in reply beg to state that the Department is much pleased with the promptness with which your exhibit in this building was installed and completed through the supervision of your able assistant, Mr. McNaughton, and also to heartily congratulate you on making a display which is in every particular attractive and dignified, and which fully illustrates in an interesting and instructive manner the graphite industry.

Yours very respectfully,
F. J. V. SKIFF, Chief.

The Page Belting Company.

This well-known company, which is said to have the largest and best equipped belt factory in this country, if not in the world, has a very extensive exhibit at the World's Fair, where it has demonstrated the possibility of manufacturing enormous belts to run tandem at tremendous speed in the successful operation of the two belts on the powerful Allis engine at the Fair, one 72-inch and the other 71-inch. These belts are run at 5,600 feet per minute and each transmits 4,000 H. P.; they were put in place and started at once at full capacity and have run perfectly without being touched since they were set to work. The Anniversary Souvenir which the company has had printed to commemorate the twenty-fifth year of its existence is a neatly printed work, containing a history of the company from its origin, a description of the belting works and their productions, and numerous illustrations, among which are pictures of the building in which the Page brothers began business and of their present extensive factories, a panorama of the World's Fair, the managers' dwellings in New York, Boston and Chicago, the company's pavilion in Machinery Hall at the Chicago Exposition, its exhibit in the Electrical Building, the processes by which the largest belts in use are manufactured, the large tandem belts running on the Allis engine at the World's Fair, interior views of the company's stores, etc. The souvenir is copyrighted.

COMMERCIAL PARAGRAPHS.

We understand that business is very brisk with the New York branch of the Mather Electric Company, and that they have recently added to their force the services of Mr. Henry M. Stiles (formerly with the Thomson-Houston Company) as electrical engineer, and Mr. Harry W. Colby (formerly with the General Electric Company) as general agent for the sale of power apparatus and lighting plants. Mr. A. E. Bowers has entered the service of Messrs. Claflin & Kimball, sole agents of the new "Novak" lamp, and can be found at the office of the company, 97 Nassau street. He will have entire charge of that line of the business.

The company, as we have said, are enjoying a brisk run of business. Last week they closed a contract with the Lynchburg (Va.) Electric Company for a 100 H. P. generator, and several contracts for small motors.

The W. S. Hill Electric Company, 133 Oliver street, Boston, have published a convenient little hand-book containing illustrations and price lists of the various switches, rheostats, switchboards, etc., manufactured by the company, all of which are in popular demand and bear a high reputation. The company also furnish motors and generators for all purposes, made under their own patents, and will be pleased to answer all inquiries.

The Wirt regulating switch used for dimming incandescent lights, particularly for use in bed rooms and nurseries, seems to be winning popular favor, as two different papers have written to the Ansonia Electric Company, the manufacturers, for electrotypes for illustration.

The Ansonia Electric Company report the sale of Wirt Brushes to be on a steady increase, and heavy sales in Stanley Moisture-Proof Transformers and Habirshaw Wire, as well as Crocker-Wheeler Motors, especially of the fan type.

A. M. Morse & Company, contracting engineers, St. Louis, and the Southwestern representatives of the Buckeye Engine Company, report several important recent contracts for Buckeye Engines. Prominent among them are a 500 horse power plant for the electric lighting station of the new St. Louis Union Depot, consisting of three tandem compound non-condensing engines, direct coupled to Siemens & Halske slow speed multipolar generators. Also an 800 horse power plant consisting of four medium speed engines for the Alton Electric Street Railway, Alton, Ill.

INCORPORATIONS.

A charter has been granted to the York and Dallastown Electric Railway Company of York, Pa. Capital stock, $60,000.

The Kings County Electric Railroad Company, Brooklyn, N. Y.—to build and operate an electric railway line in Brooklyn. Capital stock, $500,000.

The Coney Island, Fort Hamilton and Brooklyn Railroad Company, Brooklyn, N. Y.—to build an electric double-track freight and passenger road from 89th street, Brooklyn, to Coney Island. Capital stock, $500,000. Promoter, P. H. Flynn.

The Kenosha Electric Light Company, Kenosha, Wis.—to establish an electric light plant. Capital stock, $15,000. Promoters: E. G. Hazelton, L. Bain and U. J. Lewis.

The Electric Shorthand Company of Chicago, Ill. Capital stock, $10,000. Incorporators: David F. Haymes, M. E. Haymes and M. W. Kenney.

The Maine Electrical Construction Company, Fairfield, Me.—to construct and equip electrical plants. Capital stock, $10,000. Promoters: Chas. H. Maxfield, Frank Vickery, B. F. Maxfield, John R. Donnelly, all of Fairfield, Maine.

The Columbian Electrical Company, St. Joseph, Mo.—to do a general electrical business. Capital stock, $2,000. Promoters: Geo. S. Rough, Chas. E. Roehl, Frank C. Barrington, all of St. Joseph, Mo.

The O. O. Electric Company has been organized at Saco, Me., for the purpose of carrying on a general electrical and mechanical manufacturing business. Capital stock, $10,000. President, J. B. Duff; treasurer, H. B. Bennett.

The Waco (Tex.) Electric Light and Street Railway Company has increased its capital stock from $250,000 to $300,000. The company may put in an arc plant shortly.

The Painter and Morrison Company, Baltimore, Md.—to deal in electric lamps, switch sockets, electric switches and electric drop lights. Capital stock, $5,000. Promoters: J. F. Morrison, G. E. Painter, D. F. Pennington, S. Nordlinger, E. D. Crock, H. Samuel, G. A. Miller, E. O. Quigley.

The Trenton Electric Construction Company, Trenton, N. J.—to manufacture, install, construct, operate and sell every kind of electrical apparatus. Capital stock, $25,000. Promoters: Geo. F. Applegate, J. P. Toman, Carl F. Adam, Anton Adam, Paul Lupke, all of Trenton, N. J.

The Cummings and Engleman Conduit Company, Detroit, Mich.—to manufacture, sell and lay conduits for electrical purposes, also construction of electric railway and power plants. Capital stock, $300,000. Promoters: Jas. F. Cummings, Eugene M. Engleman and James H. Land.

The Richmond Light, Heat and Power Company, Richmond, Ind.—to manufacture and sell gas and electricity, and gas and electrical machinery for light, heat and power purposes. Capital stock, $300,000. Promoters: Jas. D. Platt, Joe E. Lewes, Jas. C. Reber and Archibald Stuart.

The North Chicago Electric Railway Company, Chicago, Ill.—to construct, lease, buy or acquire horse, dummy and street railroads in Chicago and adjoining territory in Cook County, Ill. Promoters: Chas. H. Gurney, Jno. E. Burke and Alex. M. Savage.

The Young-Moskowitz Railway Car Electric Lighting Company, Newark, N. J.—to manufacture apparatus and light railroad cars by electricity. Capital stock, $1,000,000. Incorporators: Charles A. Sterling, F. C. O'Reilly, Leon D. Adler, James F. Connelly, Joseph Lowenberg, Dr. H. C. H. Herold, Samuel Young, E. B. Gaddis, Morris Moskowitz and B. W Hopper.

The Eagle Electric Manufacturing Company, of South Superior, Wis. Capital stock, $4,000. Incorporators: A. Striemer, E. A. Noble and O. J. Graham.

The Washington Electric Company, Chicago—to manufacture and deal in electrical and mechanical appliances. Capital stock, $40,000. Promoters: Victor W. Johnson, Olaf R. Iverson, Wm. L. Maddock.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JUNE 20, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

499,805. Electric-Railway Grade Crossing Device. Joseph B. Stewart, Haverstraw, assignor of one-third to Joseph P. Bradfield, Syracuse, N. Y. Filed Aug. 26, 1892.

499,871. Trussed Trolley-Board for Electric Cars. Henry Cochran, Chester, Pa. Filed Jan. 16, 1893.

499,943. Trolley-Wire Hanger. Lorenz Spillman, Columbus, Ohio. Filed Jan. 21, 1893.

500,065. Closed Conduit for Electric-Railways. John C. Henry, New York, N. Y. Filed Sept. 8, 1890.

500,066. Electric Locomotive. John C. Henry, New York, N. Y. Filed Oct. 18, 1890.

500,067. Electric Locomotive. John C. Henry, New York, N. Y. Filed Dec. 16, 1891.

500,068. Electric-Railway System. John C. Henry, New York, N. Y. Filed April 29, 1892.

500,070. Electric-Railway Trolley. John C. Henry, Westfield, N. J. Original application filed Sept. 3, 1890. Divided and this application filed Feb. 1, 1893.

500,104. Electric-Railway System. Charles J. Reed, Orange, N. J., assignor of one-third to Gustav Stahl, Philadelphia, Pa. Filed June 27, 1892.

ELECTRIC LIGHTS AND APPLIANCES.

499,908. Stand for Electric Lamps. Josef Cathrein, Innspruck, Austria-Hungary. Filed Feb. 15, 1893.

499,916. Mode of and Means for Renewing the Filaments of Electric Incandescent Lamps. Gustav A. Frei, Springfield, Mass. Filed Nov. 14, 1892.

500,026. Electric-Lighting System. Charles L. Morey, Centralia, Ill. Filed Feb. 11, 1893.

500,053. Incandescent Electric Lamp. Edward E. Cary, Boston, Mass. Filed April 7, 1893.

500,075. Incandescent Electric Lamp. William E. Nickerson, Cambridge, Mass. Filed April 1, 1893.

500,076. Incandescent Electric Lamp. William E. Nickerson, Cambridge, Mass. Filed April 3, 1893.

500,077. Incandescent Electric Lamp. William E. Nickerson, Cambridge, and Edward E. Cary, Boston, Mass. Filed April 5, 1893.

500,078. Incandescent Electric Lamp. William E. Nickerson, Cambridge, Mass. Filed April 5, 1893.

500,079. Incandescent Electric Lamp. William E. Nickerson, Cambridge, Mass. Filed April 7, 1893.

DYNAMOS, MOTORS, ETC.

499,769. Regulator for Electric Motors. George H. Whittingham, Baltimore, Md. Filed March 24, 1892.

499,780. Means for Storing and Supplying Electrical Energy by Natural Force. Frederick G. Corning, New York, N. Y. Filed Nov. 14, 1892.

BATTERIES.

499,848. Secondary Battery. Fred O. Norton, Oroville, Cal. Filed May 26, 1892.

TELEPHONE AND TELEGRAPH APPARATUS.

499,748. Telephone Exchange. Alfred E. McClaren, Joplin, Mo. Filed June 13, 1892.

499,811. Telegraphy. Pierson J. Wicks, Brooklyn, assignor to the Western Union Telegraph Company, New York, N. Y. Filed March 3, 1893.

SIGNALS AND SIGNALING APPARATUS.

500,041. Electric Signal. George W. Swartz, Florence, Ala. Filed Oct. 31, 1892.

MISCELLANEOUS.

499,726. Productions of Alloys by Electro-Deposition. Charles R. Fletcher, Boston Mass. Filed Feb. 18, 1892.

499,737. Secondary Electric Clock. Richard S. Howland, Providence, R. I. Filed Jan. 4, 1893.

499,852. Electric Converter. Gustav Pfannkuche, Exeter, N. H., and Alfred Pfannkuche, Cleveland, Ohio, assignors to the Brush Electric Company, Cleveland, Ohio. Filed May 13, 1887.

499,864. Electric-Alarm Money Drawer. William J. Walker and Alexander L Bedford, St. Louis, Mo. Filed Feb. 17, 1893.

499,879. Phonograph. Thomas A. Edison, Llewellyn Park, N. J., assignor to the Edison Phonograph Company of New Jersey. Filed July 30, 1888.

499,921. Electric Stop Mechanism for Knitting-Machines. Frank Hammond, Paris, Canada, assignor of one-third to John Penman, same place. Filed Jan. 9, 1893.

499,930. Electric Cut-Out. Otto F. Persson, Lynn, assignor of one-half to Hjalmar C. Schelin, Boston, Mass. Filed May 1, 1893.

499,964. Electric-Bath Metal-Heating Apparatus and Process. George D. Burton, Boston, and Edwin E. Angell, Somerville, Mass., assignors to the Electrical Forging Company of Maine. Filed Dec. 31, 1892.

500,017. Mode of Excavating Shafts. David N. Long, Buffalo, N. Y. Filed Feb. 24, 1891.

500,022. Electric Road Vehicle. John W. Moakler, Denver, Col., assignor of one-half to Horace E. Henwood, Kansas City, Mo. Filed April 16, 1892.

500,027. Electric Bell. William J. Murdock, Boston, Mass. Filed March 18, 1893.

500,045. Automatic Electric Weighing Scale. Charles F. Wood, Richmond, Va. Filed Aug. 30, 1892.

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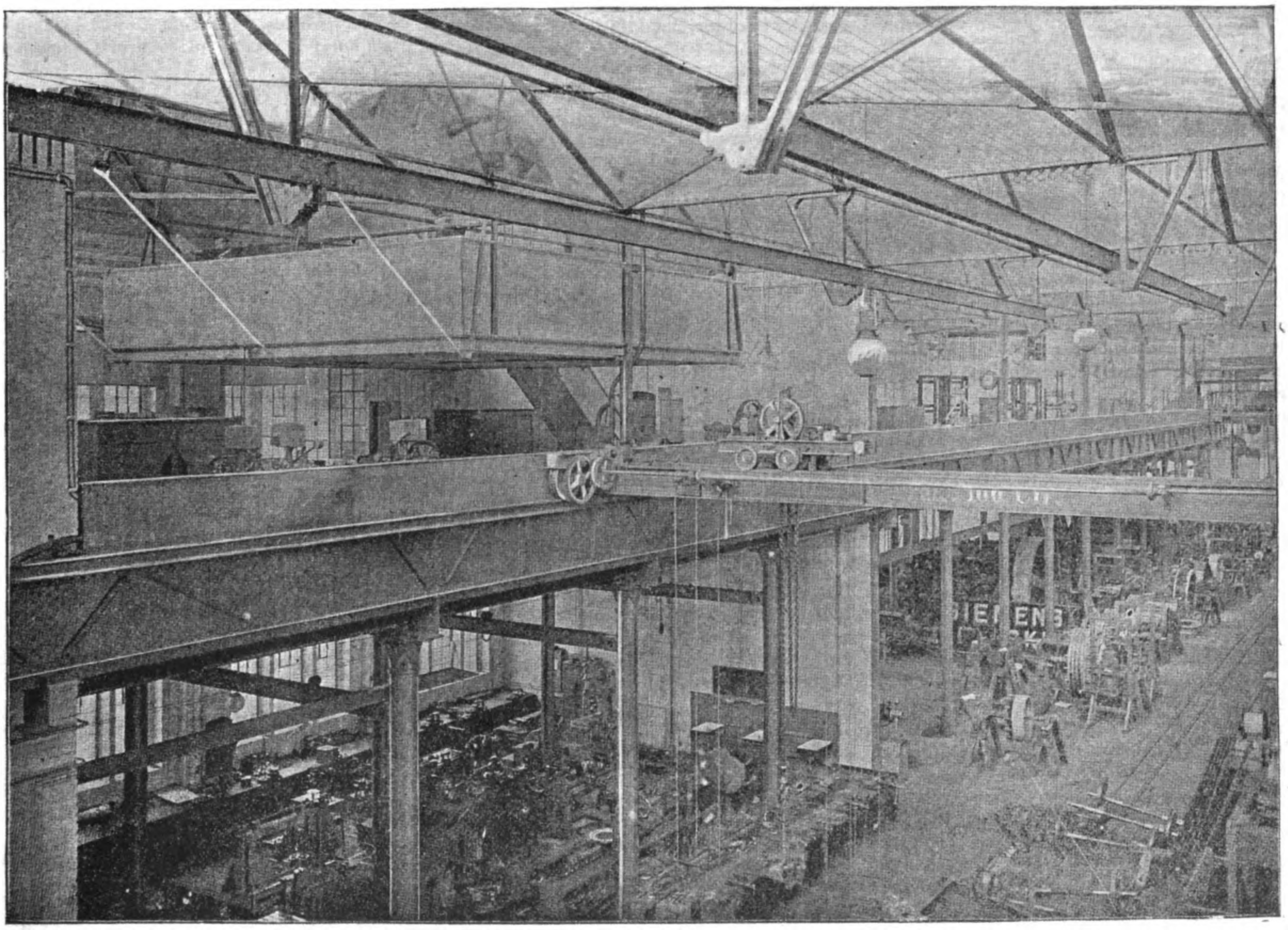

SIEMENS & HALSKE'S CHARLOTTENBURG WORKS. (SEE PAGE 338.)

Electrical Shop Equipments.

The subject of separate motors for machine tools which are directly connected to the moving parts of a machine is coming forward as an important element in manufacturing establishments, and although a comparatively recent innovation it promises to play an important part in the economy of operation of the workshop.

Some interesting data on this subject was given in a paper read before the *Electrotechnische Verein* by Mr. Richter, chief engineer of Siemens & Halske's works.

The subject was considered under three different heads:

1. The factory is driven by an electromotor in the same way as by a steam engine, a turbine, or other motor; in other words, the electromotor takes the place of the steam engine, etc.
2. The factory is divided into several groups, each of which is driven by an electromotor; so-called group working.
3. Each work machine receives its own electromotor; so-called separate or single working.

As an example of the first method may be mentioned a spinning mill at St. Blasien, in the Black Forest, which is driven by turbines, and where the water that has driven these turbines is utilized again, about one kilometre below the factory, by another turbine installation, and the 200 horse power obtained there is transformed into electrical energy and transmitted back to the factory to yield 150 horse power to the main shaft.

The same mode of working also occurs in factories consisting of separate buildings at some distance from one another, and where electromotor working, compared with steam working, will be found economical. Mr. Richter mentions an example of this from his own practice.

It was a question of replacing in a sugar refinery a 35 horse power steam engine, placed in a distant building, by an electromotor to be supplied with current from an electric central station working at a high efficiency, while the steam-engine received its steam from the same boiler plant.

The steam dynamos of the central station consume 7 kg. of steam per effective horse power per hour. At an efficiency of only 90 per cent. for the steam dynamos, of 95 per cent. for the line, and of 90 per cent. for the 35 horse power electromotor, we find a total efficiency of 77 per cent., which means that in the central station 9·1 kg. of steam per hour would have to be expended for each effective horse power produced in the distant building.

The steam consumption of the 35 horse power steam engine amounted at least to 17 kg. per horse power hour, and was, in fact inclusive of the loss in the long pipes, 20 kg. A saving of 54 per cent. was thus effected by electric working.

As an example of group working Messrs. Siemens & Halske's Charlottenburg factory may be mentioned. The arc lamp factory, opened in 1890, is provided in each of its six rooms with an electromotor driving a short transmission shaft with two safety couplings. From these two electric couplings two shafts running the length of the room are driven, and from these latter, by means of an intermediate gearing fastened to the ceiling, are driven the tool machines. Thus every room is independent of the others, and is besides by the safety coupling divided into two parts independent of each other, so that if from any reason the work has to be interrupted in one place this derangement need only extend to half the room.

There is yet another advantage attached to this arrangement, and that is that all the transmissions from one room to another are avoided, and consequently also those dangers caused by the openings in the ceilings made for belt transmission, and which have often contributed to the spreading of fire. And, further, the main transmissions, which are a source of great loss of power, are avoided by group working.

After the favorable results obtained by group working, the 100 horse power steam engine installed in the oldest portion of the Charlottenburg works has been put out of operation, the various sections of the transmission have been divided into five groups, and each group has been driven by an electromotor of proper size. The working current was supplied from the electric station, which is fitted with a highly efficient boiler and machinery plant.

In addition to the saving of energy by suppression of the main transmissions, this arrangement has also the advantage that for night work of individual tool machines the whole transmission need not be run, but only a special portion of a certain section.

Mr. Hartmann, of the firm of Hartmann & Braun, Bockenheim, who has made similar tests, found that the losses of energy caused by transmissions were by no means so small as is generally supposed. He ascertained that a triple transmission had an efficiency of from 13.7 to 66 per cent., or a mean of 47 per cent., and a double transmission of from 52.1 to 71 per cent., or a mean efficiency of 64 per cent., according to the size and extent of the transmission. The numerous investigations made by Messrs. Siemens and Halske have given similar results. In triple transmissions an efficiency of less than 50 per cent. has repeatedly been found, and in double transmissions the mean of many observations was found to be 65.6 per cent. The results, however, are entirely different in installations where all the machines are not always in operation, a condition which obtains in most of the factories. In several of the workshops of the Charlottenburg works Mr. Richter has for some time kept a careful record of the actual working hours of the tool machines, and has found that these hours amounted to from 47 to 74 per cent., or a mean of 62 per cent. of the whole working time. The mean efficiency of a triple transmission is hereby reduced to 29 per cent., and that of a triple transmission to 40 per cent.

Now, as regards electric group working, it will be clear that by arranging the tool machines in smaller groups, so that the intervals of work always affect a whole group, this running without a load can be avoided. If, further, the installation is made in such a way that a double transmission can be dispensed with, a considerable advantage, from a commercial point of view, will be obtained by electric working.

Assuming 90 per cent. to be the efficiency of the generator, 95 per cent. that of the line, and 85 per cent. that of the electromotor (all these values are taken rather low), we get a total efficiency of 72½ per cent., as against 64 per cent. or 40 per cent. for double transmission.

To distribute the machines in such a way that all the machines of the same group are always simultaneously at work will be found difficult because it must naturally tend to making the groups smaller and thus lead to single motor working. At first sight it may seem strange to provide each tool machine with its own electromotor. The objections against such an arrangement are that it renders the installation too expensive, and that on account of the low efficiency of small motors such a system is not economical. Both these contentions are true to a certain extent. As regards, first of all, the prime cost, Mr. Richter has made a large number of calculations, and has found, for instance, that in one of the rooms of the arc lamp factory, where, as has been mentioned, group working has been adopted, and which contains 42 tool machines driven by a 25 horse power electromotor, the prime cost would only have been 13 per cent. dearer if, instead of the one electromotor with transmissions and belts, 42 electromotors with their accessories had been employed. In another room containing 29 tool machines, driven by an 8 horse power electromotor, the result would have been even more favorable, so that a mean of 10 per cent. may be assumed. It must, however, be pointed out that this 10 per cent. only refers to the prime cost of the motor installation and not to the cost of the tool machines, so that on comparing the total cost of single working with that of group working of the whole installation the additional expenditure would hardly amount to more than 3 or 4 per cent.

Now, as regards the efficiency, we will at once assume the most unfavorable case. An electromotor of ¼ horse power, the smallest to be used for similar purposes, has an efficiency of 70 per cent.; taking the efficiency of the line at 90 per cent., and that of the generator also at 90 per cent., we get a total efficiency of 57 per cent. Supposing, further, the tool machine to be joined to the motor by an intermediary piece absorbing 10 per cent., we get a total efficiency of over 51 per cent. Comparing this with the 40 per cent. efficiency of a double transmission it will be seen that the result is not nearly so bad as might be expected. It is clear that in a factory where the working hours of the tool machines exceed 62 per cent. of the total working time the result would be more unfavorable, but even in this case the efficiency would only be inferior to a double transmission if the above percentage amounted to 80 per cent. In basing our calculation, not on the smallest, but on motors of average size, for instance of one horse power, we find that the above figure of 57 rises to 61 per cent., and that of 51 to 55 per cent.; assuming the working hours of the tool machines to be 81 per cent. of the total working time, the efficiency of single motor working will be found equal to that of a double transmission. Compared with group working which, on account of the larger motors employed, has a higher efficiency than single motor working in proportion of 9.8, we may say that single working with motors of one horse power mean capacity, assuming the working hours of the tool machine to be 75 per cent of the total working time, gives the same efficiency as group working where the whole of the machines of one group are either working or standing still at the same time.

Single motor working presents special advantages which will, in many cases, compensate for the higher prime cost. In the first place, by combining the motor with the tool machine, the belts, which so greatly obstruct the light, are dispensed with; the appearance of the room and the light are improved and the existing space can be utilized for the erection of gallerie . The Frontispiece shows such a gallery on which there is working room for twenty-five men. The building, not having to support transmissions, can be of lighter construction; the tool machines can easily be shifted for certain work, requiring only an alteration of the electric wires; the cost of maintenance is diminished by the absence of long belts, and finally a complete independence of the various tool machines is obtained, so that for working after hours or during the dinner hour any one of the machines can be operated without being obliged to run a transmission consuming much power.

Another Non-Infringing Lamp.

Four patents have been issued to W. E. Nickerson and one to Edward Cary, both of Boston, on an incandescent lamp which is outside of the Edison patent. The lamps will be on the market within a few weeks.

The Action of Compound Dynamos When Run in Parallel.—II.

BY WILLIAM L. PUFFER, S. B.*

In a plant of such dynamos each driven by its own engine it is most likely that the net falling characteristics of the armatures will not all have the same steepness, and consequently a fluctuating load will not be shared equally by the dynamos; but it is possible to so arrange things that the series coils do not all act equally on the armatures, and if the resistances of the series coils are slightly changed by the addition of a little German silver or copper ribbon so that the total flow of current divides between the different series coils in such a proportion that the individual net armature characteristics are raised by just the right amount, we again have a plant in which a fluctuating load will divide equally among the different dynamos. The same effect may be produced by the addition of a small resistance in the armature circuit of any dynamo which takes more than its share of an increase of load. A number of machines so adjusted will run together perfectly, and there will be no change of voltage or any difficulty experienced in cutting in or out by the use of the ordinary two or three pole switch; the only precaution to be observed is to have the voltage of a new machine nearly that of the bus bars, for then, when the series coil is put in parallel with all other series coils, it will be traversed by such a part of the total flow of current as will be sufficient to raise the voltage of the armature enough to enable it to deliver its share of the total output.

If a dynamo is to be cut out it will not do to reduce its load first by the use of the resistance in the field circuit, because by this process its load is transferred to the other dynamo armatures and the station voltage will consequently fall somewhat, because the series coils are not proportionally increased. This fall of voltage may or may not be permissible, and is avoided if the switch is opened while the dynamo has its share of the load.

Sometimes it is desirable to have a dynamo which will maintain a constant potential at a point some distance from the switchboard; in this case the series coils will have a few more turns, so as to make up for the fall of potential in the mains; and in Fig. 3 will be found the component curves for a dynamo adjusted for approximately "5 per cent. rise." Curve 1 may be called the "net shunt" falling characteristic made up of the sum of the effects due to the engine change, belt slip, and the fall of potential in the armature circuits represented respectively by the Curves 3, 4 and 5. Curve 6 shows the rise of voltage due to the current in the series coils, and is greater than the total drop Curve 1 by an amount plotted as Curve 2, which is the net characteristic of the over-compounded dynamo.

Should the demand for current exceed the capacity of one dynamo, the addition of a duplicate machine will render it impossible to maintain a constant potential at the distant centre unless both dynamos are run all the time; for while 45 amperes on one dynamo will cause a net rise at the switchboard of 9.5 volts, the same total current furnished by the pair will only produce a rise of 4.75 volts.

If this want of exact regulation does not require the constant running of two dynamos at times of high load, we meet greater troubles in the process of adding the second unit when the load is too heavy for the first one. From the data given in Fig. 3 it is possible to see what will happen under any given conditions when the machines are put in parallel. I have experimentally verified this method of predicting the actions of compound dynamos, and find it exact enough for all practical purposes.

Suppose one dynamo is loaded, what will be the effect if we connect a new one when its voltage is lower, the same as, or higher than the switchboard? I will take from my notebook the results of some experiments on two dynamos with characteristic curves like Fig. 3, first giving the observed results and then calculating them from the curves.

The armatures were mechanically coupled and therefore at same speed. Voltage of each was 222; 30 amperes were taken from No. 2 dynamo and voltage rose to 228, while that of No. 1 fell to 212; then by a double-pole switch No. 1 was put in parallel. Momentarily No. 2 tended to overload and drive No. 1 as a motor, but in a few seconds the load became steady at a voltage of 222, No. 1 furnishing 18 and No. 2 12 amperes. Now by calculation from curves of Fig. 3:

No. 1.	No. 2.	
222.	222.	Volts at switchboard with no load.
−7.5	−7.5	Curve 4. Drop due to speed change when a current of 30 amperes was taken from No. 2.
214.5	214.5	
	−8.	Curve 5. Armature drop with 30 amperes.
	206.5	
	+21.5	Curve 6. Rise from 30 amperes in series coils.
	228.0	Switchboard voltage with 30 amperes output.

Put in parallel with same load, so no change is to be made for speed change. From Curve 6 we see that the change of half of the current from the series coil of No. 2 to No. 1 will raise No. 1.

No. 1.	No. 2.	
214.5	228.0	No. 1 with no load and 30 amperes on No. 2 and then put in parallel.
+12.0	−12.0	Curve 6. Change in voltage with change of half current from series coils of No. 2 to series coils of No. 1.
226.5	216.0	
−4.	+4.	Curve 5. Suppose each armature carried one-half the current then there would be a drop in No. 1 and a rise in No. 2.
222.5	220.0	

We must now add a current to the highest voltage dynamo, or No. 1, that will cause a drop of one-half of 222.5 — 220 volts, which from Curve 5 will be 4.7 amperes.

Then the voltage of the combination will be 221.2; and dynamo 1 will deliver 15 + 4.7 = 19.7 amperes, and dynamo 2, 15 — 4.7 = 10.3 amperes.

Calculated 19.7 amperes, dynamo 1; 10.3 amperes, dynamo 2. Voltage of 221.2.

Measured 18 amperes, dynamo 1; 12 amperes, dynamo 2. Voltage of 222.

Take, for another example, the case when one of these dynamos was at full load and the new machine was brought up to exact voltage and then put in parallel, and applying these methods we shall see that it may happen that all currents may be cut off by the melting of a fuse.

Dynamo No. 1 at 220 volts and no load, then as the load of 45 amperes comes on, the switchboard voltage will be about 230 volts.

220	
−11.2	Drop due to load. Curve 4.
208.8	
−11.7	Drop in armature. Curve 5.
197.1	
+32.5	Rise from series coil. Curve 6.
229.6	Volts at switchboard.

Here the switch is closed.

No. 1.		No. 2.
229.6		229.6
−16.2	22½ amperes in series coil. Curve 6	+16.2
213.4		245.8 Armature voltage.
+ 11.7	Curve 5, to find internal voltage.	
225.1	Armature voltage.	

245.8 Armature voltage No. 2.
225.1 Armature voltage No. 1.

20.7 Difference of armature voltages.
11.7 Drop in No. 2 with 45 amperes.

2) 9.0 Acting to send reverse current through No. 1.

4.5 Curve 5 corresponds to current of about 17 amperes.

245.8 Armature voltage No. 2
−17.0 Drop with 62 amperes. Curve 5.

228.8 Switchboard voltage.

Dynamo No. 1, which was loaded, has a reverse current of 17 amperes and is driven as a motor, while the new dynamo carries the load and is 17 amperes beyond its rated capacity. We see that the switchboard voltage practically does not change under these conditions, but to offset this there is the sudden change of a loaded dynamo into a partially loaded motor and an overload on the incoming dynamo. Such changes would be accompanied by much sparking at the brushes and the liability of thrown belts or blown fuses. Then we may say that if the new dynamo is of lower voltage when connected the voltage will change considerably, but there will be no shock to the dynamos; if the new dynamo is at the same voltage, then the voltage will remain about constant and the armatures will receive a shock; if the new machine is still higher, then the shock will be very severe and the voltage will rise. I had no time for taking readings on the last experiment, but I did notice that the needle of a 150 ampere instrument was out of sight before a switch could be opened.

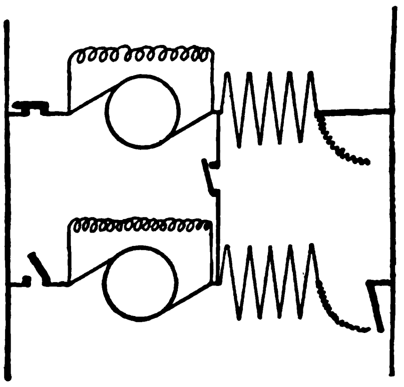

FIG. 4.

There is a very safe and simple method of throwing in a new dynamo, which does not, however, prevent a change in the switchboard voltage unless a special switch is used, as shown in Fig. 4, constructed in such a way that the equalizing connection is first made and then the outside end of the series coil gradually connected by a switch with a few resistance points in it, while at the same time the magnetizing effect of the shunt coil of the loaded dynamo is increased to make up for the loss in the series coil. In this way the series coils can be put in parallel with no jump in the voltage. If, however, there are many similar dynamos in the plant, it might be that the change produced by throwing in a series coil without its armature would not produce a greater change than would be allowable; in such a case the safest way is to connect first the series coils, then rapidly adjust the armature voltage by the voltmeter, or, if in a great hurry, by the looks of the pilot lamps, and then close the armature switch, well knowing that the steep net falling characteristic of the armature circuit will prevent an overload.

It is now clear that when we wish such dynamos to run together we must first adjust the resistances of all the series coils and connections so that when a current is passing through them but not through the armatures the armature voltages must be equally affected, and also see that the armature circuits are so arranged as to give the same net falling characteristics independent of the series coils. It is necessary for good compounding to have the brushes set once for all, and in all well-designed dynamos it is possible to find a point where there will be no excessive sparking. An easier although not so good a way to adjust is to find the best point for the lead and then alter the resistances of the series coils until all dynamos have the same net characteristics; but the rise of voltage due simply to the flow through all the series coils will in this case be different in different dynamos, and there will be a little more difficulty in adding a new dynamo, and a tendency to overload.

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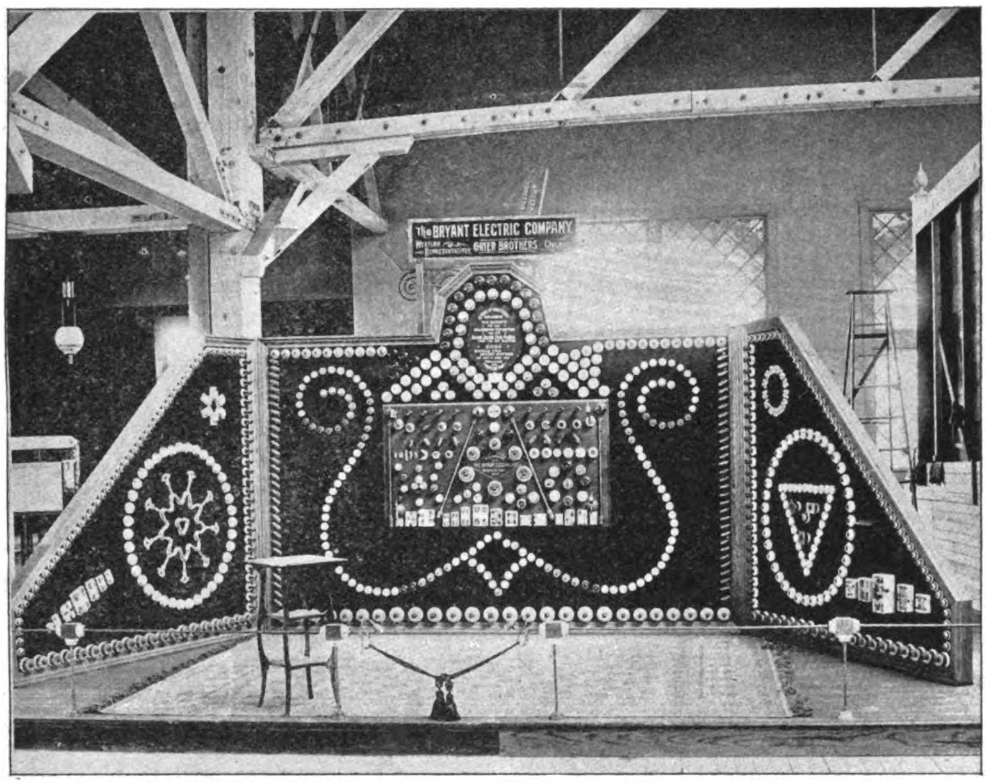
*Abstract from "Technology Quarterly," Vol. V, No. 4, read March 23, 1893.

Nearly all of the compound dynamos in the market for the last few years are purposely built with too many turns in the series coil, and then a shunt of German silver is adjusted by trial at the factory until the voltage at the terminals shows the wished for "0 per cent. rise," or whatever it may be. Now for any one dynamo running under the conditions of the experimental trial this method is simple and perfectly correct; but when such dynamos are run together in multiple it is of no service, and has no effect on the relative actions of the series coils of the dynamos, because of the fact that all coils and all shunts become parallel conductors, and therefore traversed by currents inversely proportional to their resistances. These shunts then merely diminish the total flow of current through the series coils, but in no way do they serve to adjust the effect of the series coils relatively to each other. If it should happen that one dynamo was very much over-compounded and then shunted for the "0 per cent. rise," and another only very slightly over-compounded and consequently only slightly shunted, it is plain that when the shunted series coils are in parallel the shunts will have only the effect of affording a path for a part of the total flow of current, and consequently could be wired up in any convenient place on the switchboard. These two above-mentioned dynamos would then be dissimilar over-compounded machines working in parallel, and in all probability an increasing load would be largely carried by the dynamo with most turns in the series coil, because an increase in total current flowing through the series coils would promote the voltage of this dynamo faster than that of the other. This will be the familiar condition we often see in power plants where the average load is equally divided, while an overload is taken quicker by the dynamo which takes the less at light loads, that is, the one in which the series coils have greatest effect.

In order to make such dynamos work properly it is best to examine the lead and the wiring, and, if possible, give the armatures similar net falling characteristics, and then, by the use of copper or German silver ribbon, slightly change the resistance of the series coils until all armatures are equally affected by the flow of current in the series coils; a single large shunt may be connected at any part of the bars to which the series coils are attached, or perhaps better, each machine may have a shunt across the series connections at the switchboard, on the dynamo side of the main three-pole switch, so that the total shunting capacity varies as it ought with the number of dynamos running.

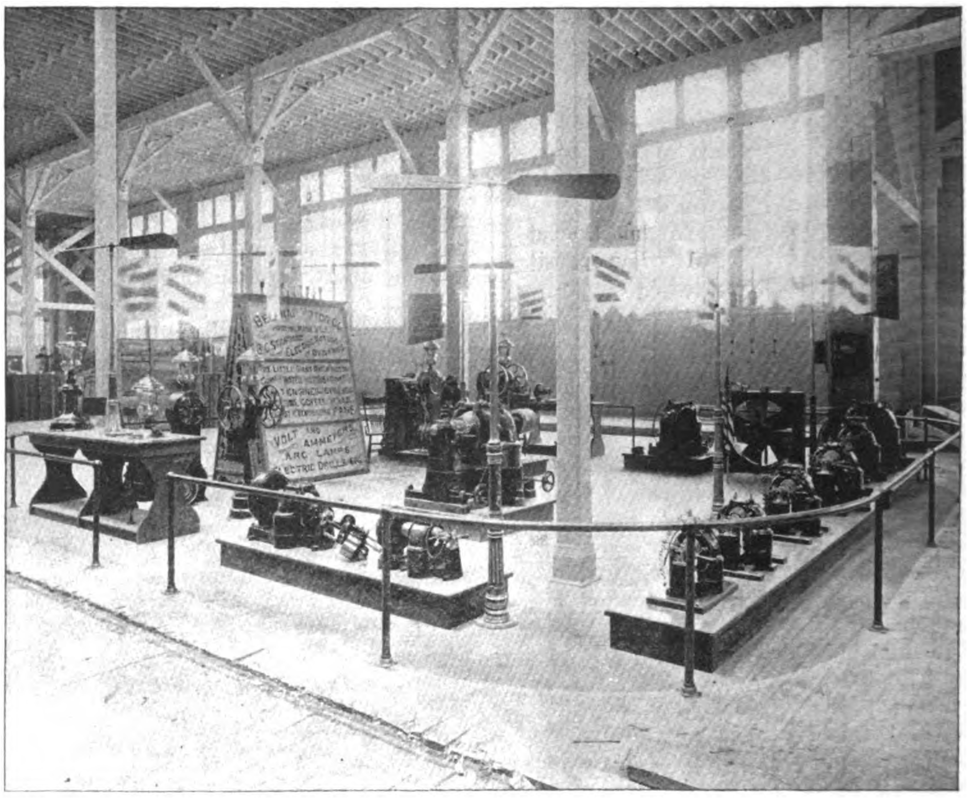


Bryant Electric Company's World's Fair Exhibit.

World's Fair Notes.

A very interesting exhibit, which is just being completed, is furnished by the Japan Government. Owing to the fact that Japan is making a very extensive display in nearly all of the Exposition buildings, and that its exhibits are installed by Japanese only, their display in the Electricity Building has been somewhat delayed. The section assigned to the Japanese Government is located in the northeast corner on the main floor of the building. It consists principally of instruments from the technical laboratory of the University of Tokio and also of instruments used by the Government in detecting movements of the earth caused by earthquakes. Among the latter are the following instruments: The siesmograph, a machine for writing the earth's horizontal and vertical movements on a smoked glass plate. The rate at which the plate moves is also marked by an electrical time ticker. The tremometer is one form of an instrument used to record the slight movements of the earth, usually called earth tremors. The action of the machine is to close a circuit at regular intervals which will cause a spark from an induction coil to perforate a band of paper which moves over a brass table. If the pointer from which the spark projects is stationary, a series of holes following one another in a straight line will be the result, but if the pointer is moving the line will be a curved one, the curves indicating the direction and extent of the motion. Among the other exhibits shown is an electrical contact maker, an electric clock and a safety lamp.

Some of the instruments in this display are of historical value as they were the ones used in the great earthquake of October 28, 1891, from which much important data was obtained.



Belknap Motor Company's World's Fair Exhibit.

The Western Electric Company during the past week have won the gratitude of a large portion of the visiting public at the Exposition by placing nearly 200 chairs and benches around their space in the Electricity Building. By performing this charitable act they not only hold the attention of the visitors longer but also keep a larger crowd interested in their display than would otherwise be possible. If the rest of the exhibitors in the Electricity Building would follow the good example set by the Western Electric this building would soon become the most popular one on the grounds. The small electric scenic theatre, which is a part of the Western's exhibit, is soon to be moved into larger quarters. A space twenty-two by forty-eight feet square has been secured by the company and is being prepared for the theatre. It will have a seating capacity for one hundred and twenty-five people. Two exhaust fans for purifying and cooling the air will be in operation during each performance. The theatre will be free to the public, performances being given every half hour.

The "C. & C" Electric Motor Company, owing to a lack of power, have been unable to get their exhibit in operation before the public until last week. They have now completed connections, and are showing one of their 50 horse power motors running a generator which in turn is used to generate current for an electric pump, an electric hoist and a fan. Besides these, seven other machines are also exhibited. A fifteen-panel switchboard, divided into two sections for a 500 and a 110 volt current, forms a very neat and attractive part of the exhibit.

The exhibits of the Bryant Electric Company and the Belknap Motor Company are illustrated in this issue, the photographs having arrived too late for last week.

A New Electric Railway System.

Operated with Insulated Trolley Wires in a Conduit.

An experimental electric railway has just been put in operation at Coney Island which is equipped with a conduit containing insulated trolley wires with which the trolley shoe under the car makes contact by means of switches placed at intervals along either side of the conduit.

The objects of this arrangement are to avoid the use of overhead wires, secure a conduit system which will not be liable to electrical leakage due to moisture or water in the conduit, and incidentally to make use of a higher voltage than is commonly used.

The experiment is being undertaken by the Universal Electric Company of New York, who own patents covering the system, to demonstrate the practicability of this method of electric railway propulsion, and the present line, which has been in operation but a few days, has so far given every evidence of satisfaction.

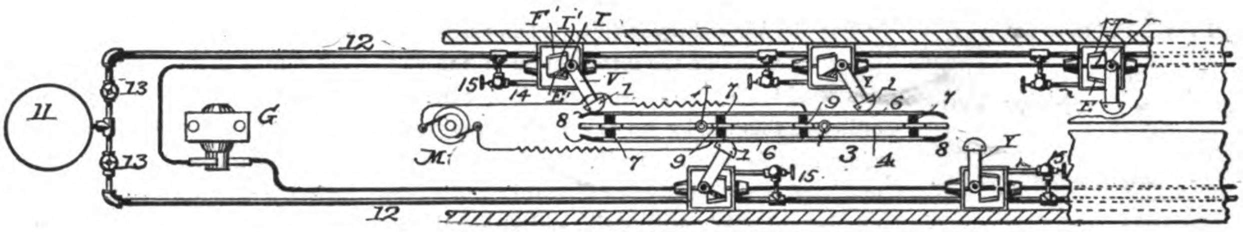


FIG. 1.

Reference to the following figures will explain the details of the system. Fig 1 shows a diagrammatic sketch of the plant and the apparatus which it contains. The station generator G is connected to the two trolley lines in the conduit, the outgoing and return circuit being placed on opposite sides. This circuit, unlike the usual trolley wire, is a heavily insulated lead-covered cable into which switches (shown in Fig. 2) are let in at distances of seven feet, those on one side being midway between the ones on the opposite side of the conduit. Attached to the car is a shoe which passes between the arms (1) of the switches from which the current is taken. The shoe is about twelve feet in length so that its two sides are always in contact with one or two switch arms, and it is held in line with the centre of the conduit by means of several vertical arms or rollers which travel in the slot. The current is led from the brass strips (7) on the shoe to the car motor.

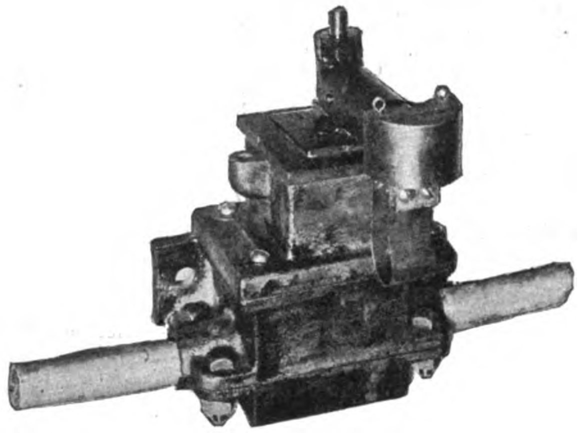


FIG. 2.

The switch boxes are filled with oil which is supplied by a system of piping (12).

Fig. 2 shows a general view of one of the switches which is explained in detail in Figs. 3 and 4. The box is composed of two parts, the lower section of which B has the cable passing through it. The insulation is removed from the cable inside the box and a contact piece E is clamped on the wire. A vertical brass rod I passes through the box, the lower end being provided with a brush L which stands normally between the two lugs of the piece E, and is brought into contact with either by the turning of the shaft I.

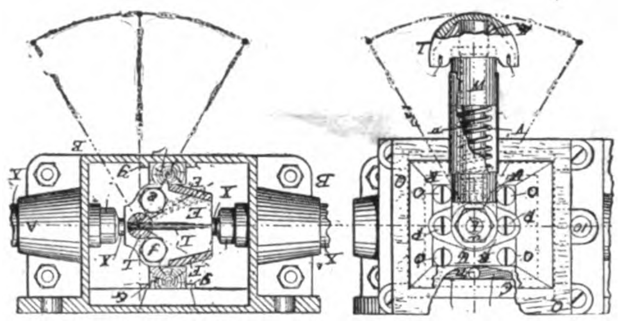


FIG. 4.

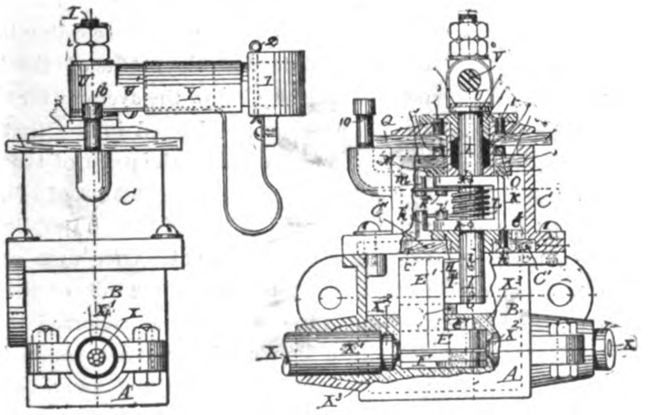


FIG. 3.

From the foregoing it will be seen that the contact arms are normally out of circuit and only carry the current when moved either way by the trolley shoe under the car. The contact arm is arranged to yield inwardly if the direction of the motion of the car is reversed, and the shoe is sufficiently flexible to conform to the sharpest possible curve of the track. In this way the leakage of the current due to water in the conduit is eliminated, and for this reason it becomes feasible to make use of currents of much higher voltage than is commonly used, thereby reducing the amount of copper necessary for the lines.

Fig. 5 shows a section of the road at Coney Island with the top of the conduit removed.

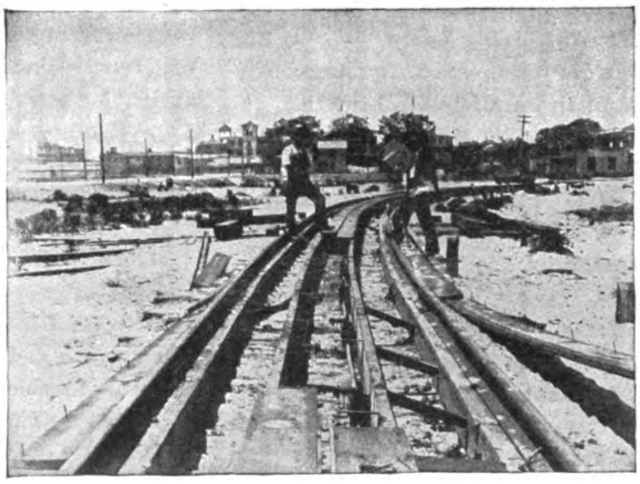


FIG. 5.

The officers of the company are: T. C. Buck, president; Julian Myers. vice-president; R. T. Keen, treasurer, and Albert Stetson, general manager.

The Northwestern Electrical Association.

The convening of this association at Madison, Wis., on the 19th and 20th inst., promises to be an event of great interest to all the participants. The programme for both days is as follows:

19th—Forenoon—Organization and President's Address. Afternoon—"Corliss Compound Engines," by E. L. Dobell, Sheboygan; "Russell Tandem Compound Engines," ——; "Gas Engines Applied to Electric Light Work." Geo. A. Farwell, Waukesha. Evening—"Alternating Current Phenomena" (with experiments), Geo. Cutter, Chicago; "Economy in the Use of Meters," Prof. Jackson, Madison.

20th—Forenoon—"Management of Central Stations," ——; "Average Charges and Methods of Charging of Northwestern Central Stations," P. H. Korst, Racine; "The Business End of Electricity," H. C. Thom, Madison. Afternoon and Evening—Pleasure.

The Hartford, Conn., Chief of Police employs electricity in putting an end to the life of vagrant dogs found in the streets unmuzzled and unmarked. In the rear of the station house he has had a cage rigged up with electrical connections. The cage is just large enough for a dog to stand in. The fore feet of the animal rest upon one electrode and his hind feet upon the other. When he is in position an electric current is switched on and death quickly ensues.

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Electric Railway Progress.

The increasing number of plans which are appearing almost constantly for electric conduit and storage battery street car propulsion must be taken as indicative of the trend in which electrical engineers are preparing to make future advances in the electric railway field in which the overhead trolley now holds almost exclusive sway.

The electric railway industry commenced on a practical extent on the introduction of the single overhead trolley with return circuit over the rails, although this was by no means the actual beginning of this work. Trolley roads with double overhead circuits had been the subject of a great number of trials previously, and although they proved impracticable at the time, this was more through the fault of the mechanical constructions attempted than through any inherent electrical defects.

The early roads were generally run at low voltages, ranging from two hundred to three hundred and fifty volts, necessitating the use of very large trolley wires. The trolleys were four-wheel carriages, weighing from thirty to forty pounds, which traveled on top of the wires and had a flexible cable connecting them to the car. The slightest obstruction, or even a change of speed, often threw these trolleys on to the cars and they not infrequently went through the roofs.

On one road of this construction a small boy with a long pole to replace the trolley was carried on the roof of each car as part of the regular equipment, and a ladder was fixed to the rear platform to give easy access to the roof.

The advent of the single under-running trolley, which may be considered as merely a mechanical change, solved most of the former difficulties, and the use of five hundred volts, which was at first denounced as too dangerous to permit, put the electric railway practically in its present condition in which it has supplanted more than one-quarter of the horse railways in this country.

Now that the overhead trolley system has thoroughly established itself as a permanent and practical institution the demand for refinements both from æsthetic and engineering standpoints are heard, the public asking for the removal of all overhead wires and the railway companies for apparatus of higher efficiency and greater economy of operation.

The prejudice which has opposed the introduction of trolley wires in some cities appears as unconquerable as it is unfounded, and this has been the chief incentive to the invention of conduit systems and storage battery cars both of which are feasible where the traffic is sufficient to warrant the high first cost. This is probably the case only in the largest cities, and the overhead system will doubtless continue to be the rule in most places.

The most serious objections which the present roads present from an engineering view are the leakage of current in wet weather and the electrolytic action on underground pipes caused by the ground return in cases where heavy currents are used. These are avoided entirely in the storage battery cars and in the double trolley conduit systems but at a large additional expense over present systems.

The conduit system, which has been generally avoided on account of its cost, has been found to fill all requirements in the case of the Budapest railway, but if the question of insulation has been solved there seems to be no reason why the cost of equipment should not be very much reduced by using a current of much higher voltage than is usually employed and thus reduce the amount of copper in the conductors. This would amount to a large item in any road of sufficient size to warrant the expense of a conduit system.

While the field for such roads would be limited, work in this direction is going on which gives promise of eventual success; at the same time the present overhead systems will be pretty sure to be found the most available for most places.

* * *

Time for a Change.

The present condition, not alone of General Electric shares in the stock market, but of the actual selling business of that company, proves conclusively that ELECTRICITY has been right from the beginning in its main contentions—that the policy of the company is all wrong, and that the management is incompetent.

We feel certain that no suggestion which we could make in regard to the policy of the company would be well received by the Board of Directors. They seem to think that ELECTRICITY is an enemy when in reality it is the best friend they have. While we have, in the line of our duty to the trade, to legitimate investors, and to the cause of honest business methods, told a great many plain truths, we have not been instigated by malice. And sooner or later the respectable and fair-minded men among the Directors will acknowledge that the criticism of ELECTRICITY has been wholesome and beneficial to their own best interests.

While, as we have said, it is a little too soon to expect a change of policy, we believe there is not a member of the Board of Directors but realizes that a change in management is imperative. The business which would naturally come to the Trust is going elsewhere, and according to the latest official statement the profits of the last five months are away below the average for the eight months previous (as claimed in the first annual statement). Moreover, the price of the stock in the market is superabundant proof of mismanagement, or at least proof that the public believes there is mismanagement. Of course all stocks are low; but the financial records of the day fail to disclose the common and preferred stock and debenture bonds of any other sound dividend paying company all selling away below par. When an 8 per cent. stock cannot be forced above 72 or 73 something is wrong.

In view of the repeated statements of various members of the Board—all, all honorable men—that the company's finances are sound, we must, of course, believe this to be the fact?

What then is wrong? Clearly nothing but lack of confidence in the management.

It is therefore natural to suppose that the Board are casting about in secret for a new president.

There is only one man in the electrical field to-day who is the superior of Mr. Coffin in ability to carry out the present policy of the Electric Trust. This One Man is hopelessly modest, and since it has been the steadfast purpose of Electricity to see that virtue gets its proper reward, we feel perfectly justified in again bringing forward our candidate, Mr. Richard Truthful McDonald.

While Mr. McDonald has abundantly proved his ability, there is danger that he would be overlooked by the Board but for our advocacy of his cause. We have heretofore outlined Mr. McDonald's characteristics; but we shall persistently revert to this subject until our man wins.

The Golden Rule of Our Candidate is, " If you don't do others, they'll do you."

What more appropriate motto could there be for the General Electric Company under its present policy?

* * *

The *Street Railway and Electrical News*, published, as we suppose from its official date line, somewhere in the green fields between Minneapolis and St. Paul, has a few words to say about Electricity in its latest issue. We thank our contemporary for its kind attention, and have put its name down in our notebook along with our other friends. Candor compels the statement, however, that the opinions of a journal getting 30 per cent. of its patronage from the Electric Trust will not carry much weight in these parts.

* * *

The latest official statement of progress given out by the promoters of the St. Louis-Chicago electric road scheme is that twenty miles of road have been built. As long ago as March 1 it was claimed that twenty miles of road had been built, and we are therefore led to believe that business is not rushing with the Through-by-Lightning Company.

* * *

All visitors to the World's Fair will be welcome at the booth of Electricity, Section Y, Northwest Gallery, Electricity Building.

Another Statement.

General Electric's Record for Five Months.

The General Electric Company has declared its regular quarterly dividend of 2 per cent., and has issued the following statement of its business for the five months ending May 1 :

Net profits $1,391,721, net profit for June (partly estimated) $360,000, total $1,751,729, less five months' accrued interest on debentures $208,333; available for stocks $1,543,396, less five months' accrued dividends on preferred stock at 7 per cent., $124,013, and five months' accrued dividends on common stock at 8 per cent. $1,014,180, total $1,138,193. Net surplus for five months over and above accrued interest and dividends $405,202. The above profits are exclusive of all license and royalty stocks and other securities received since January 31.

Electric Lighting in Spain.

Spaniards although slow in the adoption of many improvements are decidedly not so in regard to electric lighting. A large number of the principal towns as well as many very small ones have installations of their own. The latest venture is on the part of the owner of some water power near the two very limited towns, Elgalbar and Eibar, in the Spanish province of Viscaya; these towns will shortly be supplied with electric current for both lighting and power purposes.

The necessary working power will be furnished by the water of the river Dova. A newly erected system of dams supplies an available fall of 8.05 meters and 300 H. P. A " Hercules" turbine of 130 H. P. will be set up and used for the direct propulsion of a rotatory current dynamo of 80,000 watts which is supplied by Messrs. Siemens & Halske of Berlin. The current produced by the dynamo has a tension of 120 volts which is increased to 50,000 volts by means of rotatory transformers. Elgalbar, the smaller of the two towns, contemplates chiefly electric lighting; there are here to be 80 lamps for street lighting and about 140 for private consumption. In the more industrial town, Eibar, the demand for electric power takes the first prominence. Numerous locksmiths and other manufacturers have applied for the supply of electric power and the firm of Messrs. Siemens & Halske have already received orders for a considerable number of electromotors of from 1 to 25 H. P. One hundred and twenty lamps are required for street lighting and about 400 for private purposes.

It is expected that the completion of the primary station will shortly be necessary. The entire installation is a private undertaking of the owner of the water power.

Injunctions Granted.

Ten Days Allowed to Procure Other Lamps.

Judge Lacombe, of the United States Circuit Court, has granted temporary injunctions to the Edison Electric Illuminating Company of New York against the Holland House and the Imperial Hotel, prohibiting them from using incandescent electric lamps infringing the Edison patent, under which, as is well known, the Edison Electric Illuminating Company of New York is sole licensee in the city of New York. The hotels in question were given ten days to arrange for other means of illumination.

This decision was not unexpected, and will create no surprise.

Personal.

Mr. M. M. Merritt, of the Boston Incandescent Lamp Company, met with a somewhat serious accident in Cleveland recently and was confined to his room for several days.

Mr. Nelson W. Perry, editor of the *Electrical World*, and Miss Marie Eugenia Bedell were married in Brooklyn on the evening of June 28. Mr. Perry and his bride will spend the summer in Chicago.

Mr. Herbert Laws Webb, of the Electric Selector and Signal Company, has lately returned from a trip abroad, taken in the interest of his company.

Mr. S. G. Booker, of the Fidelity Carbon Company of St. Louis, has been in the city for the past week.

Mr. W. L. Garrison, of Boston, has sold out his entire interest in the Brockton Edison Station.

Mr. Morgan Brooks, of the St. Paul Engineering and Supply Company, who has been in the city for some time, has returned to the West.

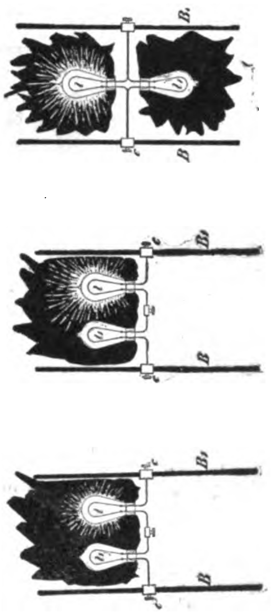
Mr. W. C. Bryant, of the Bryant Electric Company of Bridgeport, was in New York last week.

Mr. Arthur E. Bowers has been appointed New York manager for Claflin & Kimball, and will push the Novak lamp.

ON LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.—VI.

BY NIKOLA TESLA.[*]

ON THE LIGHT PHENOMENA PRODUCED BY HIGH-FREQUENCY CURRENTS OF HIGH POTENTIAL AND GENERAL REMARKS RELATING TO THE SUBJECT.



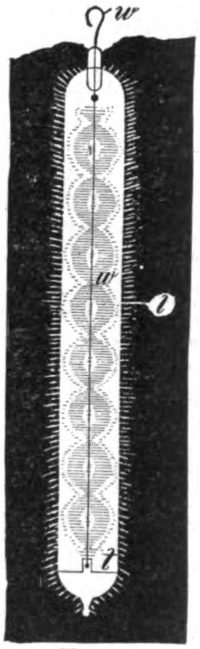


Fig. 22a, Fig. 22b, Fig. 22c.— Fig. 23.
Showing the Effect of the Presence of a Gaseous Medium.

Fig. 23.—Curious Incandescence of a Wire.

Returning now to the light effects which it has been the chief object to investigate, it is thought proper to divide these effects into four classes: 1. Incandescence of a solid. 2. Phosphorescence. 3. Incandescence or phosphorescence of a rarefied gas, and 4. Luminosity produced in a gas at ordinary pressure. The first question is, How are these luminous effects produced? In order to answer this question as satisfactorily as I am able to do in the light of accepted views and with the experience acquired, and to add some interest to this demonstration, I shall dwell here upon a feature which I consider of great importance, inasmuch as it promises, besides, to throw a better light upon the nature of most of the phenomena produced by high-frequency electric currents. I have on other occasions pointed out the great importance of the presence of the rarefied gas, or atomic medium in general, around the conductor through which alternate currents of high frequency are passed, as regards the heating of the conductor by the currents. My experiments, described some time ago, have shown that the higher the frequency and potential difference of the currents the more important becomes the rarefied gas in which the conductor is immersed, as a factor of the heating. The potential difference, however, is, as I then pointed out, a more important element than the frequency. When both of these are sufficiently high, the heating may be almost entirely due to the presence of the rarefied gas. The experiments to follow will show the importance of the rarefied gas, or generally of gas at ordinary or other pressure as regards the incandescence or other luminous effects produced by currents of this kind.

I take two ordinary 50-volt 16 C. P. lamps which are in every respect alike, with the exception that one has been opened at the top and the air has filled the bulb while the other is at the ordinary degree of exhaustion of commercial lamps. When I attach the lamp which is exhausted to the terminal of the secondary of the coil, which I have already used, as in experiments illustrated in Fig. 15a for instance, and turn on the current, the filament, as you have before seen, comes to high incandescence. When I attach the second lamp, which is filled with air instead of the former, the filament still glows, but much less brightly. This experiment illustrates only in part the truth of the statements before made. The importance of the filament's being immersed in rarefied gas is plainly noticeable but not to such a degree as might be desirable. The reason is that the secondary of this coil is wound for low tension, having only 150 turns, and the potential difference at the terminals of the lamp is therefore small. Were I to take another coil with many more turns in the secondary, the effect would be increased, since it depends partially on the potential difference, as before remarked. But since the effect likewise depends on the frequency, it may be properly stated that it depends on the time rate of the variation of the potential difference. The greater this variation the more important becomes the gas as an element of heating. I can produce a much greater rate of variation in another way, which, besides, has the advantage of doing away with the objections which might be made in the experiment just shown, even if both the lamps were connected in series or multiple arc to the coil, namely, that in consequence of the reactions existing between the primary and secondary coil the conclusions are rendered uncertain. This result I secure by charging from an ordinary transformer, which is fed from the alternating current supply station, a battery of condensers, and discharging the latter directly through a circuit of small self-induction, as before illustrated in Figs. 19*a*, 19*b*, 19*c*.

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[*] A lecture delivered before the Franklin Institute at Philadelphia, Feb. 24, 1893, and before the National Electric Light Association at St. Louis, Mo., March 1, 1893.

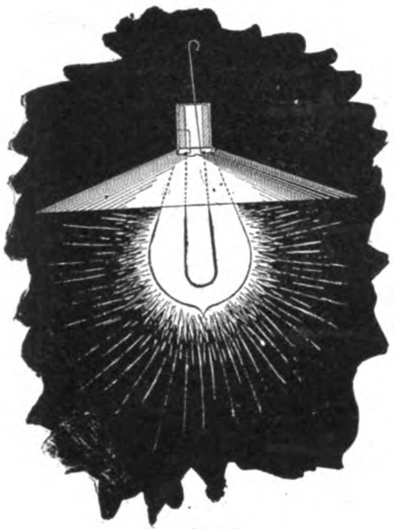


Fig. 24

UTILIZING THE HEATING EFFECT OF CONDUCTION CURRENT AND BOMBARDMENT.

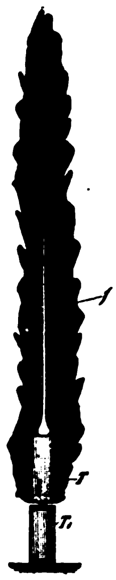


Fig. 25

FIG. 25.—ILLUSTRATING LATERAL DIFFUSION.

In Figs. 22*a*, 22*b* and 22*c* the heavy copper bars BB$_1$ are connected to the opposite coatings of a battery of condensers, or generally in such way that the high frequency or sudden discharges are made to traverse them. I connect first an ordinary 50-volt incandescent lamp to the bars by means of the clamps *c c*. The discharges being passed through the lamp, the filament is rendered incandescent. though the current through it is very small, and would not be nearly sufficient to produce a visible effect under the conditions of ordinary use of the lamp. Instead of this I now attach to the bars another lamp exactly like the first, but with the seal broken off, the bulb being therefore filled with air at ordinary pressure. When the discharges are directed through the filament, as before, it does not become incandescent. But the result might still be attributed to one of the many possible reactions. I therefore connect both the lamps in multiple arc as illustrated in Fig. 22*a*. Passing the discharges through both the lamps again the filament in the exhausted lamp l glows very brightly while that in the non-exhausted lamp l_1 remains dark as previously. But it should not be thought that the latter lamp is taking only a small fraction of the energy supplied to both the lamps; on the contrary, it may consume a considerable portion of the energy and it may become even hotter than the one which burns brightly. In this experiment the potential difference at the terminals of the lamps varies in sign theoretically three to four million times a second. The ends of the filaments are correspondingly electrified, and the gas in the bulbs is violently agitated and a large portion of the supplied energy is thus converted into heat. In the non-exhausted bulb, there being a few million times more gas molecules than in the exhausted one, the bombardment, which is most violent at the ends of the filament in the neck of the bulb, consumes a large portion of the energy without producing any visible effect. The reason is that, there being many molecules, the bombardment is quantitatively considerable, but the individual impacts are not very violent, as the speeds of the molecules are comparatively small owing to the small free path. In the exhausted bulb, on the contrary, the speeds are very great and the individual impacts are violent and therefore better adapted to produce a visible effect. Besides, the convection of heat is greater in the former bulb. In both the bulbs the current traversing the filaments is very small, incomparably smaller than that which they require on an ordinary low-frequency circuit. The potential difference, however, at the ends of the filaments is very great and might be possibly 20,000 volts or more if the filaments were straight and their ends far apart. In the ordinary lamp a spark generally occurs between the ends of the filament, or between the platinum wires outside, before such a difference of potential can be reached.

It might be objected in the experiment before shown that the lamps, being in multiple arc, the exhausted lamp might take a much larger current and that the effect observed might not be exactly attributable to the action of the gas in the bulbs. Such objections will lose much weight if I connect the lamps in series, with the same result. When this is done and the discharges are directed through the filaments it is again noted that the filament in the non-exhausted bulb l_1 remains dark, while that in the exhausted one (l) glows even more intensely than under its normal conditions of working, Fig. 22*b*. According to general ideas the current through the filaments should now be the same were it not modified by the presence of the gas around the filaments.

At this juncture I may point out another interesting feature, which illustrates the effect of the rate of change of potential of the currents. I will leave the two lamps connected in series to the bars BB$_1$ as in the previous experiment, Fig. 22*b*, but will presently reduce considerably the frequency of the currents, which was excessive in the experiment just before shown. This I may do by inserting a self-induction coil in the path of the discharges, or by augmenting the capacity of the condensers. When I now pass these low-frequency discharges through the lamps the exhausted lamp l again is as bright as before but it is noted also that the non-exhausted lamp l_1 glows though not quite as intensely as the other. Reducing the current through the lamps, I may bring the filament in the latter lamp to redness, and though the filament in the exhausted lamp l is bright, Fig. 22*c*, the degree of its incandescence is much smaller than in Fig. 22*b* when the currents were of a much higher frequency.

In these experiments the gas acts in two opposite ways in determining the degree of the incandescence of the filaments, that is, by convection and bombardment. The higher the frequency and potential of the currents, the more important becomes the bombardment. The convection on the contrary should be the smaller the higher the frequency. When the currents are steady there is practically no bombardment, and convection may therefore with such currents also considerably modify the degree of incandescence and produce results similar to those just before shown. Thus, if two lamps exactly alike, one exhausted and one not exhausted, are connected in multiple arc or series to a direct-current machine, the filament in the non-exhausted lamp will require a considerably greater current to be rendered incandescent. This result is entirely due to convection and the effect is the more prominent the thinner the filament. Professor Ayrton and Mr. Kilgour some time ago published quantitative results concerning the thermal emissivity by radiation and convection in which the effect of thin wires was clearly shown. This effect may be strikingly illustrated by preparing a number of small short glass tubes, each containing through its axis the thinnest obtainable platinum wire. If these tubes be highly exhausted, a number of them may be connected in multiple arc to a direct-current machine and all of the wires may be kept at incandescence with a smaller current than that required to render incandescent a single one of the wires if the tube be not exhausted. Could the tubes be so highly exhausted that convection would be nil, then the relative amounts of heat given off by convection and radiation could be determined without the difficulties attending thermal quantitative measurements. If a source of electric impulses of high frequency and very high potential is employed, a still greater number of the tubes may be taken and the wires rendered incandescent by a current not capable of warming perceptibly a wire of the same size immersed in air at ordinary pressure, and conveying the energy to all of them.

I may here describe a result which is still more interesting, and to which I have been led by the observation of these phenomena. I noted that small differences in the density of the air produced a considerable difference in the degree of incandescence of the wires, and I thought that, since in a tube through which a luminous discharge is passed the gas is generally not of uniform density, a very thin wire contained in the tube might be rendered incandescent at certain places of smaller density of the gas while it would remain dark at the places of greater density where the convection would be greater and the bombardment less intense. Accordingly a tube t was prepared, as illustrated in Fig. 23, which contained through the middle a very fine platinum wire w. The tube was exhausted to a moderate degree and it was found that when it was attached to the terminal of a high-frequency coil the platinum wire w would, indeed, become incandescent in patches, as illustrated in Fig. 23. Later a number of these tubes with one or more wires were prepared, each showing this result. The effect was best noted when the striated discharge occurred in the tube, but was also produced when the striæ were not visible, showing that even then the gas in the tube was not of uniform density. The position of the striæ was generally such that the rarefactions corresponded to the places of incandescence or greater brightness on the wire w. But in a few instances it was noted that the bright spots on the wire were covered by the dense parts of the striated discharge, as indicated by l in Fig. 23, though the effect was barely perceptible. This was explained in a plausible way by assuming that the convection was not widely different in the dense and rarefied places, and that the bombardment was greater on the dense places of the striated discharge. It is, in fact, often observed in bulbs that under certain conditions a thin wire is brought to higher incandescence when the air is not too highly rarefied. This is the case when the potential of the coil is not high enough for the vacuum, but the result may be attributed to many different causes. In all cases this curious phenomenon of incandescence disappears when the tube, or rather the wire, acquires throughout a uniform temperature.

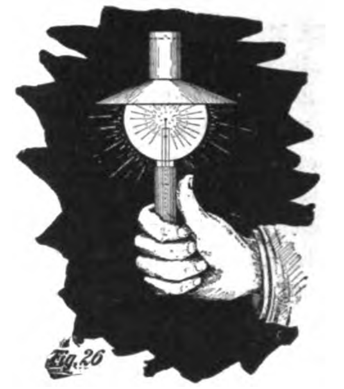


Fig. 26

INCANDESCENCE OF A SOLID.

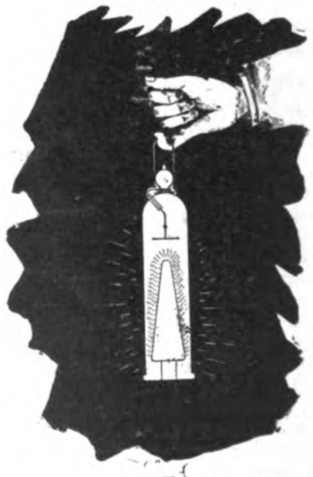


Fig. 27

PHOSPHORESCENCE.

Disregarding now the modifying effect of convection, there are then two distinct causes which determine the incandescence of a wire or filament with varying currents, that is, conduction current and bombardment. With steady currents we have to deal only with the former of these two causes, and the heating effect is a minimum, since the resistance is least to steady flow. When the current is a varying one, the resistance is greater and hence the heating effect is increased. Thus, if the rate of change of the current is very great, the resistance may increase to such an extent that the filament is brought to incandescence with inappreciable currents, and we are able to take a short and thick block of carbon or other material and bring it to bright incandescence with a current incomparably smaller than that required to bring to the same degree of incandescence an ordinary thin lamp filament with a steady or low frequency current. This result is important, and illustrates how rapidly our views on these subjects are changing, and how quickly our field of knowledge is extending. In the art of incandescent lighting, to view this result in one aspect only, it has been commonly considered as an essential requirement for practical success that the lamp filament should be thin and of high resistance. But now we know that the resistance to the steady flow of the filament does not mean anything; the filament might as well be short and thick; for if it be immersed in rarefied gas it will become incandescent by the passage of a small current. It all depends on the frequency and potential of the currents. We may conclude from this that it would be of advantage, so far as the lamp is considered, to employ high frequencies for lighting, as they allow the use of short and thick filaments and smaller currents.

Incandescence or Phosphorescence of Rarefied Gas.

If a wire or filament be immersed in a homogeneous medium, all the heating is due to true conduction current, but if it be enclosed in an exhausted vessel the conditions are entirely different. Here the gas begins to act and the heating effect of the conduction current, as is shown in many experiments, may be very small compared with that of the bombardment. This is especially the case if the circuit is not closed and the potentials of course very high. Suppose a fine filament enclosed in an exhausted vessel be connected with one of its ends to the terminal of a high tension coil and with its other end to a large insulated plate. Though the circuit is not closed, the filament, as I have before shown, is brought to incandescence. If the frequency and potential be comparatively low, the filament is heated by the current passing *through* it. If the frequency and potential, and principally the latter, be increased, the insulated plate need be but very small, or may be done away with entirely; still the filament will become incandescent, practically all the heating being then due to the bombardment. A practical way of combining both the effects of conduction current and bombardment is illustrated in Fig. 24, in which an ordinary lamp is shown provided with a very thin filament which has one of the ends of the latter connected to a shade serving the purpose of the insulated plate, and the other end to the terminal of a high tension source. It should not be thought that only rarefied gas is an important factor in the heating of a conductor by varying currents, but gas at ordinary pressure may become important if the potential difference and frequency of the currents are excessive. On this subject I have already stated that when a conductor is fused by a stroke of lightning the current through it may be exceedingly small, not even sufficient to heat the conductor perceptibly, were the latter immersed in a homogeneous medium.

From the preceding it is clear that when a conductor of high resistance is connected to the terminals of a source of high frequency currents of high potential, there may occur considerable dissipation of energy, principally on the ends of the conductor, in consequence of the action of the gas surrounding the conductor. Owing to this, the current through a section of the conductor at a point midway between its ends may be much smaller than through a section near the ends. Furthermore, the current passes principally through the outer portions of the conductor, but this effect is to be distinguished from the skin effect as ordinarily interpreted, for the latter would or should occur also in a continuous incompressible medium. If a great many incandescent lamps are connected in series to a source of such currents, the lamps at the ends may burn brightly, whereas those in the middle may remain entirely dark. This is due principally to bombardment, as before stated. But even if the currents be steady, provided the difference of potential is very great, the lamps at the ends will burn more brightly than those in the middle. In such case there is no rhythmical bombardment and the result is produced entirely by leakage. This leakage or dissipation into space when the tension is high is considerable when incandescent lamps are used, and still more considerable with arcs, for the latter act like flames. Generally, of course, the dissipation is much smaller with steady than with varying currents.

I have contrived an experiment which illustrates in an interesting manner the effect of lateral diffusion. If a very long tube is attached to the terminal of a high frequency coil, the luminosity is greatest near the terminal and falls off gradually towards the remote end. This is more marked if the tube is narrow.

A small tube, about one-half inch in diameter and twelve inches long, Fig. 25, has one of its ends drawn out into a fine fibre *f* nearly three feet long. The tube is placed in a brass socket T which can be screwed on the terminal T_1 of the induction coil. The discharge passing through the tube first illuminates the bottom of the same, which is of comparatively large section; but through the long glass fibre the discharge cannot pass. But gradually the rarefied gas inside becomes warmed and more conducting and the discharge spreads into the glass fibre. This spreading is so slow that it may take half a minute or more until the discharge has worked through up to the top of the glass fibre, then presenting the appearance of a strongly luminous thin thread. By adjusting the potential at the terminal the light may be made to travel upwards at any speed. Once, however, the glass fibre is heated the discharge breaks through its entire length instantly. The interesting point to be noticed is that the higher the frequency of the currents, or in other words, the greater relatively the lateral dissipation, at a slower rate may the light be made to propagate through the fibre. This experiment is best performed with a highly exhausted and freshly made tube. When the tube has been used for some time the experiment often fails. It is possible that the gradual and slow impairment of the vacuum is the cause. This slow propagation of the discharge through a very narrow glass tube corresponds exactly to the propagation of heat through a bar warmed at one end. The quicker the heat is carried away laterally the longer time it will take for the heat to warm the remote end. When the current of a low frequency coil is passed through the fibre from end to end, then the lateral dissipation is small and the discharge instantly breaks through almost without exception.

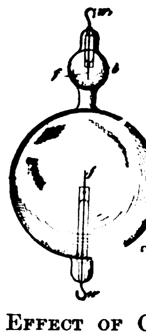
Luminosity of Gas at Ordinary Pressure.

After these experiments and observations, which have shown the importance of the discontinuity or atomic structure of the medium and which will serve to explain, in a measure at least, the nature of the four kinds of light effects producible with these currents, I may now give you an illustration of these effects. For the sake of interest I may do this in a manner which to many of you might be novel. You have seen before that we may now convey the electric vibration to a body by means of a single wire or conductor of any kind. Since the human frame is conducting, I may convey the vibration through my body.

First, as in some previous experiments, I connect my body with one of the terminals of a high tension transformer and take in my hand an exhausted bulb which contains a small carbon button mounted upon a platinum wire leading to the outside of the bulb, and the button is rendered incandescent as soon as the transformer is set to work (Fig. 26). I may place a conducting shade on the bulb which serves to intensify the action, but is not necessary. Nor is it required that the button should be in conducting connection with the hand through a wire leading through the glass, for sufficient energy may be transmitted through the glass itself by inductive action to render the button incandescent.

Next I take a highly exhausted bulb containing a strongly phosphorescent body, above which is mounted a small plate of aluminum on a platinum wire leading to the outside, and the currents flowing through my body excite intense phosphorescence in the bulb, Fig. 27. Next again, I take in my hand a simple exhaust tube, and in the same manner the gas inside the tube is rendered highly incandescent or phosphorescent, Fig. 28. Finally, I may take in my hand a wire, bare or covered with thick insulation, it is quite immaterial; the electric vibration is so intense as to cover the wire with a luminous film, Fig. 29.

A few words must now be devoted to each of these phenomena. In the first place, I will consider the incandescence of a button or of a solid in general, and dwell upon some facts which apply equally to all these phenomena. It was pointed out before that when a thin conductor, such as a lamp filament for instance, is connected with one of its ends to the terminal of a transformer of high tension the filament is brought to incandescence partly by a conduction current and partly by bombardment. The shorter and thicker the filament the more important becomes the latter, and finally, reducing the filament to a mere button, all the heating must practically be attributed to the bombardment. So in the experiment before shown the button is rendered incandescent by the rhythmical impact of freely movable small bodies in the bulb. These bodies may be the molecules of the residual gas, particles of dust or lumps torn from the electrode; whatever they are, it is certain that the heating of the button is essentially connected with the pressure of such freely movable particles, or of atomic matter in general, in the bulb. The heating is the more intense the greater the number of impacts per second and the greater the energy of each impact. Yet the button would be heated also if it were connected to a source of a steady potential. In such a case electricity would be carried away from the button by the freely movable carriers or particles flying about, and the quantity of electricity thus carried away might be sufficient to bring the button to incandescence by its passage through the latter. But the bombardment could not be of great importance in such case. For this reason it would require a comparatively very great supply of energy to the button to maintain it at incandescence with a steady potential. The higher the frequency of the electric impulses the more economically can the button be maintained at incandescence. One of the chief reasons why this is so is, I believe, that with impulses of very high frequency there is less exchange of the freely movable carriers around the electrode, and this means that in the bulb the heated matter is better confined to the neighborhood of the button. If a double bulb, as illustrated in Fig. 30, be made, comprising a large globe B and a small one *b*, each containing as usual a filament *f* mounted on a platinum wire *w* and w_1, it is found that if the filaments *f f* be exactly alike it requires less energy to keep the filament in the globe *b* at a certain degree of incandescence than that in the large globe B. This is due to the confinement of the movable particles around the button. In this case it is also ascertained that the filament in the small globe *b*



Showing the Effect of Confining the Gas Around the Electrode.

is less deteriorated when maintained a certain ength of time at incandescence. This is a necessary consequence of the fact that the gas in the small bulb becomes strongly heated and therefore a very good conductor, and less work is then performed on the button, since the bombardment becomes less intense as the conductivity of the gas increases. In this construction, of course, the small bulb becomes very hot, and when it reaches an elevated temperature the convection and radiation on the outside increase. On another occasion I have shown bulbs in which this drawback was largely avoided. In these instances a very small bulb, containing a refractory button, was mounted in a large globe and the space between the walls of both of was highly exhausted. The outer large globe remained comparatively cool in such constructions. When the large globe was on the pump and the vacuum between the walls maintained permanent by the continuous action of the pump, the outer globe would remain quite cold, while the button in the small bulb was kept at incandescence. But when the seal was made, and the button in the small bulb maintained incandescent some length of time, the large globe too would become warmed. From this I conjecture that if vacuous space (as Prof. Dewar finds) cannot convey heat, it is so merely in virtue of our rapid motion through space or, generally speaking, by the motion of the medium relatively to us, for a permanent condition could not be maintained without the medium being constantly renewed. A vacuum cannot, according to all evidence, be permanently maintained around a hot body.

In these constructions, before mentioned, the small bulb inside would, at least in the first stages, prevent all bombardment against the outer large globe. It occurred to me then to ascertain how a metal sieve would behave in this respect, and several bulbs, as illustrated in Fig. 31, were prepared for this purpose. In a globe b was mounted a thin filament f (or button) upon a platinum wire w passing through a glass stem and leading to the outside of the globe. The filament f was surrounded by a metal sieve s. It was found in experiments with such bulbs that a sieve with wide meshes apparently did not in the slightest affect the bombardment against the globe b. When the vacuum was high the shadow of the sieve was clearly proected against the globe and the latter would get hot in a short while. In some bulbs the sieve s was connected to a platinum wire sealed in the glass. When this wire was connected to the other terminal of the induction coil (the E. M. F. being kept low in this case), or to an insulated plate, the bombardment against the outer globe b was diminished. By taking a sieve with fine meshes the bombardment against the globe b was always diminished, but even then if the exhaustion was carried very far, and when the potential of he transformer was very high, the globe b would be bombarded and heated quickly, though no hadow of the sieve was visible owing to the mallness of the meshes. But a glass tube or other continuous body mounted so as to surround he filament did entirely cut off the bombardment, and for a while the outer globe b would emain perfectly cold. Of course when the glass ube was sufficiently heated the bombardment against the outer globe could be noted at once. The experiments with these bulbs seemed to show hat the speeds of the projected molecules or particles must be considerable (though quite inignificant when compared with that of light), otherwise it would be difficult to understand how they could traverse a fine metal sieve without being affected, unless it were found that such small particles or atoms cannot be acted upon directly at measurable distances. In regard to the speed of the projected atoms, Lord Kelvin has recently estimated it at about one kilometre a second or thereabouts in an ordinary Crookes bulb. As the potentials obtainable with a disruptive discharge coil are much higher than with ordinary coils, the speeds must of course be much greater when the bulbs are lighted from such a coil. Assuming the speed to be as high as five kilometres and uniform through the whole trajectory, as it should be in a very highly exhausted vessel, then if the alternate electrifications of the electrode would be of a frequency of five millions, the greatest distance a particle could get away from the electrode would be one millimetre, and if it could be acted upon directly at that distance the exchange of electrode matter or of the atoms would be very slow and there would be practically no bombardment against the bulb. This at least should be so if the action of an electrode upon the atoms of the residual gas would be such as upon electrified bodies which we can perceive. A hot body enclosed in an exhausted bulb produces always atomic bombardment, but a hot body has no definite rhythm, for its molecules perform vibrations of all kinds.

If a bulb containing a button or filament be exhausted as high as it is possible with the greatest care and by the use of the best artifices, it is often observed that the discharge cannot, at first, break through, but after some time, probably in consequence of some changes within the bulb, the discharge finally passes through and the button is rendered incandescent. In fact, it appears that the higher the degree of exhaustion the easier is the incandescence produced. There seems to be no other causes to which the incandescence might be attributed in such case except to the bombardment or similar action of the residual gas, or of particles of matter in general. But if the bulb be exhausted with the greatest care can these play an important part? Assume the vacuum in the bulb to be tolerably perfect, the great interest then centres in the question: Is the medium which pervades all space continuous or atomic? If atomic then the heating of a conducting button or filament in an exhausted vessel might be due largely to ether bombardment, and then the heating of a conductor in general through which currents of high frequency or high potential are passed must be modified by the behavior of such medium; then also the skin effect, the apparent increase of the ohmic resistance, etc., admit, partially at least, of a different explanation.

It is certainly more in accordance with many phenomena observed with high-frequency currents to hold that all space is pervaded with free atoms rather than to assume that it is devoid of these and dark and cold, for so it must be if filled with a continuous medium, since in such there can be neither heat nor light. Is, then, energy transmitted by independent carriers or by the vibration of a continuous medium? This important question is by no means as yet positively answered. But most of the effects which are here considered, especially the light effects, incandescence, or phosphorescence, involve the presence of free atoms and would be impossible without these.

In regard to the incandescence of a refractory button (or filament) in an exhausted receiver, which has been one of the subjects of this investigation, the chief experiences, which may serve as a guide in constructing such bulbs, may be summed up as follows: 1. The button should be as small as possible, spherical, of a smooth or polished surface and of refractory material which withstands evaporation best. 2. The support of the button should be very thin and screened by an aluminum and mica sheet, as I have described on another occasion. 3. The exhaustion of the bulb should be as high as possible. 4. The frequency of the currents should be as high as practicable. 5. The currents should be of a harmonic rise and fall, without sudden interruptions. 6. The heat should be confined to the button by inclosing the same in a small bulb or otherwise. 7. The space between the walls of the small bulb and the outer globe should be highly exhausted.

(To be continued.)

Turpin, the inventor of melinite, has submitted to the French War Office an electric gun alleged to be capable of discharging 25,000 projectiles in five minutes and to have a range of several miles. The apparatus is comparatively light in weight, so that it can be drawn by two horses and worked by four men. The projectiles are small shells charged with a secret chemical preparation, spreading death for sixty yards around. The English Government is said to be negotiating for the purchase of the invention, though skeptical of its value.

Boston Notes.

The project for changing the location of some of the street car tracks in Lynn is arousing more interest in that city of shoes than any other topic. The traveling public are taking the matter in hand and by petitions and enquiries are demonstrating the injustice to the community that must ensue, and especially to the working classes, should the proposed changes be made.

For some time past there have been lively doings in the suburban towns of Reading, Wakefield and Stoneham in connection with a public agitation for the adoption of the Municipal Lighting Act of 1891 entitling towns and cities to purchase or erect and operate their own gas and electric lighting plants. These communities have for some time past been acting independently. Appeals have been made to the State Legislature for power to compel the local lighting company to sell its plant at a fair market price to the town of Wakefield. As yet no such sale has been effected though negotiations still continue in progress. Now, however, the prominent men representing the local boards of trade are trying to formulate a scheme whereby the three towns shall conjointly establish a municipal lighting plant, locating it in Wakefield, the other towns taking their supply from this central station.

Much interest is being taken in the tests that are now being made with the large alternating current motor that has been installed by the Hartford, Conn., Electric Light Company. The motor is of 300 H. P. and is operated by current generated at the Farmington water power station. By this means the city of Hartford is being supplied with power from one of the best water privileges in the State.

There was quite a demonstration a few days ago in the town of North Weymouth, the occasion being the opening for regular traffic of the extension of the Quincy and Boston Electric Street Railway across Weymouth Fore River into the town of that name. The traveling public greatly appreciate the facilities by means of which they can take an electric car in the very centre of Boston and ride out fourteen miles into the shoe manufacturing region. In fact, any one can now travel by electrics from Peabody, some twenty miles north of Boston, passing through the latter city, and fourteen miles south, a direct run of thirty-four miles. Ere many months are over a like feat will be possible from Gloucester, forty miles north to Brockton, twenty-two miles south of Boston, thus making a clear run by electric cars of over sixty miles. The way in which Eastern and Southern Massachusetts is being covered by electric railways is one of the interesting features of electric railway development; still many additional new roads are under construction. There is neither lack of capital nor of enterprise in this section of the country.

The various firms in Boston who make a specialty of wiring and installing electric lights in dwelling houses are enjoying quite a boom, for among the innumerable buildings now being erected in or around this city very few indeed, whether mansions or cottages, but are wired throughout when building for bells and lights.

General News.

What is Going on in the Electrical World.

St. Louis, Mo.—Electric cars have taken the place of horse cars on the Cass avenue line.

Manitou, Col.—The franchise granted to M. A. Leddy has been recalled by the town council.

Columbia, S. C.—Electric motors have been installed in the Penitentiary shops to run the machinery.

Batavia, N. Y.—The taxpayers of this village have voted in favor of the town purchasing an electric lighting plant and operating it. $23,000 will be raised for this purpose.

Milwaukee, Wis.—The Milwaukee and Wauwatosa Railway, now employing steam as a motive power, is to be changed soon to an electric road.

Toledo, Ohio.—The Toledo Electric Company's new plant, which is said to be the finest electric light plant west of New York, is nearly ready to begin work.

Sandusky, Ohio.—The Sandusky, Milan and Norwalk Electric Railway is nearly completed. The new line is practically an extension of the People's Electric Railway of Sandusky.

Washington, D. C.—The Washington and Arlington Electric Railroad Company are having a route surveyed to Mt. Vernon for a proposed electric railway direct from Washington to that place.

Toronto, Can.—It is understood here that the Toronto and Mimico Electric Railway is to pass into the hands of the Toronto Street Railway Company in a few days, and that the cars of the latter will run to the Humber.

Houston, Texas.—The council has granted right of way to the Harrisburg Electric Railroad

Company for a period of twenty-five years. The road to be built by the company will be five miles long, beginning in this city and running to Harrisburg.

Phœnix, Ariz.—The contract for lighting the streets has been awarded to the Phœnix Light and Power Company and the East End Electric Light Company, each company to furnish the same number of lights as the other and of the same power.

Buffalo, N. Y.—If a report current here is to be credited, the Edison General Electric Company will in a few months remove its works from Schenectady to Depew, the new town near this city, being dissatisfied with its site in Schenectady, where the plant is annually liable to damage from floods in the Mohawk River.

Elizabeth, N. J.—The plant of the Electric Light Company, lately totally destroyed by fire, is now almost entirely replaced by new apparatus. In less than forty-eight hours the lights extinguished by the fire were burning again, the company having ordered dynamos, engines, etc., before the flames had subsided.

Salt Lake, Utah.—The suit of D. F. Walker against the Salt Lake and Ogden Gas and Electric Light Company has been withdrawn, the differences between the parties having been amicably settled. The company will at once reconstruct its plant and make extensive improvements both in this city and at Ogden.

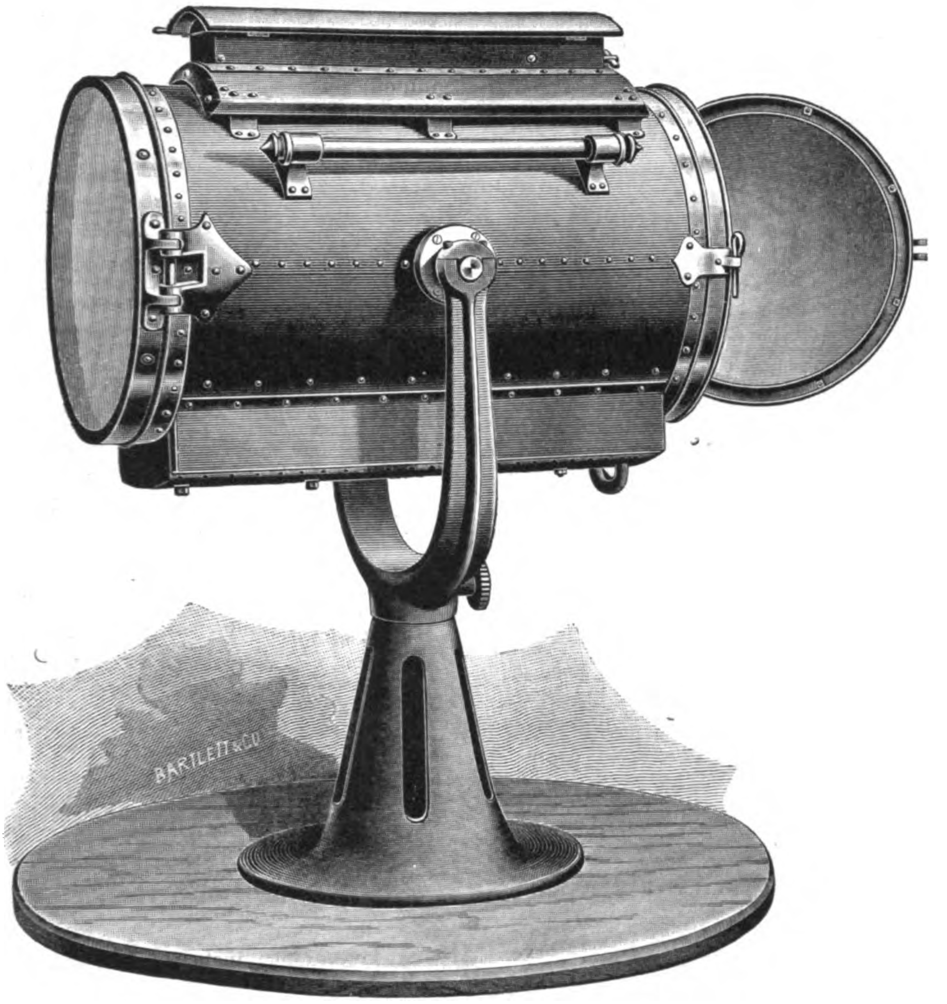
Bridgeton, N. J.—The South Jersey Traction Company has come into possession of all the franchises and property of the Bridgeton and Millville Turnpike Company and the Bridgeton Rapid Transit Company. The Traction Company is building the electric road in Bridgeton and between Bridgeton and Millville.

Roseburg, Ore.—The electric light plant, which has been in the hands of a receiver since last September, has been sold. The Northwest General Electric Company of Portland purchased the real property and part of the plant, consisting of lamps, wires, franchise, etc., and Charles A. Sprandel, of Roseburg, purchased the engine, dynamos and other appliances at the power house.

Davenport, Iowa.—An electrically operated street sprinkler has been introduced here and is doing effective work on the streets in which rails are laid. The car is operated with the greatest ease and can be shot along with any speed desirable and brought to a standstill in a twinkling. It is equipped with a Westinghouse single reduction twenty horse power motor and is fitted with an air brake instead of the ordinary brakes used on the street cars.

Providence, R. I.—The *Journal* states that the Union Railroad Company has let the contract for the overhead wire construction of upwards of seventy miles of track, and the intention is to push this part of the work to completion at the rate of a mile a day, so that the trolley can be put in operation, if unexpected obstacles are not encountered, early in the fall. Then the city will have about fifty miles of trolley, not including the four miles on the Broad street route to Pawtuxet, and the suburban districts will have nearly, if not altogether, twenty miles covered by electric cars.

Hartford, Conn.—The Hartford and West Hartford Horse Railway Company's amended charter has been reported favorably in the Senate. It provides that the company may use any motive power but steam and may use electricity for heat and light. It may sell and distribute electricity in West Hartford, Farmington and Canton. The company is authorized to increase its capital to $1,000,000. It may extend its tracks to Collinsville, New Britain and Plainville and connect at the city line with the Hartford and Wethersfield Horse Railway Company under such terms as the railroad commissioners may prescribe if the two companies cannot agree.



THE NEW WARD PROJECTOR.

The New Ward Projector.

The Electric Construction and Supply Company of New York City, well known for its line of Ward Arc Lamps, has been the pioneer concern in this country to introduce projectors using the Mangin reflecting lens which has acquired a wide reputation abroad but has heretofore been unknown in this country.

A well designed searchlight with a Mangin lens is now being manufactured by this company, and is shown in the illustration on this page. its most important features outside of the lens being the simplicity of its construction and the apparatus by means of which it is manipulated.

The frame is cylindrical and made of polished brass, and is mounted on a standard of the same material. The reflecting lens is mounted in the rear end of the cylinder, shown open in the illustration. The lamp, of the Ward pattern, is mounted in the front of the drum. the case containing the mechanism being placed in front of the carbons, which face the reflector, so that no direct rays from the arc are reflected from the front glass, the light coming entirely from the reflecting lens.

The barrel is arranged to revolve horizontally upon its standard, and can also be tilted vertically through a considerable angle, these two movements being controlled by means of gearing from the pilot house upon which the reflector is mounted.

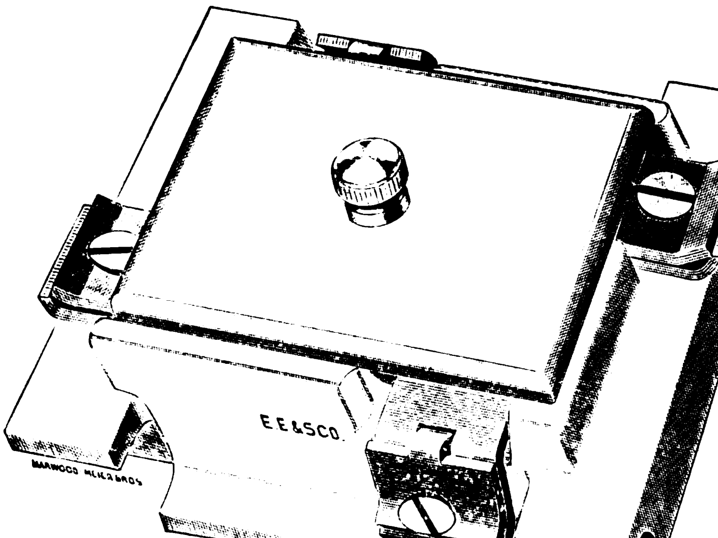
The lamp, which feeds by gravity, is controlled by nicely adjusted mechanism which operates with perfect freedom when the lamp is set at its greatest angle. The lamp is also provided with a horizontal feed along the barrel so that the focus of the carbons can be said to produce a concentrated beam of light or to spread the rays over a greater area if desired. The company has one of these projectors on exhibition in its office, 18 Cortlandt street, N.Y., an inspection of which will verify the claims made for the new instrument. The lenses, which are all made in this country, can be supplied at a great reduction over the imported ones, and the price of the apparatus is therefore but little greater than the old style metal reflectors.

The E. E. and S. Porcelain Covered Branch Block.

Herewith is given a cut of the improved Branch Block manufactured by the Electric Engineering and Supply Company. 308 and 310 West Jefferson street, Syracuse, N.Y.

In order to satisfy the underwriters' requirements and at the same time improve the appearance and add to safety and convenience in use, the E. E. and S. Company have fitted their branch blocks with porcelain covers. They are made of the well-known "Syracuse" porcelain, neatly finished and held in place by a thumb nut. These are readily removed by the fingers, avoiding the necessity of screwdriver or pliers and rendering the block unusually easy of access.

The cover protects the connections from dirt and accumulation of floating particles and in case of a melted fuse retains the metal and prevents possible damage.



THE E. E. AND S. PORCELAIN COVERED BRANCH BLOCK.

The blocks are strong and compactly made, of ample carrying capacity and easily wired, and the main and branch wires are separated by projections from the porcelain base, while both are held away from the ceiling.

These blocks are satisfactory in every respect and endorsed by underwriters and users everywhere.

COMMERCIAL PARAGRAPHS.

The Massachusetts Chemical Company, manufacturers of the well known Insullac, report an increased sale of their material notwithstanding the general depression of business. They have already begun to ship in considerable quantities to European ports, and state that the managers of twelve of the largest street railways in this country have issued orders that no new motors will be accepted by them unless they are insulated with Insullac.

The Ansonia Electric Company report that notwithstanding the long days are here the sale of Stanley Transformers does not seem to decrease in the slightest.

The W. S. Hill Electric Company, ever on the alert to sustain the fine reputation it has gained for electrical apparatus of the highest grade, has just issued one of the handsomest illustrated catalogues that have appeared for some time past in the electrical field. The volume is profusely illustrated with cuts of about every device this company manufactures, each cut being accompanied with descriptive matter and price list for every size in which the devices are made. Several handsome cuts appear of the marble switchboard for 50 circuits recently made for the Narragansett Electric Light Company's station at Providence, R. I., which switchboard is entitled to rank as the most unique and beautiful piece of work of its kind ever manufactured. Every central station manager ought to have a copy of this catalogue.

Since the Elektron Manufacturing Company opened its Boston office at 103 Milk street it has done more than a satisfactory business with its efficient motors for elevator work. A number of good contracts have been secured, and at present Mr. E. Marshall, manager, is installing complete passenger elevators in three large business blocks. In each case a 10 H. P. engine is called for to operate the elevators, and those which have already been installed are giving unbounded satisfaction. Mr. Marshall is an old hand at elevator work; knows just every modern improvement that is required, and is taking care of the Elektron Manufacturing Company's business in good shape.

The new style of porcelain cleat for inside wiring which the Hammond Cleat Company recently placed on the market has met with a prompt and ready demand. The company has received a big pile of orders and is in receipt of many flattering testimonials from those who have used this specialty.

The Consolidated Electric Manufacturing Company, Boston, has this week shipped another of its 60-arc light dynamos, equipped with the Elkins Automatic Regulator, which is proving one of the most efficient and economical devices that have yet been applied to arc dynamos.

So prosperous has the Brown Electric Company of Boston become since its recent organization that it has been decided to double up its capital so as to enable it the better to take care of its rapidly expanding business, and to carry a larger and more complete line of electrical goods.

The Mather Electric Company has just completed the installation of an isolated plant of their system in the nine story building just erected by and for the International Trust Company corner Devonshire and Milk streets, Boston. The plant is of 600 lights capacity, the dynamos used being what is known as the "Kodak," direct coupled with a Westinghouse engine, which together form the most compact and efficient combination now on the market and splendidly adapted where space is limited as in this particular case. This is the first installation of the kind in Boston, and it is naturally exciting a large share of interest.

The Boston Braid Company, which makes a specialty of braiding silk for incandescent lamp filaments, has found it necessary to lease more ample factory room, and has more than doubled its facilities for making its high grade silks, which are now in use everywhere.

Messrs. J. W. Penfield & Co., Willoughby, O., one of the largest manufacturing concerns in the State, will soon place on the market a line of friction clutches especially adapted for use in electrical power plants.

Price List No. 6 has just been issued by the Okonite Company, Limited, from the New York headquarters, 13 Park Row. It is a pamphlet of over fifty pages, containing a fund of valuable information concerning the celebrated product of the company, and should be in the possession of everyone interested in the perfect insulation of telephone, telegraph, electric light and power wires and cables. It calls special attention to three thicknesses of insulation furnished respectively for low, medium and high tension currents. The covers are rich in appearance and elaborately designed and show a lithographed title into which the well-known Okonite trademark enters conspicuously, the whole showing off finely on a gold background. There is also a view of the company's extensive works at Passaic, N. J., and Manchester, England.

The Ansonia Electric Company are now in position to fill any orders with the new Sunbeam lamp at very low prices. Judging from the number of orders they are receiving, the new lamp is even better than the old Sunbeam.

The Ansonia Electric Company report that the demand for Crocker-Wheeler motors was never as large as within the past month, particularly the fan motors. They also report a number of sales of motors for the pumping of organs.

INCORPORATIONS.

The United States Electric Lamplighter Company, Detroit, Mich. Capital stock, $50,000.

The Knickerbocker Electric Light Company of Flatbush, Kings County, N. Y.—to furnish light and power. Capital stock, $30,000. Incorporators: Richard Ficken, Flatbush; Thomas Murtha, New York; Richard Ulman, New York; William E. Martin, Brooklyn; John Murphy, Brooklyn.

The stockholders of the Salt Lake and Ogden (Utah) Electric Light and Gas Company at a recent meeting unanimously decided on an increase issue of $500.000 bonds. The purpose of the increase is to meet the expense of improvements in the gas and electric light plants.

The Cleveland Cross Town Street Railroad Company, Cleveland, O.—to construct and operate street railroads by electricity or other motive power. Capital stock, $10,000. Promoters: S. H. Short, Jotham Potter, L. A. Russell, W. C. Scofield and Geo. F. Scofield.

The Orient Electric Company, Youngstown, Ohio—to manufacture, repair and deal in arc and incandescent electric lamps, electrical machinery, specialties, etc. Promoters: F. Wagland Brown, Linus S. Denison, Clyde O. Shatto, Fred C. Brown and Albert I. Powers.

The Dills Manufacturing Company, Sprague, Wash.—to manufacture and sell an electric lamp hanger. Capital stock, $10,000. Promoters: Elbert Dills, S. E. DeRackin and Leonard F. Williams.

The Suburban Electric Company, Wheeling, W. Va.—to supply light, heat and power by means of electricity in Wheeling and vicinity. Promoters: Geo. W. Woods, J. J. Woods, I. M. Garvin and B. W. Peterson, Wheeling, W. Va.

The Farrall Electric Heat and Light Company, New York, N. Y.—to manufacture, use and sell and grant to others the right to use and sell apparatus for heating and lighting by electricity under U. S. patents of Theophilus Farrall. Capital stock, $1.000,000. Promoters: Henry A. Hubert, New York City; Wm. Albert Rudd, Brooklyn, N.Y.; Wm. E. Baskette, New York City.

The Hornberger Electric Manufacturing Company, Elkhart, Ind.—to manufacture and sell and repair electrical apparatus of all kinds. Capital stock, $20,000. Promoters: Wm. H. Hornberger, Chas. A. Hornberger and John C. Boss, Elkhart, Ind.

The Idaho Electric Railway, Light and Power Company, Weiser, Idaho—to construct an electric railway from Weiser to the Seven Devils. The company is composed of Ohio capitalists and local residents.

The Albert Lea Electric Company, Albert Lea, Minn.—to manufacture and furnish electric light and power, etc. Capital stock, $35,000. Promoters: C. G. Edwards, S. H. Cady, W. E. Todd, Harry Jones and S. S. Edwards, all of Albert Lea.

The McDonald Company, Norfolk, Va.—business: real estate and improvements; water, gas and electric works; securities, etc. Promoters: R. H. McDonald, San Francisco; Wm. A. Wrenn, Norfolk; A. P. Thorn.

The Electric Light, Heat and Power Company of Gettysburg, Pa.—to supply light, heat and power to the public at Gettysburg. Capital stock, $25,000. Promoters: E. M. Hoffer, H. G. Walmer, Harvey B. Hanck.

The Merchants and Manufacturers' Electric Light, Heat and Power Company, Erie, Pa.—to manufacture and supply light, heat and motive and mechanical power by means of electricity in Erie. Capital stock, $50,000. Promoters: E. D. Carter, Edward C. Siegel, John S. Rilling.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JUNE 27, 1893

ELECTRIC RAILWAYS AND APPLIANCES.

500,256. System for Supplying Electricity to Railways. Michael H. Smith, Halifax, England. Filed Oct. 26, 1887.

500,263. Trolley Support. William Duncan, Allegheny, Pa. Filed Dec. 7, 1892.

500,306. Conduit Railway Trolley. Ernest P. Warner, Chicago, Ill., assignor to the Western Electric Company of Illinois. Filed July 30, 1892.

500,375. Trolley. William H. Brodie, Brooklyn, N. Y. Filed March 15, 1893.

500,417. Automatic Disconnector for Trolley Wires. Ray N. Noyes, Haverhill, Mass. Filed Jan. 23, 1893.

500,432. Auxiliary Car Motor. William H. Schallioll, Chester, Pa. Filed Nov. 8, 1892.

500,506. Inclosed Conductor for Electric Railways. John A. K. McGregor, Chicago, Ill., assignor of one-fourth to Homan R. Powers, same place. Filed March 19, 1892.

ELECTRIC LIGHTS AND APPLIANCES.

500,192. Electric Lighting Device. William H. Clewley, Providence, R. I. Filed April 15, 1893.

500,199. Push Button. James S. George, Jr., Philadelphia, Pa. Filed Oct. 20, 1892.

500,200. Push Button Cut-Out. James S. George, Jr., Philadelphia, Pa. Filed Nov. 28, 1892.

500,201. Cut-Out for Electric Lighting Systems. James S. George, Jr., Philadelphia, Pa. Filed Dec. 30, 1892.

500,279. Filament for Incandescent Electric Lamps. John Criggal, Newark, N. J. Filed Oct. 31, 1891.

500,341. Electric Arc Lamp. Wilhelm Mathiesen, Leipsic, Germany. Filed Sept. 5, 1892.

500,357. Electric Lighter. Bernhard Tropp, New York, N. Y., assignor of one-half to George Curtis Wright, same place. Filed Aug. 30, 1892.

500,421. Hanging Device for Electric Arc Lamps. Charles A. Pfluger, Chicago, Ill. Filed Oct. 14, 1892.

500,422. Electric Arc Lamp. Charles A. Pfluger, Chicago, Ill. Filed Oct. 31, 1892

DYNAMOS, MOTORS, ETC.

500,132. Electric Motor and Dynamo-Electric Machine. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Oct. 4, 1892.

500,135. Electric Motor. Charles S. Jones, Chicago, Ill.; Susan H. Jones, executrix of said Charles S. Jones, deceased. Filed April 7, 1890

500,144. Brush-Holder. Sam H. Libby, Lynn, Mass., assignor to the General Electric Company of New York. Filed Jan. 19, 1893.

500,276. Electric Locomotive. Frank M. Stevens, White River Junction, Vt. Filed Feb. 29, 1892.

500,301. Electric Generator and Motor. William Stanley, Jr., and John F. Kelly, Pittsfield, Mass., assignor to the Stanley Laboratory Company, same place. Filed Jan. 9, 1893.

500,400. Dynamo-Electric Machine or Motor. Philip Lange, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, same place. Filed April 28, 1891.

500,403. Dynamo-Electric Machine. Frederick H. Loveridge, Chicago, Ill., assignor to the Standard Electric Company, same place. Filed Oct. 22, 1892.

500,455. Automatic Short Circuit for Constant Current Machines. Alexander Wurts, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, same place. Filed Oct. 4, 1892.

500,456. Automatic Circuit Breaker. Alexander Wurts, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, same place. Filed Oct. 26, 1892.

BATTERIES.

500,284. Galvanic Battery. Mortimer M. Hayden, New York, N. Y., assignor to the Law Battery Company of New Jersey. Filed April 28, 1892.

500,394. Secondary Battery. Frank King and Edward Clark, London, England. Filed March 16, 1893.

TELEPHONE AND TELEGRAPH APPARATUS.

500,226. Telegraphy. Charles Cuttriss, New York, N. Y. Filed Feb. 21, 1893.

500,481. Magnetic Telephone. Charles S. Forbes, London, England. Filed Oct. 27, 1892.

MEASURING INSTRUMENTS, INDICATORS, ETC.

500,236. Static Voltmeter. Arthur E. Kennelly, Orange, N. J., assignor to Thomas A. Edison, same place. Filed Aug. 6, 1892.

500,264. Galvanometer. Adrian H. Hoyt, Manchester, N. H., assignor to the Whitney Electrical Instrument Company, Saco, Me. Filed Sept. 5, 1892

500,359. Indicator. August Utzinger, Nuremberg, Germany, assignor to Shuckert & Company, same place. Filed Feb. 9, 1893

500,404. Electric Indicator. William B. Luce, Brookline, Mass. Filed Jan. 4, 1892.

500,543. Station Potential-Indicator. Charles F. Scott, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, same place. Filed Sept. 28, 1892.

SIGNALS AND SIGNALING APPARATUS.

500,285. Police Signaling Apparatus. William H. Kirnan, Bayonne, N. J., assignor to the Gamewell Fire-Alarm Telegraph Company, New York, N. Y. Filed Dec. 28, 1892.

ELECTRIC HEATERS.

500,272. Electric Heaters. Charles E. Roehl, Chicago, Ill., Sidney Z. Mitchell, Portland, Oreg., and Earl P. Wetmore, Helena, Mont. Filed Dec. 23, 1892.

500,288. Electrical Heater. James F. McElroy, Albany, N. Y., assignor to the Consolidated Car-Heating Company, Wheeling, W. Va. Filed Oct. 1, 1892.

500,520. Electric Heater. Earl P. Wetmore, Helena, Mont., assignor of one-half to Sidney Z. Mitchell, Portland, Oreg. Filed Dec. 23, 1892.

PHONOGRAPHS.

500,280. Phonograph. Thomas A. Edison, Llewellyn Park, N. J. Filed Nov. 21, 1890.

500,281. Phonograph. Thomas A. Edison, Llewellyn Park, N. J. Filed Nov. 21, 1890.

500,282. Phonograph. Thomas A. Edison, Llewellyn Park, N. J. Filed Dec. 3, 1890.

MISCELLANEOUS.

500,172. Electrotherapeutic Device. William R. Washburn, Cedar Rapids, Iowa, assignor of two-thirds to F. S. Washburn and F. E. Washburn, same place. Filed Nov. 11, 1892.

500,178. Lightning-Arresters. Montraville M. Wood, Chicago, Ill. Filed Sept. 22, 1892.

500,229. Electric Cut-Out. Ernst Egger, New York, N. Y., assignor of one-third to Aaron Naumburg, same place. Filed Nov. 8, 1892.

500,248. Fusible Cut-Out. Stephen A. Young and Clarence Alden, Maryville, Mo. Filed April 3, 189[illegible]

500,274. Regulating-Switch for Electric Elevators. Alonzo B. See and Walter L. Tyler, Brooklyn, N. Y. Filed Nov. 12, 1892.

500,362. Resistance-Box. Edward Weston, Newark, N. J. Filed Sept. 10, 1892.

500,423. Double-Pole Switch. Charles A. Pfluger, Chicago, Ill. Filed Dec. 19, 1892.

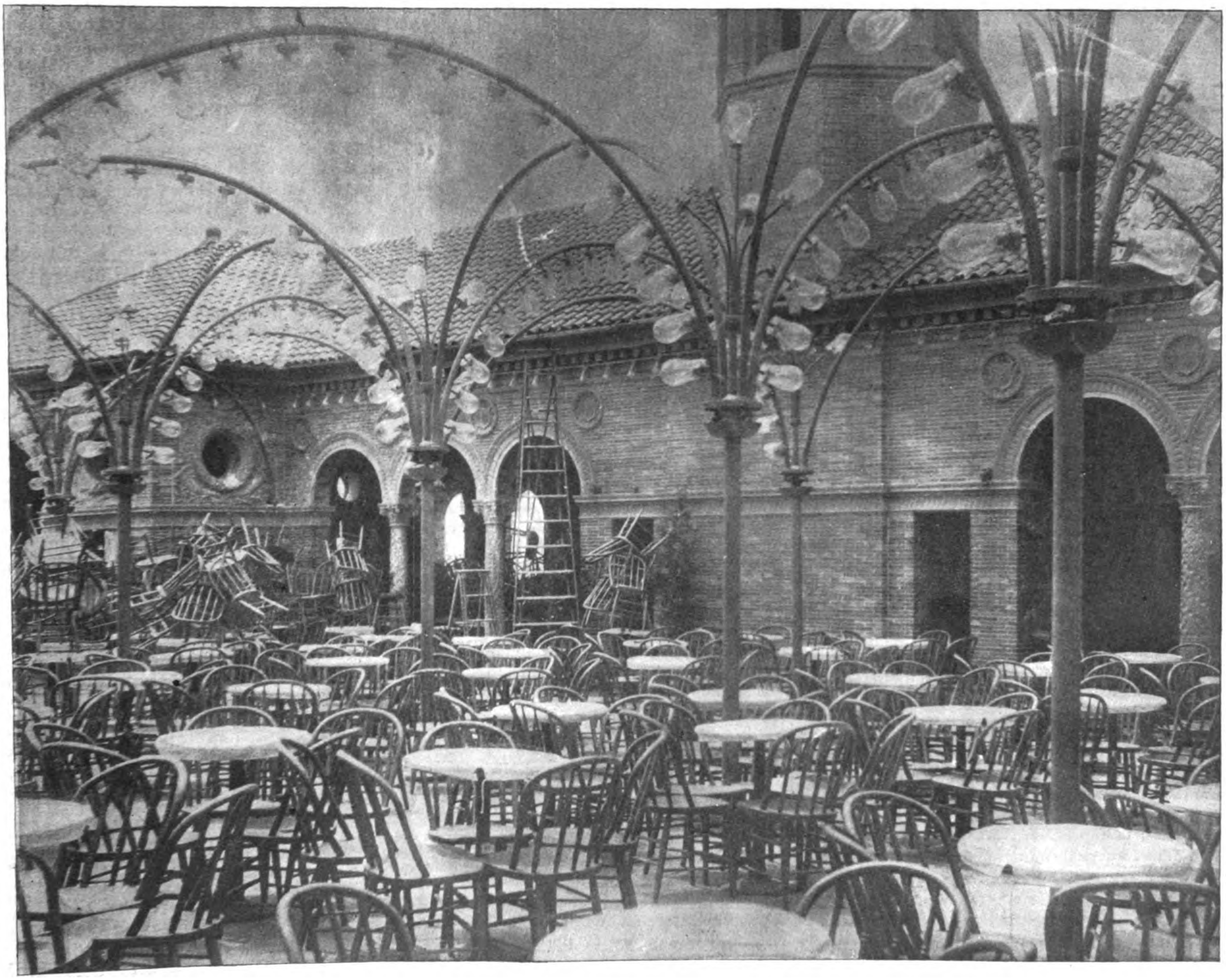
500,454. Lightning-Arrester. William Wurdack, St. Louis, Mo., assignor to the Inter State Complete Electric Construction Company, same place. Filed Sept. 12, 1892.

500,488. Insulating Device for Preventing Electric Currents in Pipes. Simeon D. Gratiaa, St. Louis, Mo., assignor to the Fay Gas Fixture Company, same place. Filed Sept. 1, 1892.

500,539. Electro-Medical Apparatus. Thomas C. Hodgkinson, Melbourne, Victoria, assignor to Henry Thomas Tompsitt, same place, and John Mildred Creed and Edward Henry Bellsario, Sydney, New South Wales. Filed Dec. 24, 1891.

ELECTRICITY.

VOL. IV. NEW YORK. JULY 12, 1893. CHICAGO. No. 26

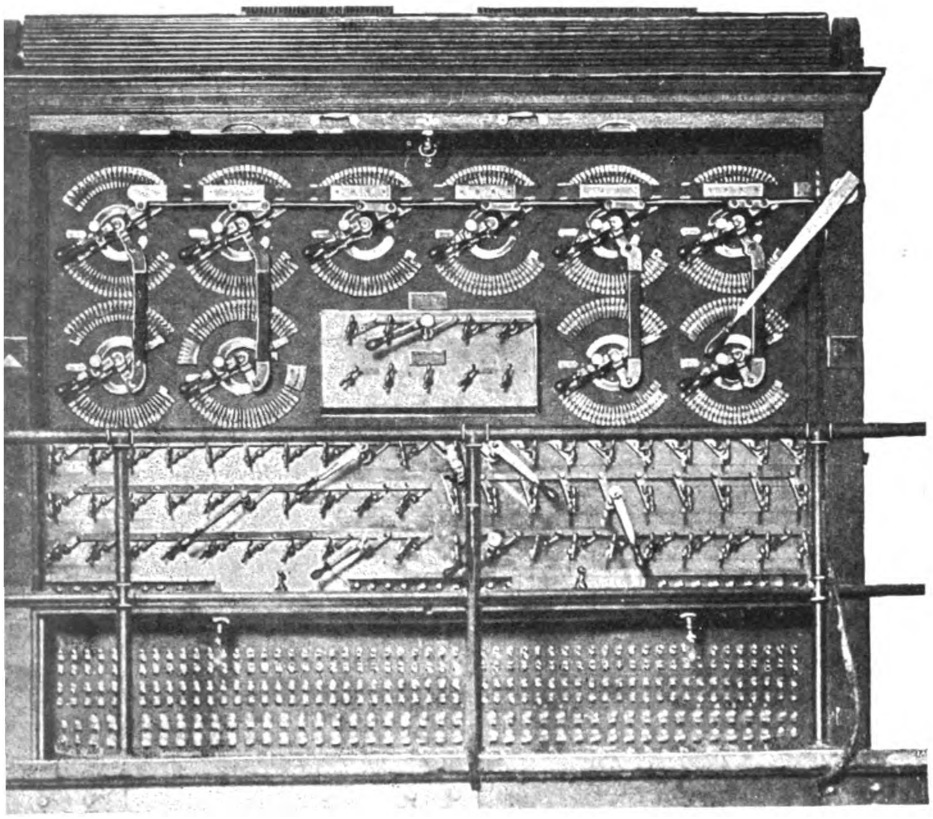


ROOF GARDEN LIGHTING, AMERICAN THEATRE. (SEE PAGE 350.)

nerican Theatre's Electric Plant.

erican Theatre, recently opened in this ins an extensive electric lighting plant designed in accordance with the best ctice in theatre lighting, and special has been given to the distribution of ts for producing every desired stage l to make any accident, such as the of a fuse, practically unnoticeable by g the lights on one circuit at consider- ces apart.

nt consists of three 25 K. W. Edison wound machines of 220 volts, three 45 hines of 125 volts, and one 15 K. W. 220 no for elevator service. The dynamos ven by horizontal high speed Arming- s engines.



STAGE SWITCHBOARD, AMERICAN THEATRE, NEW YORK CITY.

ie dynamo room switchboard independ- rs are run for the following circuits also independent: stage lighting; audi- ighting; front of house; Forty first ilding, Forty-second street building; nue building; Eighth avenue entrance; nd street entrance; roof garden; elec- Eighth avenue building; electric sign, nd street building; working lights in house; stage working lights; dressing

ing is on the three-wire system with wire having a capacity equal to the le wires, and the circuits for different ie building are all brought out to a few oints from which they are controlled.

and auditorium lighting is regulated tage switchboard, shown in Fig. 1. All for lighting in front of the house, in s, entrances, etc., are brought to the e, where the switches and cut-outs are

ge wiring has been given special atten- ially in the separation of the lamps on ch circuit. This is illustrated by the hts, of which there are seventy each of and blue. There are seven three-wire r each color, and the fusing of one side cuit cut-out would only affect the first, twenty-ninth, etc., lamps, and would noticeable to the audience. This same arrangement is carried out in all the stage lighting, and it is almost impossible for any consecutive set of lights to go out from accident.

The switchboard on the stage was manufactured by J. P. Cushing & Company, of Boston, and is the finest one ever made for this purpose. Every gradation of light needed for stage effects is readily made, and the red and white lights can be worked together in the same or opposite directions. The sets of border lights can be graded separately or any sets can be thrown out or graded independently. There are also seventeen sets of floor pockets, wired and regulated in the same way, to use for brackets, lamp posts, hearth fires, or any of the usual stage fittings requiring lights.

Any or all border lights can be thrown entirely out or up to full candle power or to any intermediate point by the simple throw of a switch without regard to their previous arrangement. A switch is also provided to throw the whole plant on to the street service in case of accident in the dynamo room, and every safeguard possible has been provided. The wiring throughout is run in interior conduit and the insulation resistance on the whole plant has been tested to over a megohm.

The entire equipment was put in by the New York Electric Equipment Company and the work was done under the personal supervision of Mr. Noll, General Superintendent of the company.

Electrical Experts.

BY G. EMIL HESSE.

Every important branch of our industries has what is called its experts, and so has electricity—good and bad ones. It certainly has too many of those who actually do not know any more about the theory of electricity than they know about the people on Mars, and that means very little. They use a language here and there intermixed with a few electrical expressions or phrases which to the outside man sound as if they were well posted in the business.

An incident with such an expert came some little time ago within my observation, and the situation would, under other circumstances, have been comical, but the great importance of the question made it serious in this case. It is very seldom that absolutely new things are presented to an expert, but this happened to be the case at this time, and such an incident requires of course a man with a good theoretical and practical education. The telephone is an example of this, and it would be interesting to know just how many of our experts endorsed Professor Bell's theory when first announced. The fact that a half interest in this patent went begging at $10,000 will probably convey a clear idea on that point. Our expert mentioned above would surely not have supported it under any circumstances.

I believe it did not take our friend one minute to decide that the thing in the present case was absolutely useless and not worth a second thought, while the manufacturer who presented it to him on behalf of the inventor and himself, and who was prepared to invest in it if pronounced good, went away satisfied that he had narrowly escaped losing his money and with the firm belief that the inventor in the case was an ordinary everyday schemer, and "the woods are full of those," as the saying goes.

Now this very same thing was afterward taken to two other experts by the inventor, both of them standing at the head of the profession, and the name of one of them especially is almost identical with the science in this country. These two men, seeing the importance of the thing, made separately a thorough examination of it, and returned it in about two weeks' time with the declaration that the theory was perfectly correct and that in practice it undoubtedly would prove a success, and recommended its speedy trial.

What I think therefore would be of value to manufacturers who are not themselves sufficiently posted in electricity is to be very careful in the selection of experts, and if it is an important case and large sums of money are involved, never to rely on the opinion of one man only, but consult men that are known to be sound both in theory and practice.

Never accept an opinion given at the spur of the moment. A new thing has to be studied up and thought over carefully if the opinion is to be of any value.

Better pay a good price for a well considered opinion given by a reliable expert. It is a great and very common mistake to think that money spent on a consulting engineer is money wasted.

It is very natural that new things are most frequently presented in such a new industry as electricity, wherefore it is more important to be on guard in this than in any other science, as a loss may just as well be incurred by investing in a new thing as by refusing to do so.

The Rochester Consolidation.

Mr. Einstein Takes Action to Get What is His.

Mr. Edwin Einstein, a New York capitalist, who was frozen out in the consolidation of the Rochester gas and electric companies some months ago, has brought suit against the companies forming the combine to recover 4,800 shares of Rochester Brush Electric Light Company's stock of the par value of $480,000.

Mr. Einstein alleges that in June, 1891, he purchased the right to use the Brush patents in the county of Monroe of C. M. Rowley, who had purchased them of the parent company; that he transferred the rights to the Rochester Brush Electric Light Company, and it was agreed that he should receive 48 per cent. of the stock of the company and the same proportion of any increase.

When the consolidation was effected the Brush Company retained its corporate name. The consolidated company, however, bought all its stock, giving five shares of consolidated for one of the Brush Company. Mr. Einstein says that there was an increase in the capital stock of just $1,000,000, and not having received his 48 per cent. he now brings suit.

Instrument for Testing Primary Batteries.

An instrument which should prove of great service for testing the condition of a primary cell has been designed by Major Holden, and was exhibited at a *conversazione* of the Royal Society. A small wooden case measuring 3½ inch. by 4½ inch. by 2 inch. deep, contains a dead beat voltmeter reading from 0·5 to 1·5 volts, and a resistance coil. The instrument, which is made by Mr. Pitkin, is shown in Fig. 1 with the outer case removed. The voltmeter *a* is constructed on the principle common to other Holden instruments, and is described in *The Electrician* (London). A club-footed magnet or a horseshoe magnet having one coil is used. The limb within the coil is circular, the outer one being flat, lying against the coil, the end projecting a little. The circular limb carries a small radial pole-piece. A jewelled arbor is mounted as an extension of the axis of the coil, and carries a soft iron radial needle; the end is tipped with brass to prevent magnetic contact. The action of the peculiar magnetic arrangement causes the iron needle to be repelled from the radial pole-piece when a feeble current passes, but when it has moved through an angle of some 10 degs. the other pole of the magnetic system begins to attract it. As a result a fairly uniform scale is obtained. A spring control is employed, which allows the instrument to be held in the hand and used in any position. A resistance coil, *b*, is provided, and a push-button, not shown in the illustration, acting on the spring-contacts, *c*, reduces the resistance from 8 ohms to 2 ohms.

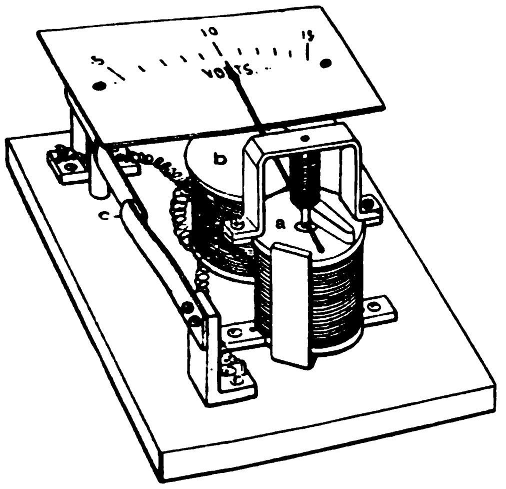
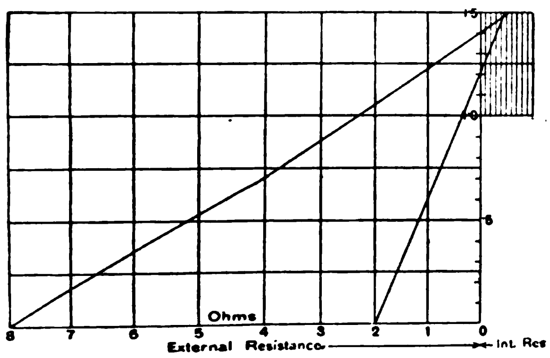


FIG. 1.



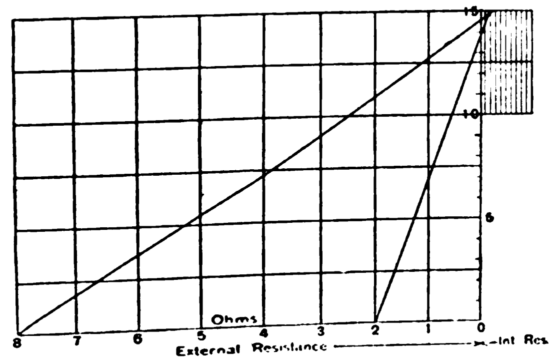


FIG. 2.—DIAGRAM FOR CALCULATING ELECTROMOTIVE FORCE AND INTERNAL RESISTANCE OF LECLANCHE, POROUS POT PATTERN (NEW).

FIG. 3.—DIAGRAM FOR CALCULATING ELECTROMOTIVE FORCE AND INTERNAL RESISTANCE OF E. C. C. DRY CELL, SPECIAL FIRING PATTERN (NEW).

The method of using the instrument is as follows: Two short, thick wires having been connected to the terminals terminating in ends or in a suitable double pointed spear, the ends or spear are put in contact with the poles of the cell it is desired to test: this gives one reading, viz., the difference of potential at the terminals of the cell when it is working through an external resistance of eight ohms (neglecting the resistance of the leads). Then by pressing the push in the side of the case another reading is obtained, this latter being the difference of potential at the terminals when the cell is working through two ohms external resistance; from these two readings (which should be taken as quickly as possible) the electromotive force and internal resistance can be calculated, or their values can be got by reference to a table. The following are the results of a few tests with well-known cells:

—	First reading.	Second reading.	E.M.F.	I. R.
1. Leclanche 6-block agglomerate round pattern (condition, very old)	1.32	1.22	1.35	0.22
2. Leclanche's porous pot pattern, 3-pint size (condition, new)	1.4	1.21	1.47	0.42
3. E. C. C. dry cell, special firing pattern, weight 6.25 lb. (condition, new)	1.43	1.38	1.96	0.15
4. Leclanche Barbier dry cell, No. 1 size (condition, fair)	1.3	1.05	1.43	0.68

The methods of ascertaining the electromotive force and internal resistance of a battery are well known, and possibly the following graphical construction is not new, but is well worthy of attention, being a singularly neat example of graphical calculation. On a piece of squared paper a scale from 0 to 8 is laid down from right to left, and on this is set off the external resistances of the instrument. On the same line, and with the same values of scale divisions, the internal resistance of the battery is to be measured. A vertical scale is chosen to give convenient angles in the construction of the diagram, and on it is set off the volts measured by the instrument. Straight lines are drawn from the 8 and from the 2 on scale of resistances through the readings on the vertical scale and meet at a point on the right-hand side of the zero resistance. The horizontal distance of this point from the zero line gives the internal resistance. The height of this point measured on the vertical scale gives the true electro motive force of the battery. Figs. 2 and 3 relate to the second and third examples already given.

The possible element of error in such a method of testing as that upon which this instrument is based is, of course, that, owing to polarization, the volts of the cell when circuited through the two ohms may be lower than its previous value when circuited through eight ohms, and that both of them will be lower than the volts on open circuit. The error is reduced to a negligible quantity by making the test quickly and by preventing very large currents from passing through the cell; but for the second precaution high resistances are necessary, and these are objectionable because of their great disproportion to the magnitude of the internal resistance which is to be measured.

A Chance for Business.

The town of Madison, Wis., is about to advertise for bids for an arc lighting plant, capacity 200 lights, for the village lighting. It is not intended that the town shall do incandescent lighting.

Germany's Electrical Exhibit at the Exposition.

The Chicago correspondent of the Boston *Herald* gives high praise to the German exhibit at the Fair as a whole, and of its electrical features he has this to say: It is in the Electricity Building, however, that we must learn the lesson of civilization, that there are four nations which to-day are really the great motor forces of the world, the United States of America, Germany, France and England. Other countries are doing practically nothing in the development of this great form of energy, and so in the one department of the Fair that is an absolute new creation since 1876 we find only these four nations, with our own clearly at the head and England as distinctly at the foot of the list. France here occupies more than three times as much space as England, but her exhibit does not equal that of Germany, which has contributions from 30 firms in the electro-technical field, and 43 in mechanics, optics, etc., Berlin, Nuremberg, Cologne, Frankfort and Hamburg being the cities most strongly represented. Then we have the great exhibit of Siemens & Halske of Berlin over in the Machinery Building; we have perhaps already noted the largest direct current dynamo ever constructed, which is 12½ feet in diameter, and is used to furnish light for the German section in that hall, the Terminal Station, the Wooded Island and a good deal more besides. Then we have here three of the biggest search lights ever built, one of them with a 7½ foot projector, throwing sufficient light for a lawn party a distance of 75 miles. This is, perhaps, the "big thing" of the German exhibit in electricity. The German catalogue tells us that the electrical industries of Germany employed 20,000 men and turned out a product valued at $9,000,000. One of the features of this department is the exhibit of telegraph apparatus, complete since 1830, which is made by the German Post-Office Department. Siemens & Halske also have a historical collection of electrical instruments that is very valuable.

Effect of Dynamos on Ships' Compasses.

The Admiralty has directed, says the London *Daily News*, that all ships fitted with 300 and 400 ampere dynamos are to be specially swung for the purpose of ascertaining the effect of the dynamos on the ships' compasses. The effect on all the compasses is to be specially noted, and a report forwarded to the Admiralty. The Lords of the Admiralty have directed that the minimum distance between dynamos and compasses is to be sixty feet in the case of a 300, and seventy feet in the case of a 400 ampere machine, and in the light of the experiments that are now to take place it would be interesting to know the distances between the dynamos and compasses of three of Her Majesty's ships that have recently been damaged by getting into positions at direct variance with the navigators' intentions.

A Subtle Poison.

Apropos of a series of tests making use of gas mains and water pipes for telephone circuits, the London *Lancet* raises a query as to the possibility of electrical lead poisoning. "The small though distinct currents that are set up when the gas and water pipes are connected are attributed to a slow chemical change in the pipes, which may thus represent the plates of a battery. This hypothesis leads one to think of the probable nature of these changes and to wonder whether any effect is produced in the water contained in the water pipes, or whether perchance minute traces of metal as a result of the change would find their way in solution into the water. If the latter event took place another and hitherto unsuspected source of lead poisoning might possibly be traced."

The Milwaukee Lamp Case.

Sensational Affidavits Offered.

A Decision Expected on July 17.

The case of the Edison Electric Light Company et al. vs. the Electric Manufacturing Company et al., on motion for preliminary injunction and on motion to raise the restraining order, came up before Judge Seaman in the United States Circuit Court at Milwaukee on Monday, July 3.

Complainants were represented by R. N. Dyer, Chas. E. Mitchell, Major S. B. Eaton, W. G. Beale and F. P. Fish, and defendants by Messrs. Witter and Kenyon, of New York, and W. H. Webster, of Oconto.

Little new evidence was introduced bearing upon the merits of the incandescent lamp question proper, complainants having rested their case chiefly on an effort to discredit the testimony introduced by the defendants in the Columbia and Beacon cases. Charges of bribery and perjury were numerous, and the proceedings were intensely interesting throughout.

Mr. Dyer, for complainants, made the opening argument, and consumed the greater part of three days. He was followed by Mr. Witter and Mr. Kenyon for defendants, and the argument was closed by Mr. C. E. Mitchell for complainants.

It was attempted by complainants to prove that Goebel lamps marked Exhibits 1, 2 and 3, and also the machines for planing the carbon filaments, had all been made since September, 1892.

Complainants offered in evidence seventeen new affidavits; that of Mr. George F. Barker, which came first, was intended to show the impracticability of the various Goebel lamps, and the inaccuracy of the tests made by Messrs. Pope and Cross. The affidavit of Mr. John W. Howell was in the same direction.

Mr. Clarence A. Seward, of counsel for complainants, who made an able and forcible argument in the Beacon and Columbia cases, made affidavit that to the best of his knowledge and belief a cross-examination of defendants' witnesses would prove the following facts: that as early as 1883, and subsequently in 1887, two lawyers other than Leonard E. Curtis, representing clients opposed to the Edison patents, had investigated the claims of Henry Goebel, and found that he was unable to produce any of his alleged early lamps, and that one of these lawyers had stated that Goebel had no evidence in his possession of having made lamps prior to the date of the Edison patent.

That lamps 1, 2 and 3 were recently and fraudulently made.

That the glass tubing out of which these lamps were made was purchased by Henry Goebel, Jr., on or about Sept. 28, 1892.

That lamp No. 4 was not made by Henry Goebel, but was made after the year 1880 by one Aug. F. Hyer at 468 Grand street, N. Y., as also lamps Nos. 9 and 11.

That Henry Goebel never had or used any incandescent lamps prior to his employment in 1881 by the American Electric Light Company.

That Henry Goebel, prior to 1881, did not employ on his telescope wagon or conveyance any electric lamp, but oil lamps only, and that prior to 1881 Goebel did not have any electric lamp of any kind.

That defendants' witnesses are mistaken as to their dates, and have confused gas light with a white shade with the electric light, and that a large number of these witnesses are ignorant of the construction of electric lamps.

That a large number of these affidavits were procured without any knowledge of the applicants as to their contents.

That prior to 1881 Goebel had never made any carbons for incandescent lamps.

That the machine which Goebel claimed to have made for cutting carbons was not made till after 1881, as also all the other tools for cutting carbons.

Joseph Steiner, an attorney, testified that a majority of defendants' witnesses were poor and ignorant people, living on the east side in New York; that Herman Kraft, who had made affidavit for defendants, was a criminal who had served a sentence for grand larceny, and that Kraft had stated to him, Steiner, that he did not know what his affidavit contained, and had no knowledge of Goebel's alleged electric lamp.

Max Hoffmann, a saloon-keeper, testified that he had seen Henry Goebel, Jr., almost daily since September last, and that the latter said when he heard of Judge Colt's decision at Boston: "That is a nice kind of a Judge; if he had dropped on lamps Nos. 1, 2 and 3, instead of on 4, he would come nearer to hitting the nail on the head. . . . I made those lamps. No. 4 was made in 1883 by a man who worked in my father's shop."

Other affidavits were introduced going to show that Henry Goebel, Jr., had made lamps 1, 2 and 3, that Aug. F. Hyer had made lamp No. 4, and that the machine for planing carbons was made upon the order of Henry Goebel in 1883 at the works of R. Hoe & Company in New York; also throwing discredit upon the affidavits of Henry Goebel, Jr., of Mary Meisinger, Azubah Rice, and Frederick Fitzpatrick, previously introduced at Boston and St. Louis.

Mr. W. H. Meadowcroft had prepared a series of tabulated statements showing that a large majority of defendants' witnesses were friends and relatives of Goebel, which was put in evidence.

The Defense.

Twenty-three new affidavits were offered by the defense, which makes now a total of over 250 affidavits, representing over 200 people in various walks of life, who have been found to testify to the early work of Henry Goebel in incandescent lighting.

In view of the claim of complainants that lamps 1, 2 and 3 were made by Henry Goebel, Jr., in September, 1892, the affidavit of Mr. J. E. Bull was perhaps the most important one introduced in the present case. Mr. Bull, as is well known, has been connected with incandescent lamp litigation since about 1880, chiefly as counsel for the companies which were the predecessors of the present Westinghouse Company.

Mr. Bull's deposition was taken at the Brevoort House, New York, June 2, 1893, just before his departure for Europe. There were present Major S. B. Eaton and D. H. Driscoll for complainants, and Messrs. Witter & Kenyon for defendants. Mr. Bull testified that he first saw lamps Nos. 1, 2, 3 and 4 at the shop of Henry Goebel in Grand street in November, 1890, and that both the Goebels, Henry junior and Henry senior, were present. "The lamps I then saw were either these exhibit lamps or lamps just like them." On returning to his office after that interview he made sketches in his office daybook of these lamps and memoranda as to the occurrence. Copies of these entries were finally offered in evidence as exhibits in this case. A few days before Nov. 15, 1890, Mr. Bull had met, at the factory of the Ball Electric Company in New York, a Mr. Bossard, who had told him of Goebel and his early work; this was the first he (Bull) had heard of Goebel.

Defendants showed by affidavits of Nicholas Finck, Charlotte Finck, C. N. Finck, R. D. Gibby, Baldwin Sebastiani, Lizzie Opry, J. A. Opry, A. D. Kenyon and Henry Goebel, Jr., bribery or attempted bribery of defendants' witnesses to secure alleged evidence of the fraudulent making of Goebel lamps.

Mr. A. D. Kenyon testified that on Feb. 16, 1893, the following statement, embodying what Henry Goebel, Jr., had just related to him in conversation, was placed in writing and signed by Goebel, Jr., in his (Kenyon's) presence:

> I, Henry Goebel, Jr., of the city of New York, hereby certify that this 16th day of February, 1893, I was approached by Max Hofmann, proprietor of the East Side Hofmann House, corner of Seventh street and Avenue A, New York City, and asked what I would take to go on the other side. I said I thought it was worth twenty-five or fifty thousand dollars. He then said to me that he thought he ought to make ten thousand out of it, and that it ought to be worth ten to twenty-five thousand to me to go on the other side, or to get out of the country. He then said he would speak to the other party to-morrow. He asked me if I would take a certified check; I said no, I would only take money. He furthermore said I would get a position for life in the company on the other side. When Hofmann first spoke to me I answered him and carried on the conversation to bring him out. This conversation took place between 3 and 4 o'clock in the afternoon in the saloon in the East Side Hofmann House. Later on, between five and six in the afternoon, I went to the office of Witter & Kenyon, 88 Park Row, and immediately told Alan D. Kenyon about the interview with Mr. Hofmann referred to above.

Complainants' moving papers are embodied in a pamphlet of 50 pages, defendants' answer occupying 486 pages.

We are privately informed that Judge Seaman expects to hand down his decision on Monday, July 17, next.

A Unique News Service.

The Telephone Usurps the Functions of the Ticker and the Newspaper.

Messrs. B. von Harksing, Eugene Godhard and Stephen Godhard, of Buda-Pesth, Hungary, at present enjoying an American tour, are quoted as follows by a Kansas City reporter in regard to the telephonic news service in their city, which was briefly noticed some weeks ago in ELECTRICITY:

"The editor of the *Telephonic Gazette* furnishes all the news of the day to his subscribers by telephone at a rate equivalent to sixty cents a month. The subscribers are given a telephone of a special pattern for which they pay $6. It receives but does not transmit sounds excepting from the central office of the *Telephonic Gazette*. It occupies a space about five inches square and has two ear pieces so that two persons can listen to the sounds on the wire at once. At 9 o'clock in the morning the first edition of the *Gazette* is announced by the simultaneous ringing of a bell in the houses of the subscribers and the business man and his wife listen to the stories of the events of the night. The editor is talking to hundreds of other subscribers at the same time and he has the instrument so arranged that inquisitive housewives must content themselves with his precise statement of the news, and not ask whether the fellow was married or not. He hasn't time, this telephonic editor, to answer all the questions women might ask, or go into all the details of the news. He states it in a laconic way.

"The second edition appears at 10 o'clock, when the foreign news comes over the wire in a condensed form for twenty minutes or less, according to the amount of foreign news on hand. At 11 o'clock the story of the meeting of Parliament is told, along with divers items of a local and political nature. The price of stocks is given and the wise broker may have time to hustle out and get 'long' or 'short' on certain securities in time to save his bank account. At 12 o'clock there is no edition. The editor of the *Telephonic Gazette*, unlike other editors, eats, and he is blessed with that desire about 12 o'clock. At 2 o'clock he begins again, though, and gives a concise statement of the debates in Parliament, telling just which members have been knocked down and giving the story of the resignation of the Ministry, which is reported so often in Hungary that it sticks on the wires. At 3 o'clock the editor in the central office opens up on local news again. He tells about fires, riots and other happenings of the day in Buda-Pesth. He gives his subscribers a chance to rest then until 6 o'clock, when he gives literary news and society news, never giving more than five words to the description of any one woman's gown. Sometimes he repeats the latest poem at 6 o'clock. This 6 o'clock edition is popular with the women and the editor speaks in a soft voice. The 7 o'clock edition is the last. It gives reports of concerts and plays in progress."

Municipal Plants.

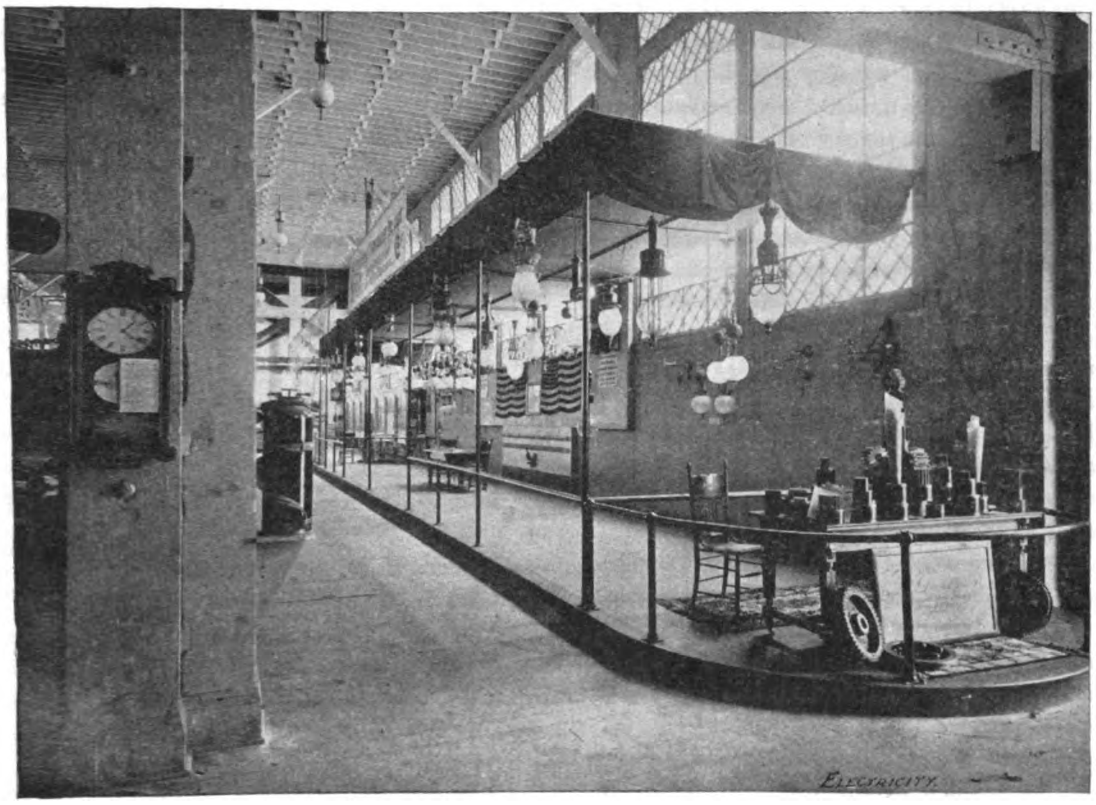
The Detroit *Free Press* has the following words of sound wisdom in regard to municipal electric lighting plants:

"It is no easy task under the most advantageous circumstances for a municipality to do its own work at a less price than the cost by contract. It could not, probably, do its electric lighting at less cost if there were free and open competition in the lighting business. It is only because of the 'combine,' which has forced the price up by excluding competition, that the project of lighting by public account promises better results for the money; and that promise can only be kept by exercising the most careful economy in the purchase of the site and in the establishment and management of the plant. It will be very easy by a lack of judgment or forethought in these matters to make the lighting cost as much under the public system as it did under the exorbitant charges of the contractors; and in that event the people will be greatly disappointed, and have the right to be."

World's Fair Notes.

In the exhibit of the General Incandescent Arc Light Company at the World's Fair, which is illustrated in this issue, is shown one of the most comprehensive displays of arc lamps for incandescent circuits that can be found on the grounds. The list includes not only the ordinary arc lamps, but also the standard, the ornamental, the railway, the series, the chain and the bijou, all of which are manufactured by this company.

The space allotted to the company is located near the northeast corner of the Electricity Building and has been very handsomely draped and decorated. Sixty lamps have been hung from the temporary ceiling and each lamp has been wired up to be turned on or off from a row of switches located on the wall behind the desk. A portion of the exhibit which is attracting considerable attention is the 6-light combination which occupies the central position of the booth. It consists of six arc lights arranged similarly to the ordinary chandeliers, but is much more handsomely decorated with brass finishings.



GENERAL INCANDESCENT ARC LIGHT COMPANY'S WORLD'S FAIR EXHIBIT.

The company have also installed 160 railway lamps in the annex to the Machinery Hall, which are run on the 500 volt circuit, to the entire satisfaction of the exhibitors in that portion of the building. The booth is in charge of C. A. Noll, of New York.

The construction department of the Exposition is to be criticised for the dangerous way in which they have left a number of the switch and fuse boxes exposed in several of the buildings. The boxes in which the wires carrying both high and low tension currents are run are set in the wall very near the floor and can be easily touched by any one standing near them. In view of the fact that the authorities have expended large sums of money in burying the conductors for the protection of the public, it would seem that a few dollars expended for covers for the boxes would be a good investment.

Unique features of the Japanese exhibit in the Electricity Building at the World's Fair are the electroliers and other fixtures. Instead of making them out of brass or other metal they are made out of bamboo. The electroliers are made to hold from one to six lamps and are very substantial and neat in design.

The Deadly Cable.

It Plays Havoc in Broadway.

Cars at a Standstill for Three Hours.

At the hour when Broadway was most crowded with loaded vehicles and busy pedestrians yesterday afternoon, says the *Sun* of July 6, one of the new cable cars of the Broadway surface line was run away with. It sped three-quarters of a mile, from Worth street to Trinity Church, before it stopped. Trucks were brushed aside and upset, horses were thrown from their feet and dragged for blocks under the wheels, four other cars were jammed into a heap in front of the runaway car, and several persons were more or less seriously injured.

During a temporary blockade, car 77, bound down, had stopped at Spring street and the gripman of course left the grip open until the cable was moving again. When he heard the wheels begin to murmur he gripped the cable and started toward the Battery. All went well until the conductor rang for him to stop at Worth street. Then he discovered that he could not open the grip and of course could not put on his brake. He tugged at the wheels in front of him with all his might, but they would not budge either way. The car kept on at full speed, and the conductor rang again to stop, but the cable did not stop, and neither did the car. It went tearing down Broadway until it had come up with five more cars, which were all compelled perforce to join in the procession.

When car 77 reached Old Trinity the cable stopped.

The Philadelphia *Times* has a writer on its editorial staff who seems to have "caught on" to the possibilities of the electric car. He says: "The electric railway is now the method of transit that is in the closest touch with the people. It is the cheapest of all motors; it requires no grading of road-beds; it can climb the highest hills with ease and descend them with complete control of speed, and it goes into the by-ways where the steam line can never penetrate. It is, in fact, the railway of the people, and as such it should be liberally encouraged. It will soon bring every rural community into close relations with the city, and open the most heartsome of rural lands into use for suburban homes."

Legal Notes.

The bondholders of the Electric Light Works of the city of St. Charles, Mo., are taking steps to bring suit against the city in the United States courts for the unpaid interest coupons on the electric light bonds. The special tax for the purpose of having this interest was refused by the authorities last January. The refusal to collect the tax was based upon a decision of the State Supreme Court declaring that cities of the third class could not levy and collect special taxes over 50 cents on the $100 valuation. It is believed the suit, if brought, will be submitted to the court on an agreed statement of facts.

Judge Livingston has granted a preliminary injunction restraining the Lancaster and Columbia Electric Railway Company and the Lancaster Traction Company from laying their railway tracks over a Pennsylvania Railroad bridge at Mountville.

Judge Lea of the Pulaski (Ark.) Circuit Court will render a decision the present week in certain suits involving the validity of $270,000 indebtedness of the City Electric Street Railway Company of Little Rock. The test suits were brought by the Banks of Manistee and Grand Rapids, Mich., and Paris, Ill., and involve the sum of $35,000. A decision in these cases will settle all.

The American Bell Telephone Company has brought suit in the U. S. Circuit Court against two Chicago firms—Wm. Hubbard & Co. and the Cushman Telephone Company—for infringement of patents. The bills of complaint state that the defendants since March 7, 1893, have been unlawfully making and furnishing for use telephones which embody the inventions still controlled under patents not yet expired and owned by the American Bell Telephone Company.

Chancellor McGill of New Jersey has granted a temporary injunction stopping work on the Asbury Park and Belmar Electric Street Railroad. Argument on the application to make the injunction permanent will be heard July 18.

The Colorado Telephone Company won a case in the United States Circuit Court at Denver a few days ago in which it was defendant. Frank G. Browning brought suit for $5,000 for infringement of patent on fire clay conduits for underground wires. The patentee was A. L. Lynch, who had sold the rights to Browning. Judge Hallett decided there was no infringement. Browning appealed.

Current Items.

A Rochester man has devised a plan by which a trolley street car can be stopped almost instantaneously, or within a space of three feet, while the car is going at full speed. His device is operated by a lever in the motorman's cab. It is, generally speaking, a steel shoe, upon which the rear wheels of the car ride, the under side of which is corrugated so as to produce great friction upon the rails of the track. On the top of the shoe is an arrangement which, as soon as the wheel rises upon the shoe, clamps the outer rim of the wheel and at the same time grasps the inner edge of the rail. The simple weight of the car crowds down the shoe upon the rail and at the same time clamps together, as in a vise, the wheel and the rail; and all this by a single movement on the part of the motorman.

Telephonemeter is the new word naming an instrument to register the time of each conversation at the telephone from the time of ringing up the exchange to the ringing off signal. Such a system would reduce rentals of telephones to a scale according to the service, instead of a fixed charge to a business firm or occasional user alike. The instrument has been constructed at the invitation of the German telephone department, and is to control the duration of telephone conversations and to total the time.

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The Earth Return.

The trouble between the telephone and electric railway interests in London, mentioned some time ago in ELECTRICITY, is referred to again by our London correspondent this week. Since the petition from the telephone companies was presented to the Board of Trade asking that the specification to prohibit the use of grounded railway circuits be included in the provisions for any future roads, a joint committee of Lords and Commons has started an inquiry in regard to the matter, and has taken the testimony of many of the leading electricians in England.

In view of the trouble that has been found in different places due to ground circuits, not only in the case of telephone and telegraph wires, but to the electrolytic action on buried pipes, it seems at present as if the most satisfactory course would be to provide metallic returns for all circuits, as in that case incidental grounds, which are almost inevitable on railway lines, would not have any noticeable effect on neighboring lines, and this would also obviate the difficulties which have occurred in connection with gas and water pipes.

The greatest advantage which would be secured in the case of insulated railway conductors would be the possibility which would be offered for using much higher voltages than are now practicable. Five hundred volts has been adopted as a standard only because it is considered a safe limit on bare wires, and the early attempts in railway work were made on 220 volts or less.

The testimony of Lord Kelvin in this connection is significant, as he says that there would be no practical difficulty in having return conductors, which if insulated would allow a much higher working pressure and decrease the amount of copper correspondingly.

The right of using the ground return is generally conceded in this country, but it is not improbable that the railways may eventually find it to their own advantage to insulate their return circuits and take advantage of the saving in copper which would result from high voltages.

* * *

THE *Review of Reviews* for July contains an extended sketch of the career of Mr. Thomas A. Edison from the pen of Charles D. Lanier, illustrated with new photographs which are interesting. The article is followed by a sketch of Lord Kelvin, the two being printed under a common heading, "Two Giants of the Electric Age."

It has for about fifteen years been Mr. Edison's chief misfortune that newspaper men fail to maintain their mental equilibrium when writing of him, and Mr. Lanier is no exception.

A correct estimate of Mr. Edison and his work has never yet been printed, and is not likely to be for many years to come. Somewhere, however, between the unfavorable picture drawn by his severest critics and the abnormal figure which exuberant reporters have painted stands the true Edison—a genius, a hard worker, and a public benefactor, but neither a god nor a monstrosity.

Mr. Lanier has quoted Mr. Edward H. Johnson, to whom Mr. Edison owes more than to any other *man* for the success of his various enterprises, and from Mr. Johnson we have about the only prosaic common sense in the article, if we except the following sentence from the author's own pen: "Electrical science is in its infancy."

* * *

An Expensive Lesson.

While the disturbances in the financial and business world this summer have not been as sensational in their nature as were the panics of 1873 and 1884, they have been fully as serious, and it will take a much longer period for a full recovery to take place.

In both of the instances referred to it was only a few weeks until values had recovered to a healthy basis and confidence was fully restored. Then, as now, Wall Street was the first to see the dangers ahead, and had practically recovered from the shock, while yet business disasters were multiplying throughout the country. We predict, however, that in the present instance Wall Street will wait a good deal longer for a boom than it has ever waited before, because the lambs have not been sheared only, they have actually been skinned.

While the Industrial stocks cannot be charged with creating the present condition of affairs, they and their promoters can be honestly charged with the wholesale robbery of the investing public. Other values have shrunk, and will again recover, but the Trust stocks will never recover, because the values never existed, and the people have been fully convinced of the fact.

The London stock markets had their period of Industrial speculation some years ago, and it ended with even more disastrous results than have been felt here. The boom lasted longer, and prices had reached even a more inflated point. Laws were speedily enacted there rendering a repetition of the schemes impossible on any large scale.

It is unfortunate that American investors could not have heeded the impressive lesson, but they did not. They were carried away by the rapid rise of Trust stocks in the market, believing that the rise represented an honest increase in value when it was nothing less than a conspiracy to defraud, engineered by the Trust themselves, and carried out by their official brokers, who sold the stocks back and forth among themselves, reaping fortunes in commissions alone. Thus the public were caught, and the public has paid the bill. Expert Wall Street judgment is that not one in twenty of the organizers of these Trusts has kept his stock on the decline. They have all unloaded enough to leave them with a handsome balance to the good, and whatever stock they have left has cost them practically nothing. It should be noted that in the case of General Electric, with which our readers have most concern, the original Thomson-Houston stockholders could sell their General Electric stock at 75 and still make a substantial profit.

The following table shows approximately the losses which the investing public has sustained through their child-like faith in Trust stocks. Present quotations are all lower (July 7) than when the table was compiled, and some of the companies have made further issues of stock since the date of the highest quotation :

Companies.	Highest since Jan. 1892.		Present quot'ns.	Loss in points.	Amount of capital.	Losses in money.
	Date.	Price.				
Am. Cotton Oil, common.	Mch. '93	51	35	16	$20,237,100	$3,237,936
Am. Cotton Oil, preferred	Nov. '92	86	73	13	10,198,600	1,325,818
Am. Sugar Ref., com.....	Feb. '93	184	136	48	36,773,000	17,651,040
Am. Sugar Ref., pfd.....	Aug. '92	107	86	21	36,773,000	7,722,330
Distil. and Cat. F'd'g, com.	Dec. '92	72	19	53	35,000,000	18,550,000
General Electric, com....	Oct. '92	119	75	44	35,395,000	15,573,800
National Cordage, com....	Feb. '93	147	new 12	61	20,000,000	12,200,000
National Cordage, pfd....	Aug. '92	123	40	83	5,000,000	4,150,000
National Lead, com.......	Jan. '93	52	31	21	14,905,400	3,130,134
National Lead, pfd.......	Aug. '92	99	72	27	14,904,000	4,024,080
Am. Tobacco, com.........	Nov. '92	126	68	58	17,900,000	10,382,000
Am. Tobacco, pfd.........	Oct. '92	115	91	24	11,935,000	2,864,400
						$100,811,538

Other stocks listed on Exchange have fallen in price, but they will all recover with an easier money market and a restoration of confidence in the future. But not so with the Trust stocks. They will all settle still further, as one by one their actual condition becomes known.

The public has paid a high price for its folly, and the Trust promoters have grown rich.

* * *

Business Is Not Always Business. It is to be hoped that some way will be found by which the builders of the electric road around the Gettysburg battlefield may be compelled to abandon their project, and make good as far as possible the damage already done.

It is extremely doubtful if the road would ever pay, if built; but, however that may be, the road has no right to be there.

Of course the only objection which can be offered is founded on sentiment; but that objection in this case is overwhelming. The whole scheme of the world's civilization is built up on sentiment, and the battlefield of Gettysburg covers the bones of thousands of brave men who gave up their lives there thirty years ago for sentiment or principles vitalized by sentiment.

The ground is sacred, and to build a road over it, or anywhere near it, is not business, but outrageous vandalism.

* * *

THE Mount Vernon *Chronicle* is sound in its contention that the new Westchester Electric Railroad Company, which obtained a franchise to use electricity, should not now be permitted to use horses. The *Chronicle* closes a strong editorial on the subject as follows : "We have been promised electricity, we want the electricity, and we want it without further delay."

* * *

THE best likeness of Henry Goebel which we have yet seen is the lithograph sent out by the Columbia Lamp Company of St. Louis.

The Prophecy Fulfilled. When ELECTRICITY a few weeks ago stated, upon what we knew to be unquestioned authority, that the Brush Company of Cleveland was to be laid as completely on the shelf as was the Excelsior Company, our statement was met with a chorus of denials from those who either knew nothing about the matter or wished to deceive the public as long as possible.

We have now to report, upon equally good authority, that the order has been actually promulgated; that all the selling offices of the Brush Company are to be closed, and that hereafter whatever Brush apparatus is sold will be sold by the General Electric Company's own offices, and will only be sold when customers insist on having it.

In other words, the Brush Company as a factor in the electric lighting business is dead and buried.

The Boston wreckers have succeeded after many years in their original intention so far as the Brush Company is concerned.

How long they will be able to continue their disgraceful career, and how many magnificent enterprises must still fall before them, are questions worth considering.

* * *

Will the Fort Wayne Co. be the Next? The placing of the Brush Company in a position where it can do no further harm to the Boston squeezers leaves the Fort Wayne Company alone of all the companies controlled by the Trust with any power to be of service to the electrical business generally, the only one which can seriously interfere with Mr. Coffin's plan to establish a dictatorship over the industry in this country.

The Fort Wayne Company is not dead. Its apparatus has always been regarded as efficient and satisfactory; it has attached to it some of the best technical minds in the country, notably Messrs. Wood and Bradley; and greatest of all, it has in Mr. R. T. McDonald a man who has few equals and no superiors as an organizer and promoter. Through Mr. McDonald's efforts, and because of his personal popularity, the company has been able to maintain, under very discouraging circumstances, an able corps of hustlers in its various branch offices. It will be seen, therefore, that this company is well prepared to do business independently. The only drawback is the iron hand of the Master at 44 Broad street, who so far has pulled the strings on Mr. McDonald whenever he saw fit, and Mr. McDonald has in turn been compelled to call his agents off from many a good contract, until 50 per cent. of the business which would come to the Fort Wayne Company if it were working independently has been diverted to other channels.

Mr. McDonald's position has been anything but an enviable one. Were it not that he had made a record for himself, he would be ridiculous in the eyes of business men. He has been for some time, as far as actual power goes, about on a par with Lieutenant Samuel Dana Greene. In brief, he has received his orders, and has been merely the medium for the transmission of orders to those who are supposed to be his subordinates but who in the eyes of Mr. Coffin are his equals in authority.

There have been for the past year signs of restiveness among the Fort Wayne people. The agents have been compelled to submit to a series of grievances the like of which broke the back of the Brush Company early in the game. Nothing, as we have said, but their personal attachment to Mr. McDonald has kept them from scattering to the four winds.

The technical men of the company have been busy with new apparatus, and it is understood that they have now ready to place on the market a new alternating system, an incandescent machine, and a railway generator.

Under present conditions, they might better have saved their time, as none of these machines, whatever Mr. McDonald may desire, will be allowed to achieve prominence in the field. It is possible, however, that a new deal is at hand.

The position of the Fort Wayne Company, it will be seen, is a very remarkable one. Whatever the company may have had to gain at one time from a consolidation, it has nothing further to gain, but can only lose steadily in business and in reputation until it finally goes the way of the other absorbed companies.

That Mr. McDonald will submit, however, to the kind of treatment he has been receiving seems impossible. He is universally recognized, among those who have followed his career closely, as being head and shoulders above Mr. Coffin as a business man, and it is not likely that he will continue for long to be snubbed and set aside. He is a wealthy man, and were it not for one thing we should look for him to sell out his holdings and retire from this business, seeking new fields for his capital and brains. That one thing is the sense of obligation which he is known to feel toward the agents who have stood loyally by him and toward the unprotected stockholders of his company. These agents and these stockholders naturally look to Mr. McDonald to save the company from wreck, and unless ELECTRICITY has over-estimated the man, they will not be disappointed.

* * *

WE HAVE in contemplation a biographical sketch of Mr. E. I. Garfield, which will occupy when published about twelve pages of ELECTRICITY. The city records of the city of Detroit will be quoted from in extenso. We are well aware that Mr. Garfield does not amount to much, but it will some day be of historic interest for the public to know just what kind of men were relied on to make an Electric Trust successful.

* * *

AN ITEM is going the rounds of the country dailies to the effect that Mr. Edison is perfecting a plan to kill all the mosquitoes in New Jersey by electricity. We do not doubt that Mr. Edison, in common with all other residents of New Jersey, would be glad to have mosquitoes abolished or annihilated, but we do not think this item is correct.

* * *

DURING the summer months ELECTRICITY will go to press on Saturday, instead of on Monday as heretofore. Copy and changes for advertisements should therefore reach us not later than Friday.

* * *

The Board of Directors of the General Electric Company is mainly composed of men who have always maintained the good opinions of their business associates. They have been generally supposed to have some regard for the proprieties of life. We doubt, therefore, if they have been made aware of the record of the secretary of the company, Mr. E. I. Garfield. When they are conversant with the facts, they will no doubt call upon him to retire at once.

* * *

The employees of the General Electric Company throughout the country, who have been made aware of a general cut in salaries of from 25 to 33⅓ per cent., are unable to discover any evidence in this of the remarkable prosperity of the company.

* * *

"Mr. Perry is one of the most correct and forcible writers connected with the technical press of the country."—*Western Electrician.*

This may be the language of the Chicago Browning Club and the Dante Society, but it is not English.

General Electric.

(*Boston Commercial Bulletin.*)

Information comes from Providence which reports that the General Electric Company is in the market there as a borrower of money. A prominent banker of that city, who had much to do with electrical companies before the consolidation of the Thomson-Houston and Edison Companies, is said to be very bearish on General Electric. We also hear that the Rhode Island Hospital Trust Company purchased some time ago, before the present financial disturbances became so great, $1,000,000 of the bonds of the Electric Corporation.

This company, it will be remembered, was formed by Mr. Coffin and his associates to finance street railways, etc. In other words, the General Electric Company supplies the machinery and apparatus, etc., and the stocks and bonds which it receives in payment therefor are in turn turned over to the Electric Corporation for cash. In fact, the Electric Corporation is practically a scheme to keep the General Electric Company supplied with cash, for its chief function will be to pay cash for the securities which the parent concern turns over to it.

If memory is correct, an instalment on the subscription to the Electric Corporation securities comes due the 20th of July. This payment will give the General Electric about $1,000,000 in cash.

Queer Prosperity.

(*From the Wall Street News.*)

As an evidence of success (?) the General Electric Company announces that reductions are being made in its salary list, and that a saving has already been made in this item during the past two months of nearly $200,000. This news is given out as a bull tip, and like the sale of the company's gilt-edged treasury stocks recently, the public is asked to believe that this indicates prosperity. Our experience with corporations of this character justifies the belief that this action signifies exactly the reverse. When salaries are cut down and forced economies introduced, it is generally a sign that "the boot pinches" somewhere. When companies are, as this one claims to be, rushed with work to the fullest extent, they don't generally cut down salaries: and when you find they are doing so it is generally good business judgment to let somebody else buy and carry your stock.

Where the Trouble Lies.

"The keynote of the whole situation," says an expert accountant in the *Commercial Bulletin*, "is over-capitalization by industrial corporations and the neglect to provide sufficient working capital; and," he says, "I wish this were the worst that could be said of scores of these Industrials and other stock corporations, but it is not. Many absolutely make a practice of submitting false balance sheets at the end of the year, so false that a stockholder or outsider can know nothing about the real condition of the company. As an illustration of this, I know, and if it should become necessary, I can give the name of one of the largest companies of this country which issued a false balance sheet some time ago."

The "Earth" Question.

An Important Inquiry.

(*From our Regular Correspondent.*)

In consideration of the expected advance in the development of electric traction in England there was recently appointed a joint committee of Lords and Commons to consider and report whether the grant of statutory powers to use electricity ought to be qualified by any prohibition or restriction as to earth return circuits, or by any provision as to leakage induction.

The committee commenced sitting on June 19, and is being watched and its decision awaited with general interest. Parliamentary debates have taken place in recent years as to the protection of telephonic lines from electrical disturbance, and it is unnecessary to dwell on the form or the effect of the various clauses which Parliament has from time to time inserted in the provisional orders of promoters seeking powers for electric traction. The more immediate matter is the decision of Mr. Justice Kekewich in the beginning of February last in the case of The National Telephone Company vs. Graff Baker. In that case the plaintiff, a limited company carrying on the business of supplying telephonic communication under a license from the Postmaster-General, sought relief against the defendant, Mr. Graff Baker, who was the lessee of a tramway line at Leeds, constructed by the Corporation of that city under the authority of a provisional order of the Board of Trade and worked on the trolley system, on the ground that the leakage incident to that system created a serious disturbance in their circuits. Mr. Justice Kekewich held that the disturbance complained of existed, and that it amounted in law to an actionable nuisance, but that, as the corporation of Leeds had statutory powers to work their tramway by electricity, Parliament had legalized it by anticipation. Thereupon the telephone company applied to the Board of Trade to insert a proper protective clause in all provisional orders settled by that department, and after some delay the matter was referred to the joint committee which has just commenced sitting. The clause which the National Telephone Company desire the committee to adopt is that, "in the event of any tramway being worked by electricity otherwise than by electrical power, the persons working it shall be bound so to construct and work their lines as to prevent any injurious interference with the electric circuits from time to time used or intended to be used by the telephone company." The telephone company is, however, to take reasonable and proper precautions in the erection of future circuits, and not to place them in needless proximity to the tramway lines or works, and disputes are to be referred to the arbitrament of the Board of Trade. Several of the railway companies, which allege that they also are prejudicially though differently affected by electric traction, have joined hands with the National Telephone Company in this case.

The present inquiry is said to be the most important one relating to electrical matters that has been held since the electric light inquiry of 1888. In the course of evidence Sir Courtenay Boyle on behalf of the Board of Trade explained the relative positions of the telephone and traction companies. Wm. W. H. Preece was the first technical witness, and the gist of his evidence was as follows: The first telephone fixed in London was operated on a metallic circuit, and ever since the Post Office had used the metallic return. The effect of leakage and induction from the City and South London Railway was most evident on the Post Office telegraph circuits. Whenever a train was started leakage currents had been noticed as far away as North Walsham, in Norfolk. He considered that if London were perforated with electric railways the matter of leakage would become serious. With proper supervision, however, he thought it possible for every tramway in England to use the earth accidentally without doing harm.

Mr. Gaine (manager of the telephone company) gave numerous details as to the number of messages and the cost in various towns of the National Telephone Company's system. The National Company had spent large sums in adopting the metallic circuit in London; the return wire, he considered, was absolutely valueless to the company commercially. Taking Liverpool as an instance, it would cost £20,000 for a switchboard alone, and assuming that electric traction were adopted throughout the country without using a metallic return it would cost the National Company £2,000,000 to protect their system. The company had already spent £100,000 in the London district in changing from the earth to the metallic system. The witness admitted that the Postmaster-General had said that he would give no more licenses to telephone companies unless they used the metallic return. In his estimation a complete metallic circuit system in London would cost £250,000, and it would take five or six years to arrange it.

Dr. John Hopkinson spoke of the disturbance caused to the telephone system at Leeds by the electric tramway. From what we have heard we should imagine this witness stands alone in his experience of the London telephone service when he remarks that there is no disturbance. He considered that only slight complications would be added if tramway companies were obliged to use two conductors.

Lord Kelvin was the next witness, and he said there would be no practical difficulty in having return conductors in either an overhead or an underground system. Two insulated conductors would allow of a much higher working pressure, and would very much diminish the quantity of metal used in the conductors.

Mr. W. E. Langdon (superintendent of the electrical department of the Midland Railway) said that the block signals of the railway he represented had been very seriously affected to a distance of between three and four miles from where the electric tramway crossed the line. There were thirty-two towns on the line where power had been granted for electrical tramways. He recommended the disassociation of those high currents from the earth entirely.

Mr. C. E. Spagnoletti (past president of the Institution of Electrical Engineers, and who had been for thirty-seven years chief engineer of the Great Western Railway,) gave like testimony regarding the disturbance caused by the tramway currents.

Further lengthy evidence was given by Mr. James Swinburne, Mr. R. E. B. Crompton, Mr. A. R. Bennett, Mr. Alexander Siemens, Mr. J. H. Greathead (of the City and South London and the Liverpool Overhead Railways), Mr. J. F. Parsons, Mr. Sellon, Major-General Webber. Evidence was also called on behalf of the Corporations of England and Scotland.

Although the committee had now been sitting for five days, there remained a number of witnesses to be examined. A. B.

London, Eng., June 27, 1893.

The Westinghouse Electric Company at Pittsburg made an arrangement with the Pennsylvania Railroad Company for a special train to carry those of their employees who wished to visit the Columbian Exposition during the week of the Fourth, the fare for the round trip to be $12. Of this the Westinghouse Company paid $2 on each ticket, making the fare for the employees $10.

ON LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.—VI.

BY NIKOLA TESLA.*

Most of the considerations which apply to the incandescence of a solid, just considered, may likewise be applied to phosphorescence. Indeed, in an exhausted vessel the phosphorescence is, as a rule, primarily excited by the powerful beating of the electrode stream of atoms against the phosphorescent body. Even in many cases, where there is no evidence of such a bombardment, I think that phosphorescence is excited by violent impacts of atoms, which are not necessarily thrown off from the electrode but are acted upon from the same inductively through the medium or through chains of other atoms. That mechanical shocks play an important part in exciting phosphorescence in a bulb may be seen from the following experiment. If a bulb, constructed as that illustrated in Fig. 10, be taken and exhausted with the greatest care so that the discharge cannot pass, the filament *f* acts by electrostatic induction upon the tube *t* and the latter is set in vibration. If the tube *o* be rather wide, about an inch or so, the filament may be so powerfully vibrated that whenever it hits the glass tube it excites phosphorescence. But the phosphorescence ceases when the filament comes to rest. The vibration can be arrested and again started by varying the frequency of the currents. Namely, the filament has its own period of vibration, and if the frequency of the currents is such that there is resonance, it is set easily vibrating, though the potential of the currents be small. I have often observed that the filament in the bulb is destroyed by such mechanical resonance. The filament vibrates as a rule so rapidly that it cannot be seen and the experimenter may at first be mystified. When such an experiment as the one described is carefully performed, the potential of the currents need be extremely small, and for this reason I infer that the phosphorescence is then due to the mechanical shock of the filament against the glass, just as it is produced by striking a loaf of sugar with a knife. The mechanical shock produced by the projected atoms is easily noted when a bulb containing a button is grasped in the hand and the current turned on suddenly. I believe that a bulb could be shattered by observing the conditions of resonance.

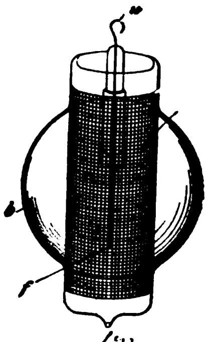

Fig. 31

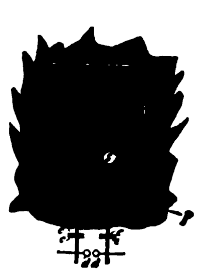

Fig. 32

Showing the Inefficiency of a Metal Screen.

Fig. 32.—Electrostatic Action Between Primary and Secondary, with Extremely High Frequencies.

In the experiment before cited it is, of course, open to say that the glass tube upon coming in contact with the filament retains a charge of a certain sign upon the point of contact. If now the filament again touches the glass at the same point while it is oppositely charged, the charges equalize under evolution of light. But nothing of importance would be gained by such an explanation. It is unquestionable that the initial charges given to the atoms or to the glass play some part in exciting phosphorescence. So, for instance, if a phosphorescent bulb be first excited by a high frequency coil by connecting it to one of the terminals of the latter and the degree of luminosity noted, and then the bulb be highly charged from a Holtz machine by attaching it preferably to the positive terminal of the machine, it is found that when the bulb is again connected to the terminal of the high frequency coil the phosphorescence is far more intense. On another occasion I have considered the possibility of some phosphorescent phenomena in bulbs being produced by the incandescence of an infinitesimal layer on the surface of the phosphorescent body. Certainly the impacts of the atoms are powerful enough to produce intense incandescence by the collisions, since they bring quickly to a high temperature a body of considerable bulk. If any such effect exists, then the best appliance for producing phosphorescence in a bulb, which we know so far, is a disruptive discharge coil giving an enormous potential with but few fundamental discharges, say 25-30 per second, just enough to produce a continuous impression upon the eye. It is a fact that such a coil excites phosphorescence under most any condition and at all degrees of exhaustion, and I have observed effects which appear to be due to phosphorescence even at ordinary pressures of the atmosphere, when the potentials are extremely high. But if phosphorescent light is produced by the equalization of charges of electrified atoms (whatever this may mean ultimately), then the higher the frequency of the impulses or alternate electrifications, the more economical will be the light production. It is a long known and noteworthy fact that all the phosphorescent bodies are poor conductors of electricity and heat, and that all bodies cease to emit phosphorescent light when they are brought to a certain temperature. Conductors, on the contrary, do not possess this quality. There are but few exceptions to the rule. Carbon is one of them. Becquerel noted that carbon phosphoresces at a certain elevated temperature preceding the dark red. This phenomena may be easily observed in bulbs provided with a rather large carbon electrode (say a sphere of six millimetres diameter). If the current is turned on after a few seconds, a snow white film covers the electrode just before it gets dark red. Similar effects are noted with other conducting bodies, but many scientific men will probably not attribute them to true phosphorescence. Whether true incandescence has anything to do with phosphorescence excited by atomic impact or mechanical shocks still remains to be decided, but it is a fact that all conditions which tend to localize and increase the heating effect at the point of impact are almost invariably the most favorable for the production of phosphorescence. So, if the electrode be very small, which is equivalent to saying in general that the electric density is great, if the potential be high, and if the gas be highly rarefied, all of which things imply high speed of the projected atoms, or matter, and consequently violent impacts—the phosphorescence is very intense. If a bulb provided with a large and small electrode be attached to the terminal of an induction coil, the small electrode excites phosphorescence while the large one may not do so, because of the smaller electric density and hence smaller speed of the atoms. A bulb provided with a large electrode may be grasped with the hand while the electrode is connected to the terminal of the coil and it may not phosphoresce; but if instead of grasping the bulb with the hand the same be touched with a pointed wire the phosphorescence at once spreads through the bulb because of the great density at the point of contact. With low frequencies it seems that gases of great atomic weight excite more intense phosphorescence than those of smaller weight, as for instance, hydrogen. With high frequencies the observations are not sufficiently reliable to draw a conclusion. Oxygen, as is well known, produces exceptionally strong effects, which may be in part due to chemical action. A bulb with hydrogen residue seems to be most easily excited. Electrodes which are most easily deteriorated produce more intense phosphorescence in bulbs, but the condition is not permanent because of the impairing of the vacuum and the deposition of the electrode matter upon the phosphorescent surfaces. Some liquids, as oils for instance, produce magnificent effects of phosphorescence (or fluorescence ?), but they last only a few seconds. So if a bulb have a trace of oil on the walls and the current is turned on, the phosphorescence only persists for a few moments until the oil is carried away. Of all bodies so far tried, sulphide of zinc seems to be the most susceptible to phosphorescence. Some samples obtained through the kindness of Prof. Henry, in Paris, were employed in many of these bulbs. One of the defects of this sulphide is that it loses its quality of emitting light when brought to a temperature which is by no means high. It can therefore be used only for feeble intensities. An observation which might deserve notice is that when violently bombarded from an aluminum electrode it assumes a black color, but singularly enough, it returns to the original condition when it cools down.

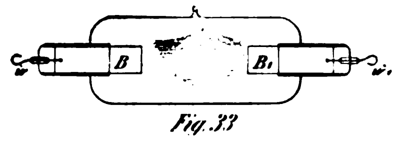

Fig. 33

Carbon Deposit in Tube in a Magnetic Field.

The most important fact arrived at in pursuing investigations in this direction is that in all cases it is necessary in order to excite phosphorescence with a minimum amount of energy to observe certain conditions. Namely, there is always, no matter what the frequency of the currents, degree of exhaustion and character of the bodies in the bulb, a certain potential (assuming the bulb excited from one terminal) or potential difference (assuming the bulb to be excited with both terminals) which produces the most economical result. If the potential be increased, considerable energy may be wasted without producing any more light, and if it be diminished, then again the light production is not as economical. The exact condition under which the best result is obtained seems to depend on many things of a different nature, and it is to be yet investigated by other experimenters, but it will certainly have to be observed when such phosphorescent bulbs are operated, if the best results are to be attained.

Coming now to the most interesting of these phenomena, the incandescence or phosphorescence of gases, at low pressures or at the ordinary pressure of the atmosphere, we must seek the explanation of these phenomena in the same primary causes, that is, in shocks or impacts of the atoms. Just as molecules or atoms beating upon a solid body excite phosphorescence in the same or render it incandescent, so when colliding among themselves they produce similar phenomena. But this is a very insufficient explanation and concerns only the crude mechanism. Light is produced by vibration which goes on at a rate almost inconceivable. If we compute, from the energy contained in the form of known radiations in a definite space the force which is necessary to set up such rapid vibrations, we find that though the density of the ether be incomparably smaller than that of any body we know, even hydrogen, the force is sometimes surpassing comprehension. What is this force, which in mechanical measure may amount to thousands of tons per square inch ? It is electrostatic force in the light of modern views. It is impossible to conceive how a body of measurable dimensions could be charged to so high a potential that the force would be sufficient to produce these vibrations. Long before any such charge could be imparted to the body it would be shattered into atoms. The sun emits light and heat, and so does an ordinary flame or incandescent filament, but in neither of these can the force be accounted for if it be assumed that it is associated with the body as a whole. Only in one way may we account for it, namely, by identifying it with the atom. An atom is so small that if it be charged by coming in contact with an electrified body and the charge be assumed to follow the same law as in the case of bodies of measurable dimensions, it must retain a quantity of electricity which is fully capable of accounting for these forces and tremendous rates of vibration. But the atom behaves singularly in this respect, it always takes the same "charge."

It is very likely that resonant vibration plays a most important part in all manifestations of energy in nature. Throughout space all matter is vibrating, and all rates of vibration are represented, from the lowest musical note to the highest pitch of the chemical rays, hence an atom, or complex of atoms, no matter what its period, must find a vibration with which it is in resonance. When we consider the enormous rapidity of the light vibrations, we realize the impossibility of producing such vibrations directly with any apparatus of measurable dimensions, and we are driven to the only possible means of attaining the object of setting up waves of light by electrical means and economically, that is, to affect the molecules or atoms of a gas, to cause them to collide and vibrate. We then must ask ourselves—How can free molecules or atoms be affected ?

It is a fact that they can be affected by electrostatic force, as is apparent in many of these experiments. By varying the electrostatic force we can agitate the atoms and cause them to collide under evolution of heat and light. It is not demonstrated beyond doubt that we can affect them otherwise. If a luminous discharge is produced in a closed exhausted tube, do the atoms arrange themselves in obedience to any other but electrostatic force acting in straight lines from atom to atom ? Only recently I investigated the mutual action between two circuits with extreme rates of vibration. When a battery of a few jars (*c c c c*, Fig. 32) is discharged through a primary P of low resistance (the connections being as illustrated in Figs. 19*a*, 19*b* and 19*c*), and the frequency of vibration be many millions, there are great differences of potential between points on the primary not more than a few inches apart. These differences may be 10,000 volts per inch, if not more, taking the maximum value of the E. M. F. The secondary *s* is therefore acted upon by electrostatic induction, which is in such extreme cases of much greater importance than the electro-dynamic. To such sudden impulses the primary as well as the secondary are poor conductors, and therefore great differences of potential may be produced by electrostatic induction between adjacent points on the secondary. Then sparks may jump between the wires, and streamers become visible in the dark if the light of the discharge through the spark gap *d d* be carefully excluded. If now we substitute a closed vacuum tube for the metallic secondary *s*, the differences of potential produced in the tube by electrostatic induction from the primary are fully sufficient to excite portions of it; but as the points of certain differences of potential on the primary are not fixed, but are generally constantly changing in position, a luminous band is produced in the tube, apparently not touching the glass, as it should, if the points of maximum and minimum differences of potential were fixed on the primary. I do not exclude the possibility of such a tube being excited only by electro-dynamic induction, for very able physicists hold this view; but in my opinion there is as yet no positive proof given that atoms of a gas in a closed tube may arrange themselves in chains under the action of an electromotive impulse produced by electro-dynamic induction in the tube. I have been unable so far to produce striæ in a tube, however long and at whatever degree of exhaustion, that is, striæ at right angles to the supposed direction of the discharge or the axis of the tube, but I have distinctly observed in a large bulb, in which a wide luminous band was produced by passing a discharge of a battery through a wire surrounding the bulb, a circle of feeble luminosity between two luminous bands, one of which was more intense than the other. Furthermore, with my present experience I do not think that such a gas discharge in a closed tube can vibrate, that is, vibrate as a whole. I am convinced that no discharge through a gas can vibrate. The atoms of a gas behave very curiously in respect to sudden electric impulses. The gas does not seem to possess any appreciable inertia to such impulses, for it is a fact that the higher the frequency of the impulses with the greater freedom does the discharge pass through the gas. If the gas possesses no inertia then it cannot vibrate, for some inertia is necessary for the free vibration. I conclude from this that if a lightning discharge occurs between two clouds there can be no oscillation, such as would be expected considering the capacity of the clouds. But if the lightning discharge strikes the earth, there is always vibration—in the earth, but not in the cloud. In a gas discharge each atom vibrates at its own rate, but there is no vibration of the conducting gaseous mass as a whole. This is an important consideration in the great problem of producing light economically, for it teaches us that to reach this result we must use impulses of very high frequency and necessarily also of high potential. It is a fact that oxygen produces a more intense light in a tube. Is it because oxygen atoms possess some inertia and the vibration does not die out instantly? But then nitrogen should be as good and chlorine and vapors of many other bodies much better than oxygen, unless the magnetic properties of the latter enter prominently into play. Or, is the process in the tube of an electrolytic nature? Many observations certainly speak for it, the most important being that matter is always carried away from the electrodes, and the vacuum in a bulb cannot be permanently maintained. If such process takes place in reality, then again must we take refuge in high frequencies, for with such electrolytic action should be reduced to a minimum, if not rendered entirely impossible. It is an undeniable fact that with very high frequencies, provided the impulses be of a harmonic nature, like those obtained from an alternator, there is less deterioration and the vacua are more permanent. With disruptive discharge coils there are sudden rises of potential and the vacua are more quickly impaired, for the electrodes are deteriorated in a very short time. It was observed in some large tubes, which were provided with heavy carbon blocks B B_1 connected to platinum wires w w_1 (as illustrated in Fig. 33), and which were employed in experiments with the disruptive discharge instead of the ordinary air gap, that the carbon particles under the action of the powerful magnetic field in which the tube was placed, were deposited in regular fine lines in the middle of the tube as illustrated. These lines were attributed to the deflection or distortion of the discharge by the magnetic field, but why the deposit occurred principally where the field was most intense did not appear quite clear. A fact of interest, likewise noted, was that the presence of a strong magnetic field increases the deterioration of the electrodes, probably by reason of the rapid interruptions it produces, whereby there is actually a higher E. M. F. maintained between the electrodes.

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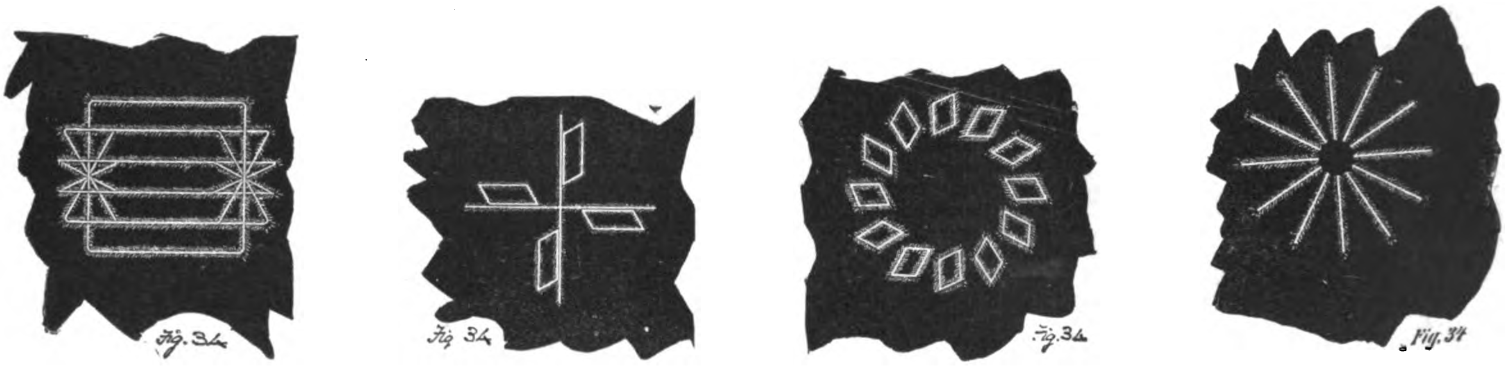
* A lecture delivered before the Franklin Institute at Philadelphia, Feb. 24, 1893, and before the National Electric Light Association at St. Louis, Mo., March 1, 1893.



Some of the Designs Produced by Intermittent Discharges · [1] Drum Winding, [2] Alternate Motor Winding, [3] Ring Winding, [4] Spoke Wheel.

Much would remain to be said about the luminous effects produced in gases at low or ordinary pressures. With the present experiences before us we cannot say that the essential nature of these charming phenomena is sufficiently known. But investigations in this direction are being pushed with exceptional ardor. Every line of scientific pursuit has its fascinations, but electrical investigation appears to possess a peculiar attraction, for there is no experience or observation of any kind in the domain of this wonderful science which would not forcibly appeal to us. Yet to me it seems that of all the many marvelous things we observe, a vacuum tube, excited by an electric impulse from a distant source, bursting forth out of the darkness and illuminating the room with its beautiful light, is as lovely a phenomenon as can greet our eyes. More interesting still it appears when, reducing the fundamental discharges across the gap to a very small number and waving the tube about we produce all kinds of designs in luminous lines. So, by way of amusement, I take a straight long tube, or a square one, or a square attached to a straight tube, and by whirling them about in the hand I imitate the spokes of a wheel, a Gramme winding, a drum winding, an alternate current motor winding, etc. (Fig. 34). Viewed from a distance the effect is weak and much of its beauty is lost, but being near or holding the tube in the hand one cannot resist its charm.

In presenting these insignificant results I have not attempted to arrange and co-ordinate them as would be proper in a strictly scientific investigation in which every succeeding result should be a logical sequence of the preceding, so that it might be guessed in advance by the careful reader or attentive listener. I have preferred to concentrate my energies chiefly upon advancing novel facts or ideas which might serve as suggestions to others, and this may serve as an excuse for the lack of harmony. The explanations of the phenomena have been given in good faith and in the spirit of a student prepared to find that they admit of a better interpretation. There can be no great harm in a student taking an erroneous view, but when great minds err the world must dearly pay for their mistakes.

(*Concluded.*)

An Electric Conduit System.

The Hieatzman electric conduit system, a Baltimore invention, has recently been introduced by Hieatzman Bros. of that city, who are the inventors of the system.

The arrangement adopted is to place two conductors of the same polarity in a single conduit which is situated between the inner rails of a double track and contains two parallel slots, one of which is used by the car on the adjacent track. The object of this arrangement is to reduce the cost of construction by utilizing a single conduit for both tracks, and as the space occupied is the highest point of the road the conduit is less susceptible to the street drainage than when placed between the rails of a single track. In equipping existing roads the conduit is independent of the tracks and may thus be constructed without disturbing or relaying the tracks.

Instead of a copper conductor, as usually employed for the trolley wire, heavy steel rails are used, and the conduits are designed to be about three feet deep, so as to accommodate any extra circuits desired. The return current for the railway is carried by the track as in the overhead trolley system.

Boston Notes.

Notwithstanding the stringency in the money market, the work on electric street railways goes along developing and expanding throughout New England; and the American Railroad Improvement Company of this city, Mr. George A. Beatey, treasurer and general manager, is securing quite a large share of the contracts. A large staff of men employed by this company has started on the construction of a new road that is to connect Braintree with Rudolph, Holbrook, Weymouth, Hingham and Nantasket Beach.

During the past two weeks the two formidable Russian warships, the Dimitre Donskoi and Rynda, which took part in the Columbian pageant, have been at anchor in Boston harbor, the reason of their coming being to have a part in the inauguration of the monument erected to the memory of Admiral Farragut in Marine Park, South Boston. On the evening of July 4th these two ships, together with the U. S. warship San Francisco and torpedo boat Vesuvius, were brilliantly illuminated by variegated colored electric lamps from stem to stern and right to the mastheads. During the evening the thousands of lights were shut off, and the powerful searchlights were brought into play, producing some weird effects among the shipping in the harbor. For hours thousands of spectators thronged the water front, such a brilliant display of electric lights and fireworks never having been before witnessed in Boston harbor.

There was quite a blaze on Wednesday in the building formerly occupied as New England headquarters of the Edison General Electric Company before the consolidation on Otis street, Boston. In the extensive salesroom and the superbly fitted blue and white showrooms were many handsome electric and combination fittings which were considerably damaged by fire, smoke and water. The fire is thought to have been caused by an electric wire.

The electrical supply houses of Boston are naturally feeling the effects of the present uncertainty in trade, and so are not rushing shipments at the same rate they were ten days or a fortnight ago. Nevertheless they are all getting their stocks in order, for they all have the assurance that as soon as the present tightness relaxes, as it must shortly do, their customers' stocks will have become so depleted that a big boom in orders will be experienced and they desire to be ready for the rush.

A new piece of apparatus has been patented recently by a Boston inventor, having for its purpose the operating of the switches on street railways by means of electricity, the apparatus being set in motion by the driver or motorman of each car as he approaches the switch. The device has been examined and tested by engineers, electricians and railroad men and they report very favorably upon it.

The unique and efficient electric burglar alarm system in use at the Security Safe Deposit vaults in this city, a fully illustrated description of which we published in our columns last December, has proved so great a success that the company using it now finds itself enjoying the largest number of clients and with more valuable property entrusted to its care than any similar company in Boston. A new and artistic circular, calling attention to this apparatus as securing the most absolute safety, has just been issued, and is still further increasing the business done by the Security Safe Deposit Company.

The North Shore Traction Company, which at present is operating more miles of railway track than any other company in New England, it being composed of Philadelphia, New York, Boston and Lynn capitalists, is reported as having in contemplation the purchase of the Essex, Beverly and Gloucester street railway, which would give it a continuous line from Boston to Gloucester, a distance of over forty miles. The company may also engage in freight as well as passenger traffic in time.

General News.

What is Going on in the Electrical World.

Hillsdale, Mich.—The council has decided to get a Westinghouse electric lighting plant to cost $14,000.

Calais, Me.—An electric road is to be built here, extending to St. Stephen, as soon as council decides upon a route.

Sing Sing, N. Y.—The Sing Sing Electric Railway Company intends to extend its line to Pleasantville on the Harlem Road.

Weston, W. Va.—The electric light plant here was totally destroyed by fire on the morning of the 3d inst.; loss $10,000, insured for $1,500.

Flushing, L. I.—The board of trustees will consider the question of awarding the contract for an electric fire alarm system on July 18.

Norfolk, Va.—Preparations for the change from the present horse cars to the electrical system are being made by the street car company.

Batavia, N. Y.—The council has authorized its light and lamp committee to advertise for bids for a complete electric lighting plant for the city.

Florence, S. C.—The business men of this city and of Darlington are being canvassed with success in regard to establishing telephone exchanges in the two places.

Cleveland, Ohio.—Fifteen thousand street car tickets were stolen from the Cleveland Electric Railway Company's office last week. They represent a value of about $700.

Milwaukee, Wis.—The Milwaukee Electric Railroad, known also as the Hinsey line, is now the property of Charles F. Pfister, who bought it at receiver's sale for $200,000.

Whitesboro, N. Y.—The Utica Electric Light Company has been awarded the contract for lighting this village, and will do it directly from the Utica plant by special wires.

San Jose, Cal.—An extension of time has been asked for the completion of the electric railway between San Jose and Los Gatos, a franchise for which was granted some time ago.

Middletown, N. Y.—The Middletown and Goshen Traction Company have been granted a franchise for the electric road they propose building between this city and Goshen.

Jefferson, Iowa.—At a special election held here on granting a twenty year franchise for electric lighting, the local electric light company carried the day by a large majority.

Indianapolis, Ind.—Judge Brown has rendered a decision transferring the cause of the City Railway Company against the Citizens' Street Railroad Company to the Federal Court.

Marion, Ind.—An electric railway between Marion and Pennville, to run by way of Montpelier, is being talked of here, and several local capitalists have expressed a willingness to aid the project.

Niagara Falls, N. Y.—The contract for street lighting awarded to the Buffalo and Niagara Falls Electric Light and Power Company has been duly executed and the construction of the power house is begun.

Buffalo, N. Y.—Surveys have been completed for an electric road to be known as the Buffalo, South Shore and Hamburg Electric Railway, and running to points on the lake shore between Buffalo and Hamburg.

Brooklyn, N. Y.—All of the horse cars on Fulton street east of the City Hall have been superceded by the trolley and only three horse lines run to Fulton Ferry where a short time ago there were a score of them.

St. Louis, Mo.—St. Louis will within a few weeks have the most complete electric car system in the world. Only two of the old horse lines remain to be converted into electric systems, and they will make the change in a short time.

Montgomery, Ala.—The Cloverdale Electric Street Railway was sold on the 3d inst., under a decree of the City Court, and was bid in for Townsend & Brown, the contractors who built the road, at $3,000. The road has six miles of track.

Denver, Col.—The Western Union has reduced its rates here from 40 cents for ten words to 25 cents. Among the places to be benefited by the reduction besides Denver are Colorado Springs, Pueblo, Canon City, Leadville, Aspen, La Junta and all intermediate towns.

Salt Lake, Utah.—Robert M. Jones has been granted a franchise for electric lighting and transmission of electrical currents for all purposes in this city for a period of twenty-five years. Mr. Jones will transmit current from his Big Cottonwood Cañon power plant.

Fair Haven, Conn.—The Hon. James R. Langdon, of Montpelier, Vt., has purchased the land on which Carver's Falls are situated, about three miles from this city, and will use the water power at that place in generating electricity. About 2,000 horse power will be developed.

San Francisco.—The palatial mansion which Ralph Brisbane Nonesuch, the South African diamond millionaire, is building in the Temescal district, near this city, is to be electrically equipped so as to have all the heating, lighting, cooking and ventilation done by electricity.

Madison, Wis.—The street lighting committee of the city council has advertised for bids for doing the city lighting for a period of years by private corporation, and also for putting in an electric lighting plant for the city complete except grounds and building, which the city now has.

Missoula, Mont.—The purpose of the Missoula Electric Light Company to erect a dam and power house on the Missoula River at a point about a mile up from this town has been checked by a suit brought by J. D. Morgan contesting the validity of the transfer of the site on which the dam was to be built.

Mt. Sterling, Ky.—The Mt. Sterling Gas Company and the Citizens' Electric Light Company (Thomson-Houston) will consolidate July 15. The Electric Light Company will increase their facilities with the object of furnishing power for an electric car line to Sharpsburg now under contemplation.

San Antonio, Tex.—There are two companies—the San Antonio and the Citizens' Electric Street Railway—constructing almost parallel lines to Dignowity Hill, an attractive suburb, and several hundred men are making the dirt fly on both lines in a race for the coveted advantage of "getting there" first. Gangs are working night and day.

Portsmouth, Ohio.—An electric street railway line here is now an assured fact. The contract for building the road, power house, etc., has been awarded, and work is begun. The officers of the company are: President, George Davis; vice-president, Floyd L. Smith; secretary and treasurer, Sam. B. Timmonds.

Lockport, N. Y—A company is to be formed here to build and operate an electric road to Williamsville. The road will be about 13 miles long and will cost $100,000. After it is completed the electric line from Buffalo to Lockport, by way of Williamsville, will, it is said, be nine miles shorter than any steam road connecting the two places.

Elizabeth, N. J.—The board of aldermen, being of the penny-wise and pound-foolish order, are in favor of lightening the burden of taxation by excessive demands on persons or corporations desiring franchises. The mayor of the city, on the contrary, says that Elizabeth should offer more encouragement to enterprises that would help to build it up and especially electric street railways.

Bangor, Me.—The Hampden and Winterport Electric Railroad and Light Company have elected the following directors: J. Manchester Haynes, Geo. E. Macomber, of Augusta; H. L. Shepherd, of Rockport; Edward W. Mayo, of Hampden; Henry A. Mitchell, Eugene C. Nichols, of Bangor, and Fred Atwood, of Winterport.

Gloversville, N. Y.—The opening of the electric line between Gloversville and Fonda the other day was celebrated with great eclat. All along the line in Gloversville, Johnstown and Fonda the houses and the places of business were gayly decorated and everybody evinced an enthusiasm which showed that the new road was a welcome enterprise to the people.

Washington, D. C.—The Washington and Arlington Electric Railway has passed under the control of a Philadelphia syndicate, two-thirds of the former stockholders having accepted 50 cents on the dollar for their shares. A transfer of the property to the new owners will be made as soon as possible, when steps will be taken to complete the road into Washington, which will necessitate the building of a bridge across the Potomac.

Shreveport, La.—Through Percy Thompson & Company, investment bankers, New York, the Belt Line Electric Road and the Short Electric Road of this city have been consolidated and placed under one management. The company is now operating fifteen miles of road and proposes to extend the line five miles further. The consolidated securities of the company were sold by Percy Thompson & Company.

Worcester, Mass.—The franchise granted about a year ago to the Quinsigamond Electric Light and Power Company to supply electric lights in this city has been revoked by the State Gas and Electric Light Commission on the ground "that a competing company is not desirable, because it would needlessly encumber the streets with wires, it would not furnish light or power more cheaply than the present company, and there would be danger of consolidation or absorption with consequent 'stock development' and an increased tax on consumers."

Nashville, Tenn.—The new cars of the Overland electric line in this city are peculiar in construction, and were designed by the president of the road. They are open at each end, with seats for eight persons on each platform, and have a closed section in the centre with twenty seats. The entire car can be thrown open when needed and all the seats face in the direction the car is going, with an aisle in the centre. The cars are twenty-seven feet long.

Providence, R. I.—The Pawtuxet Valley Electric Street Railway Company, incorporated nearly two years ago to build and operate an electric street railway in the Pawtuxet Valley, has completed its organization by electing new officers, as follows: Nelson W. Aldrich, president; Henry L. Greene of River Point, vice-president; H. V. A. Joslin, secretary; Cyril A. Babcock, treasurer; directors, Nelson W. Aldrich, Henry L. Greene, Enos Lapham, Charles H. Perkins, Marsden J. Perry, Gorham P. Pomroy, William G Roelker, Arthur H. Watson, Webster Knight, Henry V. A. Joslin, Cyril A. Babcock.

Chloride of Silver vs. Aluminum-Iodine Cells.

To the Editor of ELECTRICITY:

DEAR SIR: We notice in your issue of June 28th an article entitled "The Aluminum-Iodine Portable Testing Set, manufactured by Queen & Company, of Philadelphia, or more properly speaking, a comparison of E. M. F. between the aluminum-iodine and the chloride of silver cell. In reply to this article we desire to say that there are several points which need correction, and which the author no doubt failed to recognize in his composition.

In the first place, our present form of chloride of silver dry cell has an E. M. F. of about one volt.

Secondly, there is absolutely no local action, so that there is, not only practically but positively, no waste of the elements while not in use.

Thirdly, a chloride of silver cell can be made with an E. M.

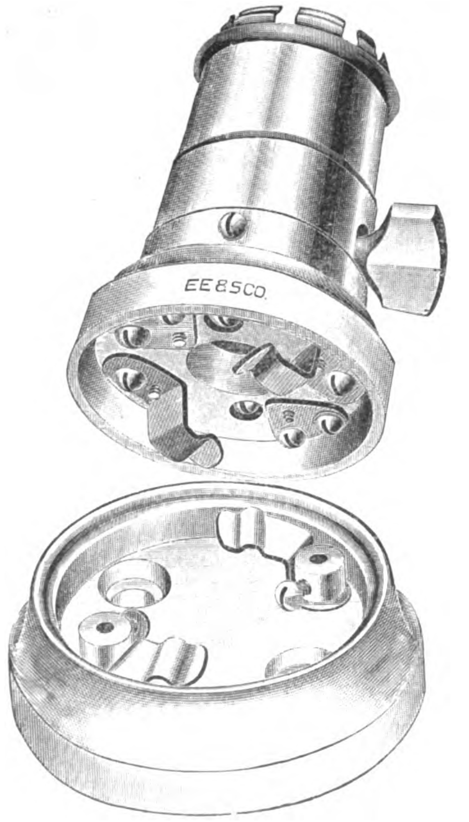
F. of not only 1.4 volts, but with from 1.5 to 1.6 volts. But why did we not bring such cells prominently before the electrician? Simply from the fact that they were too closely related to the aluminum-iodine cell, in which the local action, which you state is practically eliminated, was nevertheless still going on, and however slight, resulted in inevitable ruin to the elements. For this reason we preferred our one volt cell, which is devoid not only of any injurious waste but of any waste whatever, to a cell of 1.5 volts in which a local action of the slightest nature would invariably mean destruction.

We regret exceedingly that we are not now in a position to go into such details as we would desire, for the manufacturers of the aluminum-iodine cell have placed before us a barrier which we cannot at present overcome, by refusing to place in our hands a cell of their production. . . . Respectfully,

THE CHLORIDE OF SILVER DRY CELL BATTERY COMPANY.
Baltimore, July 5.

The E. E. and S. Fusible Wall Socket.

The combination represented in the illustrations accompanying this notice is said to give universal satisfaction. It is the well-known E. E. & S. socket with fused



THE E. E. AND S. FUSIBLE WALL SOCKET.

detachable base and wall standard, manufactured by the Electric Engineering and Supply Company of Syracuse. The contrivance has a number of good points. The porcelain is tough and strong, the parts are well made and carefully finished, and it is neat and attractive in appearance.

As the two parts of the base are not fastened by screws, no tools are needed to separate them, a simple quarter turn being sufficient, and the contact is always sure. A special feature is the fact that the fuse is carried on the removable part. When necessary to replace the former the socket is removed and the work done without danger of accident or short circuit.

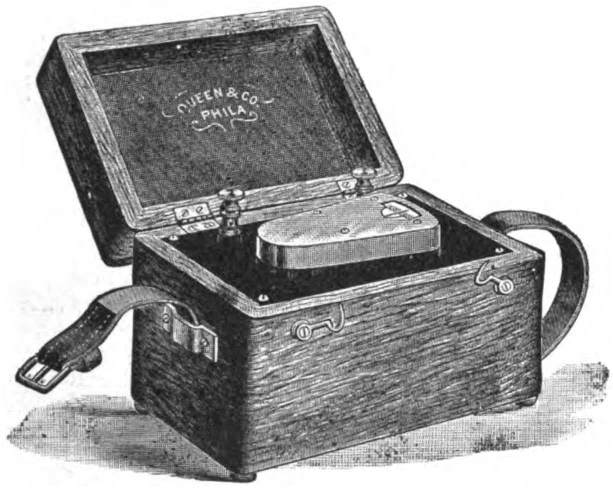
This combination can be used in many cases instead of more expensive fittings, for side brackets, temporary and advertising work, where rosettes and cut-outs would otherwise be necessary. The company makes them with either Edison, Thomson-Houston or Sawyer-Man key or keyless sockets.

Queen Portable D'Arsonval Galvanometer.

In completing a line of portable testing instruments Queen & Company, Philadelphia, have placed on the market a D'Arsonval Galvanometer, as illustrated, which deserves more than passing notice. It is of the type used heretofore in their testing sets, and is admirably adapted to laboratory or station measurements and for use as a detector of faults in line wire. The Index is quite dead beat, so that rapid readings are possible, and because of the principle of construction employed, magnetic fields and mechanical vibrations produce practically no effect.

As the Galvanometer is a "zero" instrument, readings cannot be made by direct deflection, but to determine resistance a rheostat and bridge are necessary exactly as in regular testing sets.

For manufacturing companies, especially where quick work is an item, the above will prove of much value. It is well suited for ascertaining the resistance of carbon filaments for incandescent lamps, and has been used for this purpose by some of the large lamp makers. As a simple ground detector the Galvanometer is quite complete in itself, being conveniently mounted in a handsome mahogany case with leather strap.



QUEEN PORTABLE D'ARSONVAL GALVANOMETER.

COMMERCIAL PARAGRAPHS.

In ordering a fresh supply of brushes for the motors made by the Boston Motor Company and in use at the Lawrence Scientific School, Harvard University, one of the professors says that the motors work splendidly. Another correspondent in forwarding a repeat order for a fan equipment, says that though these motors are like small toys they are as scientifically and well made as any large sized motors now on the market. These and many similar endorsements prove the popularity of the Boston Motor, which now sells like hot cakes.

The "Novak" lamp is making a great record for itself wherever used, and nowhere more satisfactorily than at the World's Fair. In the Libbey Glass Company's Factory, which is one of the chief attractions at the Exposition, 1,200 "Novak" lamps were installed and went into service May 1st, since which date they have been in regular use. With the exception of 35 lamps, the bulbs or filaments of which have been broken by accident, the whole 1,200 are burning with as great brilliancy as when first installed. This must be very gratifying to all interested in the Waring Electric Company, which manufactures this first-class lamp.

INCORPORATIONS.

The McCay-Howard Engineering Company, Baltimore, Md.—to deal in electric light plants and power plants and other business in which electricity through wire is applied. Capital stock, $5,000. Promoters: H. K. McCay, B. Howard, A. H. McCay, A. Hamilton, S. Post, L. E. Wolfe.

The Pittsburg, Crafton and Mansfield Street Railway Company Pittsburg, Pa.—to construct and operate an electric railway in Allegheny County, Pa. Capital stock, $500,000. Promoters: Thos. S. Bigelow, Wm. J. Burns, John E. Reilly, Pittsburg.

The Pentz Reckenzann Electric Company, Philadelphia, Pa.—to manufacture electric meters and other electrical apparatus and appliances. Capital stock, $30,000. Promoters: A. J. DeCamp, Chas. D. Horton, L. Webster Fox, Chas. Schaffer, Philadelphia; Lincoln Godfrey, Merion, Pa.

The College and Grandview Electric Street [illegible] Company, Beaver Falls, Pa.—to construct and [illegible] electric railway in College Hill Borough, Beaver [illegible] Pa. Capital stock, $15,000. Promoters: Chas. P. [illegible] John P. Sherwood, A. R. Loyds, Beaver Falls.

The American Burglar Alarm and District Telegraph Company, at Oakland, Cal. Capital stock, $50,000. Directors: A. H. Hogg, D. S. Henderson, A. G. Gunnett, [illegible] Graham and Cary Howard. The objects of the corporation are to operate and maintain a district burglar alarm and telegraph systems, also to operate electric light and power machinery and appliances for the distribution of electricity for purposes of lighting, power, or any other purpose for which electricity may be used.

The New Hampton Electric Light and Power Company, New Hampton, Iowa.—to deal in electric light and power. Promoters: T. C. Clary, L. L. Briggs, J. F. Babcock, E. G. Porter, D. K. Gardner, New Hampton.

The West Side and Gordon Park Street Railroad Company, Cleveland, O.—to construct and operate street railroads by electricity or other motive power. Capital stock, $10,000. Promoters: W. C. Scofield, C. W. Scofield, Geo. F. Scofield, S. H. Short and L. A. Russell.

The Elsinore Electric Power and Water Company, Elsinore, Cal.—to erect and conduct electric light and power plants, etc. Capital stock, $200,000. Promoters: Jas. F. Jones, Elsinore; Ray D. Wellman, Redlands; Cal. Dawson, B. Day, Downey, Cal.

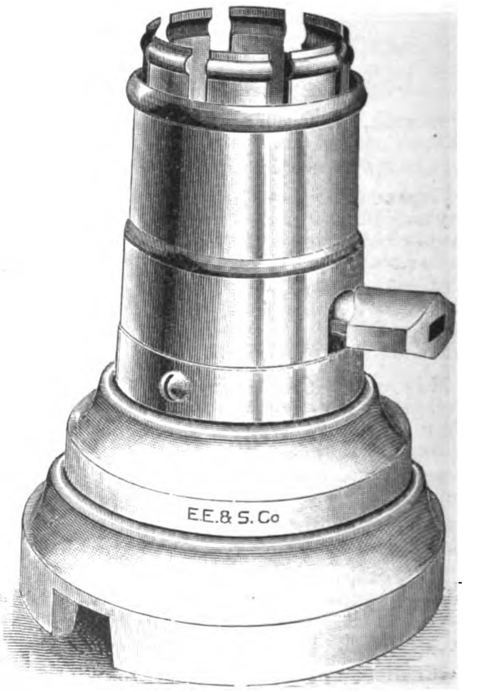
The Louisville and Jeffersonville Terminal Railway Company, Louisville, Ky.—to construct and operate railways by steam, electricity or other motive power. Capital stock, $100,000. Promoters: Dennis Long, Samuel A. Miller, W. L. Lyons, Jos. Huffakes, Jas. W. Baird and Thaddeus W. Spindle.

The Electric Light, Water and Milling Company, Milwaukee, Wis.—to erect and operate water works and electric light plants. Capital stock, $80,000. Promoters: J. Seeveland, J. Davidson and W. Schlosser.

The Adams Electric Manufacturing Company, Chicago, Ill.—to manufacture and deal in all kinds of electrical machinery, appliances and other metallic goods. Capital stock, $500,000. Promoters: Wm. B. Mather, Wm. L. Sutherland, Jas. S. Wheeler, Jr.

The City Illuminating Company, Chicago, Ill.—to furnish light and electricity for houses, streets, etc., distribute electric currents for operation of motors, etc. Capital stock, $6,000. Promoters: M. B. Austin, R. H. Watson and H. W. Ames.

The Chelora Brade Sewage and Electric Light and Power Company, Atlantic City, N. J.—to supply and distribute electricity for electric light, heat and power, etc. Capital stock, $15,000. Promotors: H. Monback, D. S. Dengler, E. Wood, Philadelphia; I. G. Adams, E. Ford, W. Riddle, Atlantic City.



THE E. E. AND S. FUSIBLE WALL SOCKET.

The Cornelius & Rowland Company, Camden, N. J.—to buy, sell and manufacture gas and electrical fixtures, etc. Capital stock, $50,000. Promoters: R. Cornelius, J. Brannen, B. H. Buck, C. Thackera, J. Meadows, Philadelphia; L. Plant, New York City; J. W. Morgan, Camden, N. J.

Articles of incorporation have been filed at Camden, N.J., by the New Jersey Improvement Company, the purposes of the corporation being to equip ready for operation railroads and to construct electric light and power plants, etc. Capital stock, $150,000. Incorporators: Louis C. Maus, Theodore T. Hansen and Benjamin T. Wagner.

ELECTRICITY.

VOL. V. NEW YORK. JULY 19, 1893. CHICAGO. NO. 1.

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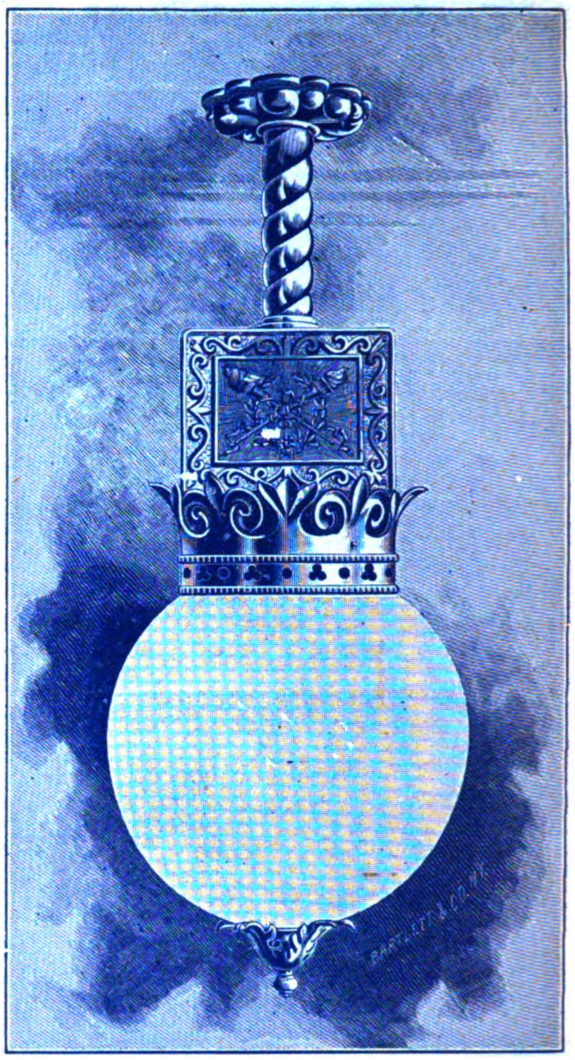

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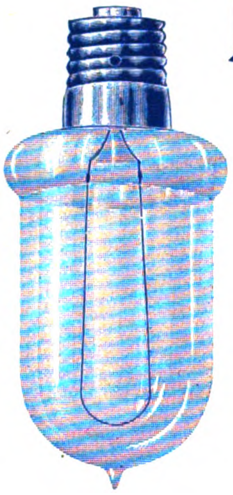

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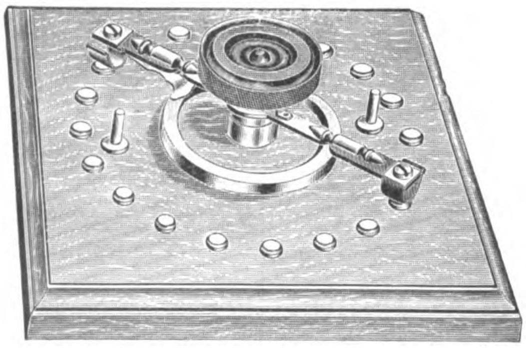

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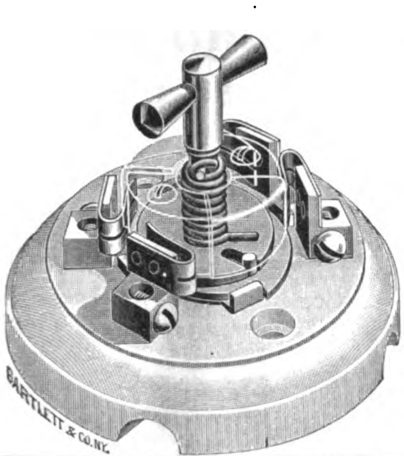
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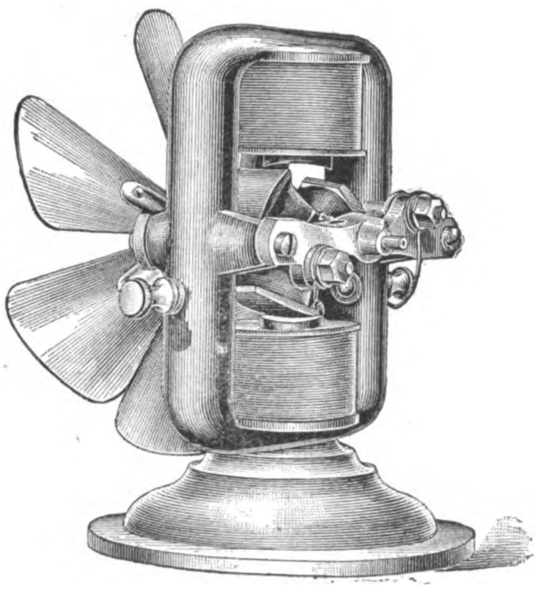

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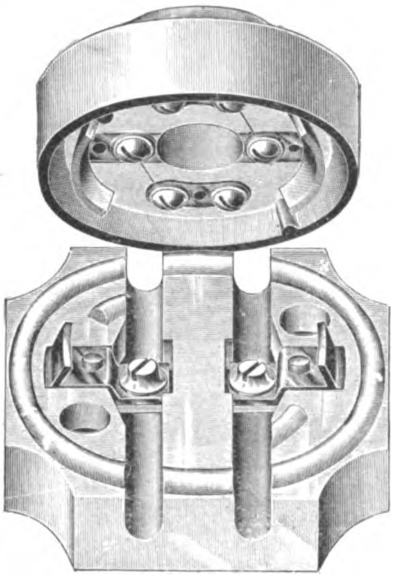

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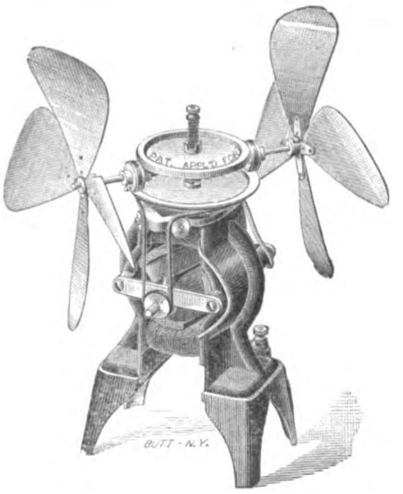

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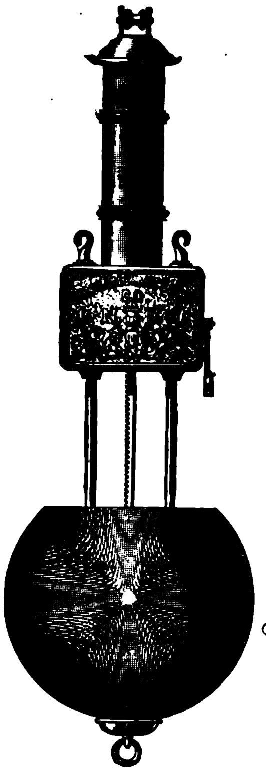

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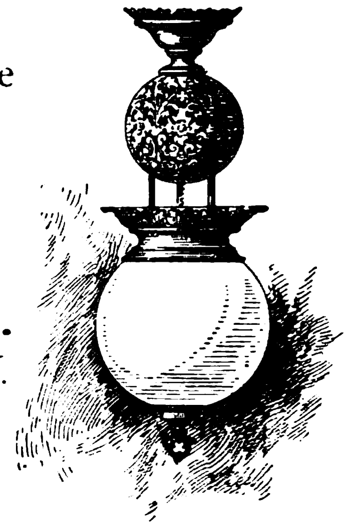

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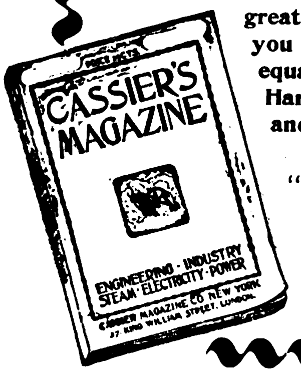

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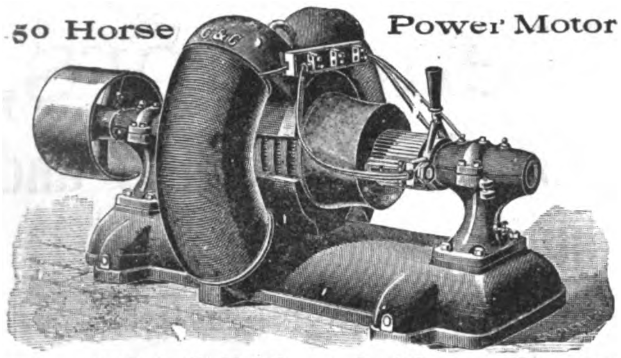

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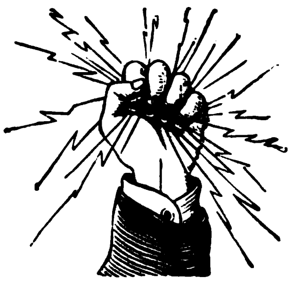

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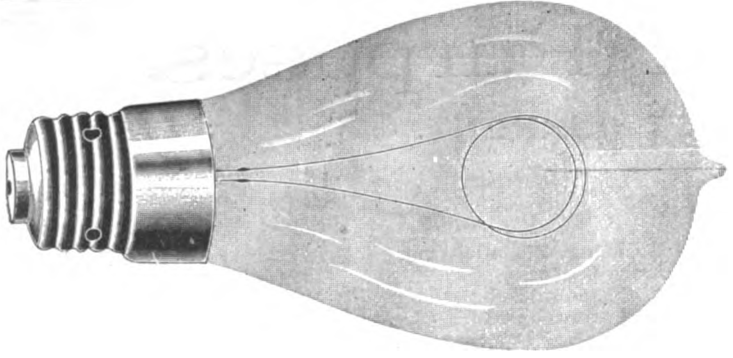

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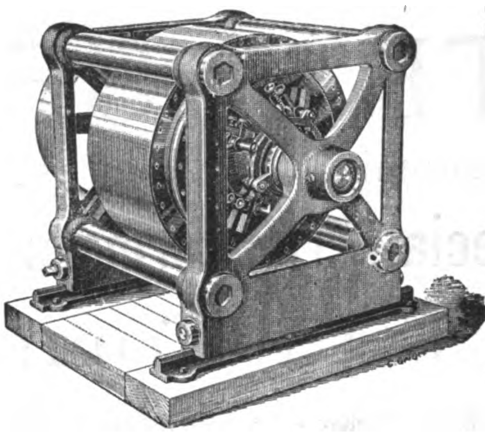

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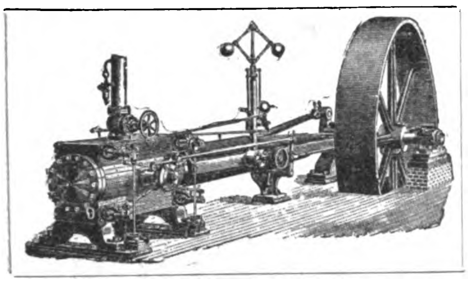

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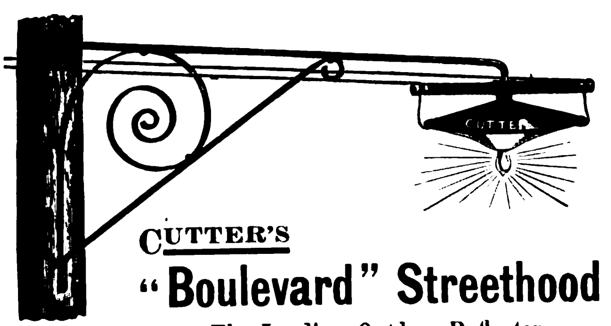

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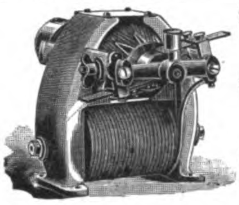

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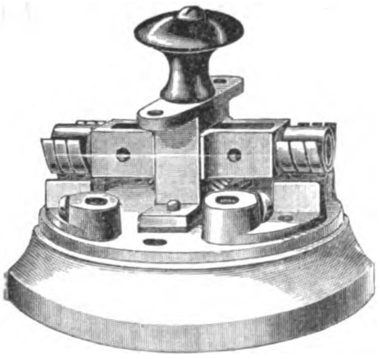

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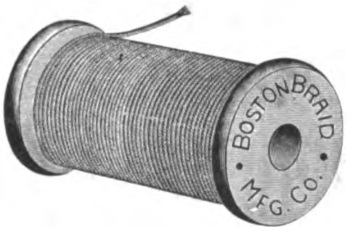
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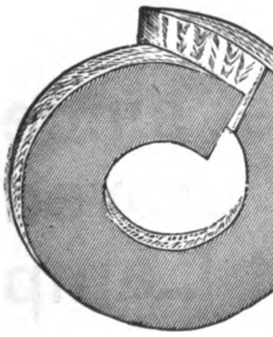

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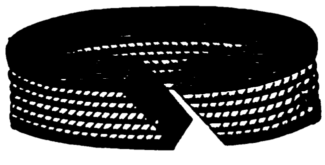

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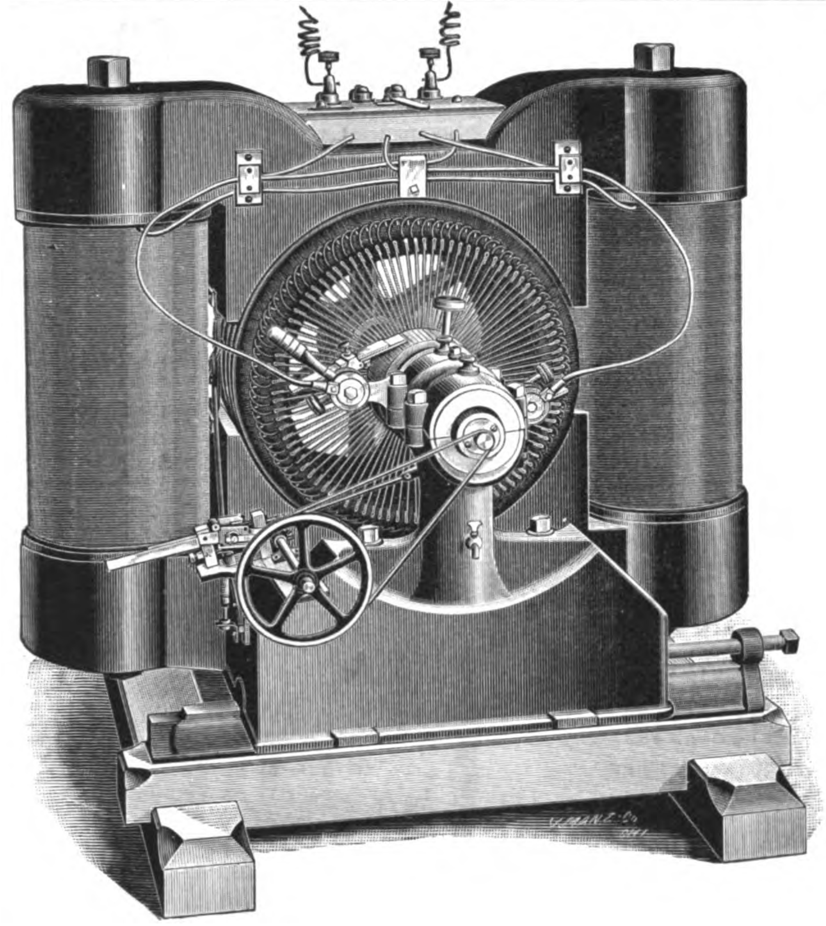

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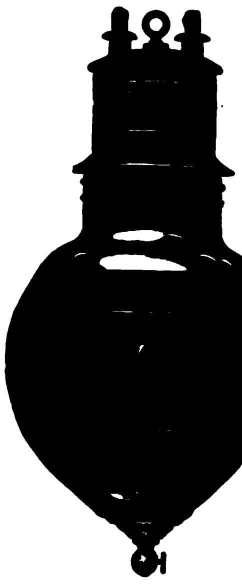

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SINGLE & DOUBLE POLE & THREE WAY.
THE BEST,
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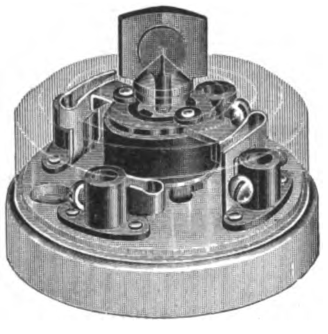

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and
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MANUFACTURERS OF
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FOR COVERING
Telegraph,
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WIRE.
Large Single and Double
BRAIDERS
FOR COVERING CABLES.
SINGLE,
DOUBLE and
TRIPLE
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FINE CASTINGS A SPECIALTY.

Location at World's Columbian Exposition:
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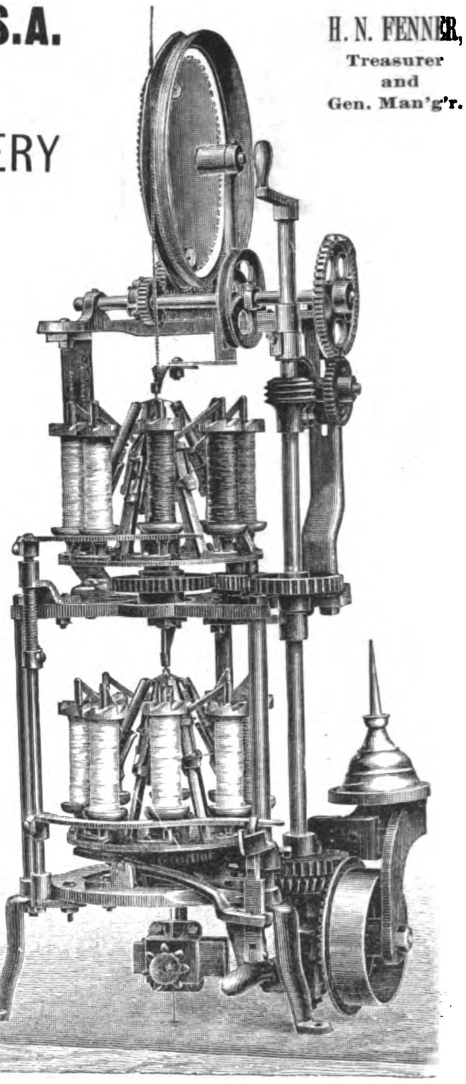

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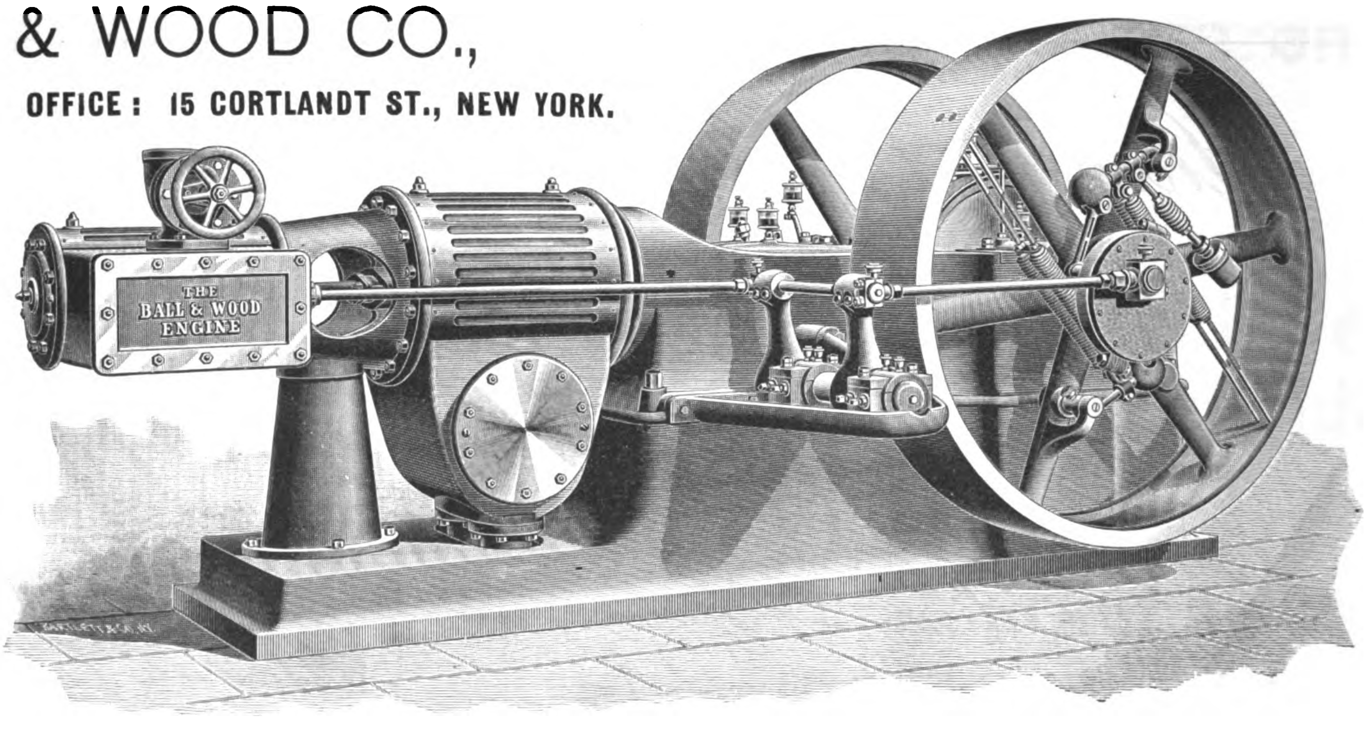

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PETITION.

To the Honorable ....

Representative in the United States Congress from the ....

District of ....

Your undersigned constituents, being engaged in the manufacture or sale of electrical apparatus, in which business there are large amounts of capital invested in your district, hereby beg to urge upon you to do all in your power to secure Congressional investigation of the plan of organization and methods of doing business of the General Electric Company, whose main offices are at 44 Broad street, New York City, with branch offices in all the large cities and towns of the country.

We urge this action, believing that a thorough and impartial investigation will establish the following :

1. That the said General Electric Company is and has been since its organization conducting its business in direct violation of the laws of the United States.

2. That the said General Electric Company as at present organized and conducted is a formidable barrier in the way of further development in the electrical art, and a standing menace to those concerns of smaller capital engaged in the electrical trade.

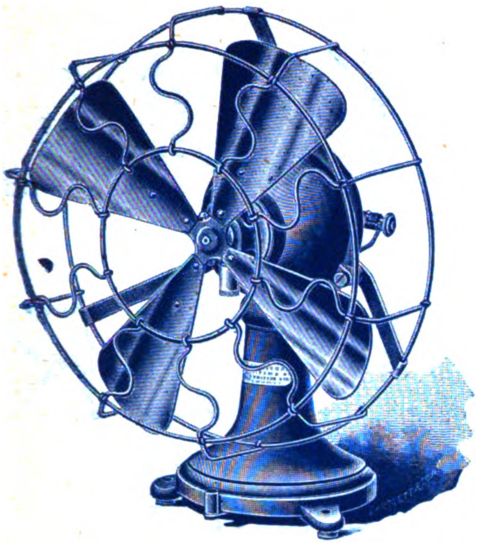
3. That the said General Electric Company is and has been making since its organization an entirely unwarranted and illegal use of certain patents granted to it and to its component companies by the United States Patent Office.

4. That it is about to solicit from the honorable body of which you are a member, an extension of United States Patent No. 223,898 (the Edison incandescent lamp patent) which patent expires November 10, 1893.

5. That the best interests of the public demand an open and unrestricted competition in the electrical trade, and a strict enforcement of the law against Trusts.

6. That the General Electric Company is composed of twelve or more sub-companies, which have been absorbed or taken over at various times, and is in its very essence a Trust, conducting its business in defiance of the law.

[Firm Name.]	*[Address.]*



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Lundell Fan Motors

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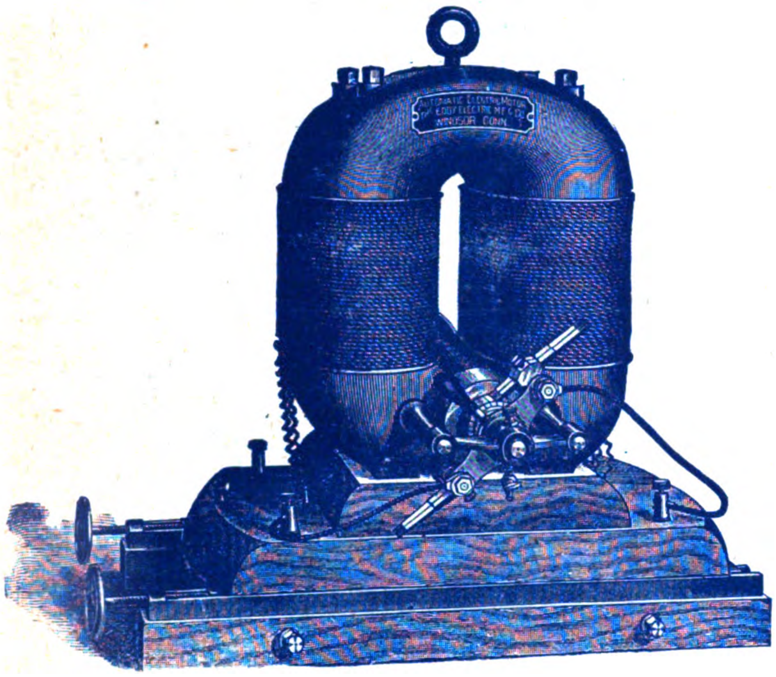

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ANY SIZE UP TO 300 H. P. AND ANY VOLTAGE.

THE EDDY ELECTRIC MOTOR

IS SIMPLE, EFFICIENT, DURABLE, ECONOMICAL AND ALWAYS RELIABLE.

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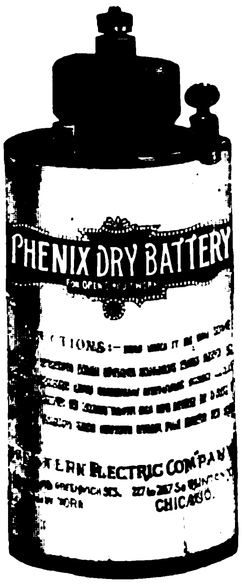

"We will say again that the Phenix has proved to be equal to if not better than any we have used heretofore, furnishing a current for a much longer time."
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Morgan & Beach, Fort Wayne, Ind.

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Chicago Electric Protective Co., Chicago.

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CAPACITY 50,000 BELLS PER DAY. ORDERS FILLED PROMPTLY FROM STOCK.
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for Light and Power

and other purposes.

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What do you know about Wagner Transformers? It may pay you to investigate.

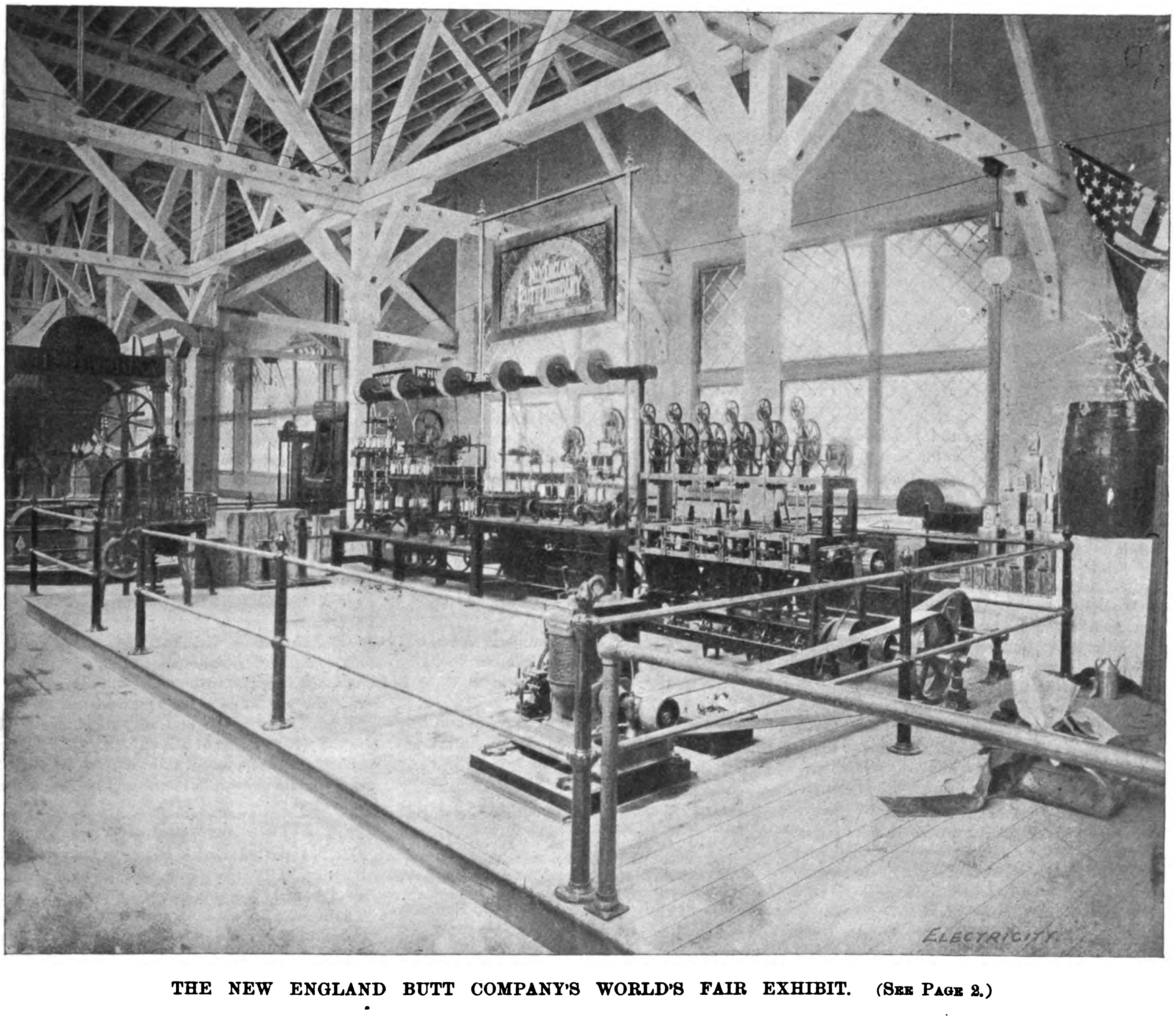
TAYLOR, GOODHUE & AMES,

MANUFACTURERS OF ELECTRICAL MATERIAL,
348 Dearborn Street, Chicago.

WAGNER TRANSFORMERS ARE THE BEST.

ELECTRICITY.

VOL. V. NEW YORK. JULY 19, 1893. CHICAGO. No. 1

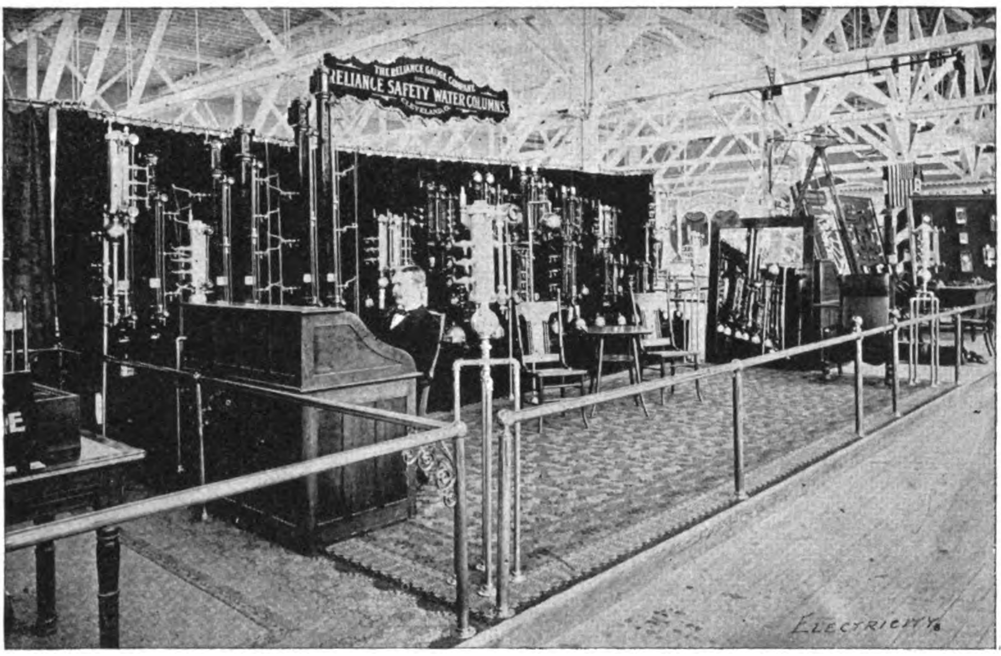


THE NEW ENGLAND BUTT COMPANY'S WORLD'S FAIR EXHIBIT. (SEE PAGE 2.)

World's Fair Notes.

NEW ENGLAND BUTT COMPANY'S EXHIBIT.

Among the interesting exhibits located in the gallery of the Electricity Building is that made by the New England Butt Company. It is especially interesting to that portion of the public that has never before had the opportunity of seeing the insulation put on the wires used for electrical purposes. Seven machines are shown in operation, four of which are double braiders, which show the method of putting on a double coating of insulation. Two others are used as single braiders, and are designed for covering small wire with a single layer for insulation. A six-spindle machine is also shown in operation. This machine is designed for covering the smallest of wires used on magnets. The smallest fraction of insulation can be obtained by a simple adjustment of any one of the six spindles. A heavy braider for making cables is another interesting part of the exhibit. This machine is used in insulating the heavier electric wires, and can be operated so that a compound can be distributed over the surface of the cotton insulation. All of the machines are belted to a line shaft which is in turn belted to an electric motor.



THE RELIANCE GAUGE COMPANY'S WORLD'S FAIR EXHIBIT.

THE RELIANCE GAUGE COMPANY.

The Reliance Gauge Company's exhibit is one of the most attractive exhibits on the second floor of Electricity Building, showing a full line of their celebrated Reliance safety alarm water columns for steam boilers varying in size from 1 to 1,000 horse power. The exhibit is very handsomely and tastefully arranged, the floor being covered with Brussels carpet, the stands with plush, and olive plush draperies for a background. The highly polished aluminum, brass and nickel-plated columns add to the luster, giving to the exhibit a very pretty and attractive effect.

The Reliance safety columns go on the boilers taking the place of the ordinary water columns in every detail, having both the gauge cocks and the water gauges, but on the inside there are two floats and a valve. When the water gets above the third gauge the high water float comes up, raises the valve lever, sounds the alarm for high water at the third gauge, compels the fireman to keep the water down where it should be all the time, also informs his superiors of his carelessness. It is an impossibility for him to get 1-16 of an inch more water in the boiler than he should have at any time without being instantly reported. This insures good dry steam, which to an electrical or power plant is invaluable. When the water falls to the first gauge cock it is as low as it should be allowed to go. When it gets below that point of the gauge cock the float falls by gravity and sounds the alarm for low water at the first gauge cock, calling the attention of the attendant. Another feature of the Reliance column is its trap sediment chamber. With the ordinary water column whenever any mud or foreign matter comes in through the feed pipe it comes up, circulates around through the column, dirties up the water glass, and in fact often stops it up, then falls right back into the feed pipe, only to come back again the next time the gauge cock is tried, but the Reliance column feeds at the side. Every particle of mud which comes in the column is trapped down into the sediment chamber. After once in that, it cannot possibly get back into the column. It holds the mud in the chamber, lets the water free and clear circulate through the column, keeping the glass clean all the time.

The exhibit is in charge of Mr. Geo. B. Clark, who will be pleased to meet his many patrons and friends and all others who are interested. The boilers in Machinery Hall are equipped with these columns, and to see them working practically call in the boiler room, but the aluminum models cut open, showing the working parts, gives one a better idea of their simplicity and value as safeguards.

The following judges were announced last week to pass upon the electrical exhibits in the Electricity Department by the National Commission:

H. S. Carhart, Professor of Physics and Electrical Science, Michigan University, Ann Arbor, Mich.

Michael O'Dea, Professor of Physics, University of Notre Dame, Ind.

Ernest P. Warner, Electrician Western Electric Company, Chicago.

Harris J. Ryan, Professor of Electrical Engineering, Cornell University, New York.

W. M. Stine, Professor of Electrical Engineering, Ohio University, Athens, Ohio.

R. B. Owens, Professor of Electrical Engineering University of Nebraska, Lincoln, Neb.

B. F. Thomas, Professor of Electrical Engineering, Ohio State University, Columbus, Ohio.

T. C. Mendenhall, Washington, D. C.

Samuel Reber, U. S. A.

H. A. Rowland, Baltimore, Md.

Geo. F. Barker, Philadelphia.

The *British* exhibit, which has just been completed, is the most complete in its line shown in the Electricity Building. The display is located in the northwest corner of the building, on the ground floor, and occupies a space of about twenty by forty feet square. The exhibit consists principally of a collection of historical telegraph instruments loaned from Her Majesty's Postmaster's exhibit at South Kensington, and is shown in such a manner that it readily illustrates the advances and the growth and development of the telegraph from the first instrument ever used up to the present. A very interesting part of the exhibit is Delany's telegraph system, which provides for the transmission of six messages simultaneously over the same wire, all in the same direction or divided up in any manner most suitable to the traffic at any moment, thereby enabling the operator to make the maximum use of each circuit. It is interesting to note the great difference between this system and the original fine needle system, which is also exhibited, and which required five wires to transmit one message.

The remainder of the German exhibit is being installed in the middle of the west gallery of the Electricity Building. It will consist of historical apparatus from the Government Museum and from the different German electrical manufacturers. The central portion of the space will be occupied by a bust of Siemens, the sides will be draped with old gold curtains and silk plush portieres.

Among the number killed in the fire which occurred in the cold storage building on the Fair grounds last week was Norman H. Hartman, a wireman in the employ of the Harter Electric Company.

The space formerly assigned to the Spanish Commission for the display of Spanish electrical goods in the Electricity Building has been given to the Newman Clock Company.

The Electric Heat Alarm Company's exhibit, which is in charge of Mr. Ed. Nashold, is credited with having one of the handsomest booths in the building.

Electricity for Marking Meat.

Although electricity has for some time invaded many unexpected places, and is familiar in a number of abattoirs for supplying illumination, a recent suggestion of Mr. Manville, an English electrical engineer, promises to bring butchery still more closely in touch with electricity.

A Parliamentary committee has been appointed in England to make inquiry into the subject of marking meat imported from different countries. Among the witnesses called was Mr. Manville, who proposed an electrical machine, a model of which was presented for the consideration of the committee.

The machine contains a wheel with projections on its circumference consisting of various letters which is supplied with an electric current. When the wheel is rolled along a carcass, the letters are branded on the skin and may be applied very rapidly to any part of the animal. The device is cheaply manufactured, and where electric light is supplied its use would incur only an insignificant expense.

Electrically Welded Steel Barrels.

It is reported that a large industry is being built up at Barrow, Eng., in the production of steel barrels for the conveyance of petroleum. The barrels are made in halves by means of compression in a mold, when hot. Afterward they are welded together by means of electricity. The barrels are intended for use by the large oil carrying companies engaged in the oil trade in the East, where the temperature has a great effect on wood casks, and results in so much leakage.

Practical Aspects of Low Frequency Electrical Resonance.*

BY M. I. PUPIN, PH.D.

A large part of the subject of the following discourse was discussed by me, but in a different way, in three papers. Two of these appeared in the April and May numbers of the *American Journal of Science*. The third will appear in the June number of the same journal. The method which I have adopted in the following discussion seemed preferable to the mathematical method which I followed in those papers. It is probably just as exact, and certainly a much clearer way of viewing the variable flow of electricity, especially those features of it which have a more or less direct practical bearing.

1. ON THE NATURAL PERIOD OF AN ELECTRICAL CIRCUIT.

An electrical circuit possessing self-induction and capacity behaves in a great many respects as a body does in consequence of its inertia and elasticity. The fundamental reason for this analogy is simply this: the electro-magnetic energy of a coil through which a current flows has all the characteristic properties of the kinetic energy of a moving body, whereas the energy of the static charge of a condenser has all the characteristic properties of the potential energy of a strained elastic body. If the neutral state of such an electrical circuit is disturbed, it will return to it again after performing a certain number of oscillations about the position of its neutral state. But a return to the neutral state is impossible until the energy which is spent upon the circuit to disturb its neutral state has left the circuit, or to use a more technical expression, until the energy has been dissipated or given off to some other circuit. The two principal causes which produce dissipation and compel the circuit to return to its neutral state again are frictional resistances and radiation. Just as in the case of vibrating bodies, so also in the case of electrical oscillations, losses due to radiation, especially when no other electrical circuits are near, are exceedingly small when the oscillations are slow. In Herzian oscillations they are quite considerable. In oscillations of the Tesla frequency they are probably not negligible. My remarks refer to electrical oscillations of long period, therefore losses due to frictional resistances are the only losses which I shall consider. Consider now an electrical circuit consisting of a coil *A* and a condenser *B* (Fig. 1) in series with it. It is a circuit with localized self-induction and capacity. I trust that my discussion will lose as little in its generality as it will in its practical bearing if I confine it to such circuits only. Let a sudden electrical impulse disturb the neutral state of the circuit; electrical oscillations will result. These oscillations follow laws practically identical with the laws of the motion of a slowly vibrating body. Their period is constant, as we all know, and it is in general completely determined by *the electro-magnetic moment of inertia* and the *dielectric elasticity* of the circuit—that is, by its coefficient of self-induction and its capacity. When, however, frictional losses due to ohmic resistance, magnetic and dielectric hysteresis are large, then the period of this circuit is no longer defined by the self-induction and capacity alone, but it is also influenced by these frictional losses.

When ohmic resistances and hysteresis losses are small enough, then the natural period of the circuit is given by the well-known formula

$$T = \frac{2\pi}{10^3}\sqrt{L\,C}$$

where T is the natural period of the circuit in seconds, L its coefficient of self-induction in henrys, and C its capacity in microfarads. For instance, a large Bell telephone whose coefficient of self-induction is 0.5 henrys when connected in series to a condenser of 1 microfarad capacity will have a natural period of very nearly $\frac{1}{225}$ seconds, that is to say, an electrical disturbance would set up oscillations in it 225 of which would take place in one second. If a permanent magnet were brought into the vicinity of the telephone coil and then suddenly removed, the telephone would sing a note whose pitch would be a little below the well-known note C. But it would not sing it very long. For since the ohmic resistance is 100 ohms these oscillations would disappear almost entirely after 10 complete oscillations, somewhat in the manner represented in diagram Fig. 2, that is to say, the telephone would sing only during about $\frac{1}{22}$ part of a second. By diminishing the resistance we could prolong its song. But diminish the resistance as much as you please, the pitch of the note of the telephone will remain the same, because, as I said, the natural period of the telephone circuit just described is within wide limits independent of the ohmic resistance.

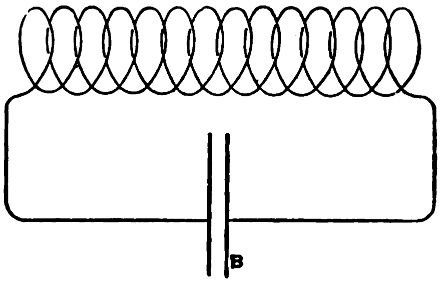


FIG. 1.

2. ON THE TUNING OF AN ELECTRICAL CIRCUIT.

To change the note, say to make it higher, it would be necessary to diminish the capacity of the condenser. When a piano tuner wishes to raise the pitch of a piano string he gives it more tension; so in *tuning an electrical circuit*, in order to change its pitch, it is necessary to change its *electrical elasticity*, that is, its capacity. But there are other ways of tuning an electrical circuit, just as there are different ways of tuning musical instruments. Consider a reed pipe, say a clarionet. The musician places a little bit of wax on the reed. When the instrument is too low in pitch he takes off some of the wax, so as to diminish the moment of inertia of the reed, and when the pitch of the instrument is too high, he sticks on more wax so as to increase the moment of inertia. At any rate this used to be the method of old-fashioned country musicians. And so it is in tuning an electrical circuit. Instead of varying its *electrical elasticity*, that is, its capacity, we can vary its *electro-magnetic moment of inertia*, that is to say, its coefficient of self-induction. To show how this may be done in a telephone circuit just mentioned, insert into this circuit a small coil *a* (Fig. 3) an auxiliary coil, with a removable iron core *c* made up of very fine iron wire. In doing this we do exactly what the country musician does when he puts wax on the reed of his clarionet. If the electrical pitch of the circuit does not suit, say it is too high, then simply put on more electro-magnetic wax, that is to say, insert the iron core and move it back and forth until the correct position is found, which will give the correct electrical moment of inertia, that is to say, the correct coefficient of self-induction. This is, briefly stated, what I mean by the expression *tuning an electrical circuit.* From the simple expression given above for the natural period of an electrical circuit, it is evident that the tuning of an electrical circuit, if not simpler, is certainly quite as simple a process as the tuning of a musical instrument.

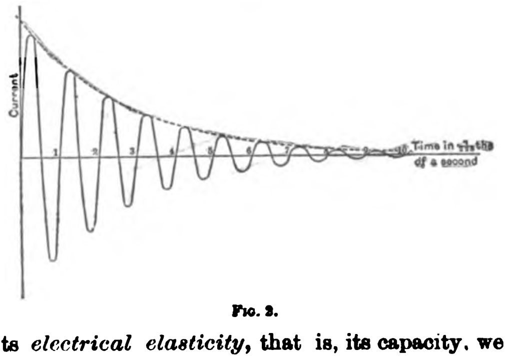


FIG. 2.

3. ON THE DETERMINATION OF THE PITCH OF AN ELECTRICAL CIRCUIT.

If we wish to know the pitch of a musical instrument, say of a tuning fork, to choose a simple illustration, we simply give it an impulse, say a tap with the finger, and then listen to the vibrations, which in general will last for several minutes, and give us sufficient time to make up our minds as to what the vibrations sound like. In examining the pitch of an electrical circuit it is more convenient to adopt a different method. The reason is that as a rule electrical oscillations are, as pointed out in the example above, much more damped, so that the oscillations resulting from a single impulse would not last long enough to give us sufficient time to see what they look like, or to listen and hear what they sound like. The method suggested by the stroke of a violin bow over the string is preferable. The stroke of the bow produces a series of impulses which quickly succeed each other and maintain the string in uniform vibration. It is interesting now to observe that the same thing can be done with an electrical circuit. Consider the circuit A B C, Fig. 4. The condenser B represents the tension on the violin string, coil A represents its inertia. The air gap C stands for the point where the bow by its stroke excites the string. If you now wish a musician who plays with a one-sided stroke, use a high potential direct current generator D, and for an alternating stroke substitute an alternator. The discharges at the air gap C succeeding each other quickly enough, and at proper intervals, will maintain in the circuit A B C practically uniform electrical oscillations. This is one of Tesla's favorite circuits, and I have no doubt but that he will accomplish great things with it yet.* Bring a few turns of wire of a telephone circuit into inductive influence of this circuit, and you will have in the telephone a musical note of exactly the same pitch as the pitch of the electrical oscillations in the circuit A B C. The note is not perfectly pure. It is marred by the noise of the spark discharge of the air gap C Neither is the note of the violin string pure; there is always more or less of the scraping noise of the bow. Just as it is necessary to keep the bow well rosined so as to give a good grip upon the string, so it is necessary to apply a strong current of air or the action of some other of Tesla's devices upon the air gap C, otherwise an arc is formed and the generator D loses its grip upon the circuit A B C.† If we had a number of different coils with condensers like A and B alongside of each other, and arranged in such a way as to be able to place them at will, now the one and now the other, and now again a number of them in multi-

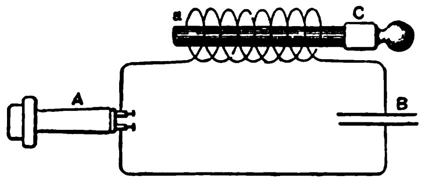


FIG. 3.

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[*] A lecture delivered at the Tenth General Meeting of the American Institute of Electrical Engineers, Columbia College, New York.

[*] It must be observed, however, that Hertz, in 1887, produced his oscillations by a circuit of this identical form

[†] The importance of blowing out the arc for the production of powerful oscillations seems to have been first organized by H. Classen, *Wiedemann Annal. d. Physik und Chemie*, Band xixxx, p. 647, 1890.

ple under the action of the electrical bow which the generator D keeps moving over the air gap C, and at the same time vary the capacities, we should be able to change the electrical vibrations of our system with that ease, precision and grace which the violin player displays when with the one hand he guides his obedient bow while the busy fingers of the other hand glide over the trembling strings, eliciting from them delightful notes which blend into pleasing harmonies.

So with our system of properly tuned electrical circuits, we could produce harmonies, but they would be harmonies of silence, harmonious oscillations in the ether that affect neither eye, nor ear, nor taste, nor smell. But bring a part of a telephone circuit into inductive action of our harmonic system, and let a skilled experimentalist manipulate a properly constructed keyboard which controls the coils and condensers of the various circuits, and harmonies which before were as silent as the grave will now agitate the responsive diaphragm of the telephone and produce music that could be made to re-echo in every telephone in the United States.

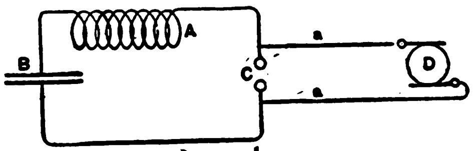

FIG. 4.

But after all, such an arrangement when used for such a purpose would be a mere toy in comparison to the purpose for which our distinguished colleague, Mr. Tesla, employs it. To convert high potential but small current electrical energy into low potential big current energy, or *vice versa*, accompanied by all possible variations in the frequency of oscillation was the purpose for which Mr. Tesla constructed the device. To a physicist who delights, not less than the engineer, in neat, simple devices for the accomplishment of big and brilliant effects this device of Tesla naturally appeals more than all his other ingenious inventions. Many a delightful hour have I spent in watching experiments on a circuit like the one in Fig. 4. The coil A consisted of a short, stout copper wire; the condenser B consisted of a battery of Leyden jars, which my distinguished teacher, Professor Rood, of Columbia College, kindly lent me. The wires *aa* were thin copper wires connecting the air gap C to the poles of an induction coil which is now in the hospital. It is a delightful sight to see the stout wire aglow under the powerful agitation of the rapid oscillations, whereas the thin wires *aa* adjoining them remained perfectly cool. Twist now the thick wire A into a few convolutions, say ten or twelve, and surround them by a few hundred turns of fine wire, and you will have the now well-known oscillatory transformer with which Mr. Tesla and Professor Elihu Thomson produced some brilliant effects, a transformer that will give you any number of volts, especially if—and now I am going to touch a point which forms the central point of my discourse—especially if the thin wire coil contains *capacity in series with it, so that the natural period of this circuit is the same as the period of the thick wire coil, that is, if the two circuits are in resonance.*

4. ON RESONANCE.

Here again I have borrowed a term employed in music. But a few simple considerations will show you that it is very natural that I should, for the phenomena of sound and those of oscillatory flow of electricity are governed by nearly the same laws. Very high frequency electrical oscillations would in all probability be identical with light, as first announced by the immortal Maxwell. It is, therefore, not surprising to find that low frequency electrical oscillations should resemble so much the other group of oscillatory phenomena which next to light pleases our senses best, namely, the phenomena of sound, especially agreeable sound, that is, music.

To gain a clear conception of what is meant by electrical resonance consider the following simple mechanical analogon—I call it the *torsional pendulum.* I used it often with my students in discussing alternating current phenomena and they liked it very much. A heavy bar A (Fig. 5) is suspended on a stiff elastic wire B, which is attached to a plate C whose weight may be neglected. This plate C slides in a groove *aa* which in consequence of friction acts like a brake. Suppose now that the friction between C and *aa* is such that when the angular velocity of C is ω the rate at which heat is generated by the friction between C and *aa* is equal to $\omega^2 R$ where R is independent of the angular velocity. This torsional pendulum resembles then very much an electrical circuit having localized self-induction, capacity and ohmic resistance. The moment of inertia of A, the elasticity of B, and the friction in C act exactly the same as the coefficient of self-induction of the coil, the capacity of the condenser, and the ohmic resistance of the circuit. Let $\frac{1}{B}$ stand for the elastic capacity of the wire, that is, if the wire be twisted through an angle θ, then the moment of the elastic force which opposes this twisting is $\frac{\theta}{B}$. Let I stand for the moment of inertia of the weight A, then as long as the frictional resistance is within certain limits we shall have for the natural period of the pendulum

$$T = 2\pi\sqrt{I \times B}.$$

You see that this expression is exactly the same as the one which expresses the natural period of the circuit in terms of its coefficient of self-induction and capacity.

If this pendulum is set in motion by a single impulse it will oscillate with a constant period. The first elongation will be largest, and the successive elongations will be smaller and smaller, just as represented in Fig. 2, until the pendulum is reduced to rest again. This will happen when the energy of the impulse has been entirely dissipated into heat, which is the work done against frictional resistances in the break at *C*. The smaller this frictional resistance, the longer will the pendulum swing, in consequence of the impulse, before it is reduced to rest. On the other hand we can increase the resistance in *C* to such an extent as to make the swing a-periodic or dead beat, as is for instance the case in the Weston voltmeters and ammeters.

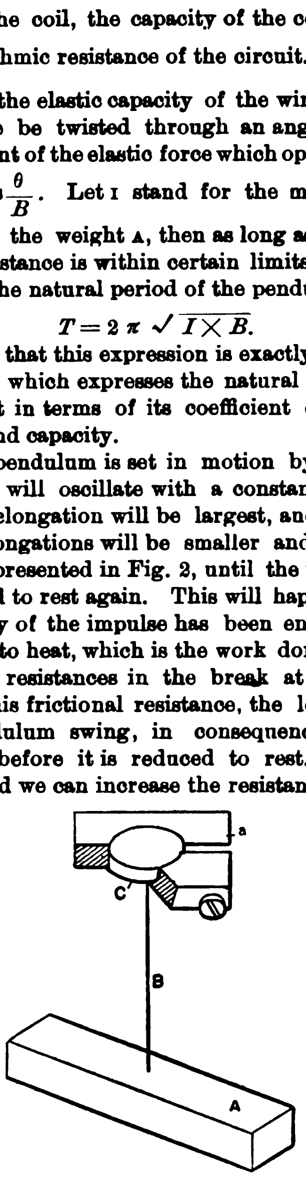

FIG. 5.

Repeat the impulse at regular intervals, alternating them, the pendulum will keep on swinging; but you can easily see that if the intervals of the impulses are measured off in such a way that every time the pendulum passes through its position of equilibrium the impulse strikes it, and strikes it in the direction in which the pendulum is moving, then the amplitude of the swing will be much larger than if the intervals of the impulse are not measured off in such a way. In other words, when the period of the impulses *is the same as* the natural period of the pendulum then the swing is largest. The impulses are said then *to be in resonance* with the pendulum.

The same effect will be produced if for the impulses we substitute a periodically but gradually alternating force, say a simple harmonic force, having the same period as the natural period of the pendulum.

Such a force when acting upon the torsional pendulum just described will continually increase the amplitude of the swing until the swing is so large that the work done during a swing against the frictional resistances is just equal to the work of the moving force during that time. From that point on, the pendulum will swing with constant amplitude. It is evident, therefore, that the larger *the amplitude of the moving force and the smaller the frictional resistances, the larger will be the amplitude of the swing.* But a large amplitude implies two things: 1st, A *large torsional reaction* in the suspension wire, and secondly, a *large velocity* whenever the pendulum passes through its position of equilibrium.

The bearing of this mechanical analogon upon the electric circuit having self-induction and capacity is very direct, as I shall presently point out. Let a simple harmonic E. M. F. $E \sin pt$, act upon such a circuit. I shall presently consider a complex harmonic E. M. F., and also circuits possessing Foucault current losses, and losses due to magnetic and dielectric hysteresis. They will form the last and in my opinion the most important part of my discourse. A simple harmonic E. M. F. acting upon an *elastic electrical circuit* in which the only frictional losses are those due to ohmic resistance will, when its period is the same as the natural period of the circuit, that is when *it is in resonance with the circuit*, continually increase the amplitude of the electric displacement, that is, the amplitude of the condenser charge and therefore also of the current, until the work done against the ohmic resistance is exactly equal to the work of the impressed E. M. F. From this point on the amplitude of the current will remain constant and equal to the amplitude of the impressed E. M. F. divided by the ohmic resistance. Or, to state it in terms which are more generally employed: *Capacity and self-induction neutralize each other when the circuit is in resonance with the impressed* E. M. F.

It is evident also that in a resonant flow there can be no difference in phase between the current and the impressed E. M. F., since in this case the current at any moment depends on the E. M. F. and the resistance, and on nothing else.

It is clear, however, that if losses due to Foucault currents, magnetic and dielectric hysteresis are present, then the current cannot be made equal to the ratio between the E. M. F. *and the ohmic resistance by any combination of capacity and self-induction, although, as a simple reflection will show, the difference in phase between the current and the* E. M. F. *may be educed to zero in this case also,*[*] *in which case we should have no false current, as it is generally called.* I shall presently discuss this point a little more fully.

(To be continued.)

The scene shifting in the new Opera House at Cleveland, Ohio, will be done by electricity. At present the Auditorium in Chicago is said to be the only playhouse in the world in which the scenes are shifted by means of electricity.

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[*] Professor Duncan of Johns Hopkins University informed me yesterday that he deduced the same result in the course of an investigation, a short account of which he read before this Institute at its General Meeting in Chicago in 1892, "Note on some Experiments with Alternating Currents."—TRANSACTIONS, Vol. IX, p. 179.

The Physiological Effects of Electrical Currents of High Frequency.*

BY H. LEWIS JONES, M.D.

The application to medicine of electrical currents of great rapidity of alternations, or high frequency currents as they are commonly called, has occupied the minds of medical men to a great extent during the past twelve months. In France especially is this the case, where D'Arsonval has given much study to this difficult subject. The demonstrations which were given at the Royal Institution by Tesla in the spring of last year left an impression upon the minds of many people that enormous voltages were harmless to the human body if only they could be made to alternate with sufficient rapidity, and people were astounded at the spectacle of a lecturer placing himself in a circuit carrying a current alternating some hundreds of thousands of times per second, at a pressure of many thousands of volts. These experiments, coming not long after the accounts of the execution of criminals by electricity in America with pressures of 1,200 to 1,500 volts, and compared with the occasional notices in the newspapers of fatal accidents to workmen engaged upon electric light cables at 1,000 volts, made it seem as though the rapidity of alternation was the factor which protected Tesla from injury by the enormously high voltages which he was handling. The same view is taken by D'Arsonval in his papers before the Société de Biologie. He there describes an apparatus consisting of an induction coil supplying current to Leyden jars, the jars being made to discharge through a circuit including a helix of ten to fifteen turns of thick wire and an air gap. In this way there is set up in the circuit a succession of sudden rushes of current, which oscillate hundreds of thousands or even millions of times per second, the rate being determined by the Leyden jars; and the wire helix becomes the seat of electro-magnetic induction effects, comparable exactly to the induced primary currents of a medical induction coil, but very much more intense. These induced currents of the helix are the subject of D'Arsonval's experiments. By attaching wires to the beginning and end of the helix, the induced currents or extra currents can be held off; their energy was sufficient to bring to full incandescence a lamp requiring two amperes to light it, and it was therefore assumed that they had a magnitude of two amperes. The electromotive force of the currents was at least 8,000 or 10,000 volts, because they were able to lead across an air gap of several millimetres, and yet their effect upon the tissues of the body was very slight; in fact, they were hardly felt.

Now it is certain that a current of far less than 1 ampere, either steady or alternating 20, 50 or 100 times per second, would produce unbearable and dangerous shocks in its passage through the tissues; and the inference drawn is that the extreme frequency of alternation can render a current of dangerous magnitude innocuous. But I am not satisfied that such an inference is a proper one, for the following reasons:

1. A Leyden jar discharging through the body, produces effects which are painful and severe, as all who have felt them will agree; but yet this is a discharge of high frequency of alternation; in fact, it is by the Leyden jars in the circuit that the oscillatory character and the rapid rate of alternation of the discharge is determined. Oliver Lodge gives the rate of oscillation for a pint-sized Leyden jar at ten million per second; for jars of greater capacity the rate is less rapid.

2. The high frequency and high potential discharges of Tesla's apparatus are not altogether harmless, but can produce severe shocks and can kill small animals, as Elihu Thomson has shown. The discharges from the terminals of such an apparatus can produce severe muscular contractions even with the resistance of a considerable air space interposed in the circuit; so much so, that in some recent experiments which the writer was enabled to make through the kindness of Mr. Campbell Swinton, it was considered prudent to proceed no further with the experiment of actually touching both the terminals of the coil at once.

3. It is very doubtful whether D'Arsonval's estimation of the magnitude of the current of his apparatus is correct. The incandescence of a lamp filament with currents of high frequency has been recently under discussion in some of the electrical journals, and a very satisfactory explanation of the phenomenon has been forthcoming. It is well known that for alternating currents the resistance of a conductor is greater than it is for steady currents, and the increase of resistance rises rapidly as the rate of alternation becomes greater; and with frequencies approaching one million per second, the effective resistance of the lamp used by D'Arsonval would be raised enormously; this would require the energy needed to bring it to incandescence to be applied at a proportionally higher voltage, while the magnitude of the current would be lessened in an equal degree. For example, the energy of two amperes at 100 volts is the same in amount as that of 0.02 of an ampere (20 milliamperes) at 10,000 volts.

We are, therefore, able to say that the current which raised D'Arsonval's two-ampere lamp to bright incandescence was very much less than two amperes, and was probably only a few milliamperes, and herein lies the pith of the whole question. The experiments with high frequency currents of high tension are harmless if the magnitude of the current is small, and as the high potential is, in fact, obtained at the expense of the current, this latter diminished in proportion as the potential is raised by each successive step-up in the transforming apparatus. For the present, it may be taken as not yet proved that high frequency of alternation can render electrical currents harmless; and it may still be accepted that the effect produced by the passage of a current through living tissues depends primarily upon the magnitude of the current, as measured in amperes, which is made to traverse them, and upon its density or concentration therein.

A Telegraph Line in Africa.

The *Pall Mall Gazette* gives some interesting information in regard to the proposed telegraph line from Cape Cairo to an important point in the interior of Africa. Capital to the extent of £140,000 has been subscribed, and this is considered sufficient to construct the line as far as Uganda. The materials are now being ordered in London, and will be shipped shortly. The poles are to be of iron of light construction, in order to out-manœuvre the white ants, who would eat away wooden poles. From Fort Salisbury the line is to be carried to Tete, on the Zambesi, and from thence to Blantyre. There Consul Johnston will report the result of his surveys as to the best manner of proceeding on to Uganda, and the construction party will have to come to terms with the natives and the Arabs by subsidizing the chiefs and others of influence. There will be nothing in the way of impenetrable undergrowths or rank vegetation to contend with, as the line will avoid the low country and keep to the high plateau the entire distance. There are two alternative routes for the conveyance of the materials. There is good transport from the Transvaal to Fort Salisbury, or a shorter route would be adopted if materials were shipped direct to Beira, carried along the railway now being built as far as it extends, then conveyed the rest of the distance by ox-wagons. The scheme is being pushed forward with great activity now.

General Electric.

Suspicion Renewed by Last Week's Developments.

It Touches 58 1-2 on Sales of 11,000 Shares, July 12.

(*Wall Street Daily News.*)

This stock sold "ex-dividend" yesterday, and the way long holdings came out we should say it also sold "ex-confidence." It ranked third in point of activity, and sold down, dividend added, to 63¾. The price tells the story. If the millionaire directors had any confidence in the property, does it stand to reason they would permit a gilt-edged (?) 8 per cent. dividend paying stock to kick around at that figure? It is surmised that some one has been badly hit in this security, and that some out-of-town banks have been throwing it over.

(*The Daily American.*)

The insiders are still shouting vigorously for this property. They declare that it is earning 20 per cent. and will continue to pay annual dividends of 8 per cent. right along. Incidentally the company's treasurer denied that the suspension of the Chamberlain Land Company meant any loss to them outside of a few hundred dollars. The spectacle, however, of an 8 per cent. dividend payer like General Electric selling between 60 and 65 is rather unusual. There is a theory in Wall Street that when a stock behaves in the weak fashion that General Electric has behaved over a long period of time something inherently wrong must be the matter with it. It is argued that if the property is all right the stock is so cheap that insiders would buy it.

Active Material of Accumulators.

W. A. Boese has invented a process of preparation of active material for accumulators of some interest. It consists in mixing metallic oxides, such as oxide of lead, with sulpho-combined acids of anthracene and other organic compounds, and forming the mixture into plates. In practice, the metallic oxides are mixed with the residue of coal tar, transformed into sulphur combinations by extracting the petroleum ether, adding sulphuric acid, distilling the solvent and provoking the formation of the desired compounds. For the extraction of the residues of distillation, alcohol may be employed as solvent instead of petroleum ether, so that by mixing the product with the sulphuric acid and a metallic oxide (oxide of lead), the heat given off by the action of the acid on the alcohol is sufficient to provoke the chemical action on the hydrocarbons at high molecular weights contained in the alcoholic extract, without recourse to external heat. According to the inventor, the plates obtained by this process acquired great stability in consequence of the agglutinative properties of the salts when mixed with anthracene-sulphonic acids or their analogues.—*Review Industrielle.*

The State Board of Railroad Commissioners has sent a circular to every street service railroad in the State recommending that every car operated by the electrical trolley system in this State on a double-track line be equipped with gates on both ends, and that only one gate, that opposite the other track, on the rear platform, be open for the ingress and egress of passengers; also that no person (except an instructor, when necessary) be allowed to ride on the platform with the motorman on an electric car. The board also recommends that on all open cars operated by the electrical trolley system on double tracked lines there shall be attached a guard on the side of the car next to the opposite track, running the entire length of the car, to prevent passengers entering or leaving the car on that side; this guard to be of such a nature that it may be transferred from one side to the other.

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* *British Medical Journal.*

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Electrical Engineering Practice. It is not to be denied that the conservatism which has been characteristic of the introduction of electricity in Europe, and especially in England, has been productive of some good results in the way of engineering practice which the pioneer work on this side of the Atlantic lacks, but American enterprise must be credited with having set the example and furnished the experience which have been the basis of the industry, to which European engineers have added many practical refinements.

The history of the electric light is an illustration of this fact; and judging from the agitation of the electric railway question in England, history promises to repeat itself in this branch of the science.

In the case of incandescent electric lighting, which was only introduced about eleven years ago, the progress of its adoption in this country was without a parallel in any other new industry, and central stations were established in several hundred cities before the subject was seriously considered abroad. The foundation which was laid in this country, however, for the business of electric lighting was of the greatest service to our conservative neighbors, who, profiting by the experience already gained, eventually constructed some of the finest stations in the world from an engineering standpoint. Having decided upon the work with great deliberation, the details of these plants were worked out with the object of producing permanent, solid and efficient systems which may be considered as types of the best practice in electrical engineering.

This class of work is now becoming the rule in most of our large cities, but previously it had been customary to install the cheapest kind of stations possible, with the idea, which was not without reason, that the best system would soon become out of date owing to the improvements which are being constantly made.

This argument is often advanced even at present as an excuse for the construction of cheap stations and lines, but if the case is considered carefully, there is but little reason to warrant such an opinion. The conversion of mechanical into electrical energy is accomplished by most of the standard dynamos with a loss of only about ten per cent., and with large machines under favorable conditions of load it is even less, while the line losses may be fixed at the most economical figure with precision. In the electrical part of the plant the efficiency is very close to the highest possible, while it is in the boilers, engines, shafting, etc., the chief losses occur. For this reason any possible future improvements in the dynamo can only increase the efficiency of the plant by a very small fraction, while on the other hand thorough mechanical engineering can effect a much greater saving in the design and construction of the steam plant. The building of cheap steam plants and lines has invariably proved a shortsighted policy which has been dearly paid for in depreciation and repairs within a short time. There is no question but that in the end a well built plant is the cheapest.

In electric railway work, as with electric lighting, the system was worked out and put in practical operation all over this country before it was attempted abroad. Nearly every town here of any size has its electric railway, while in England the subject has just begun to be agitated now—about five years after the business has been thoroughly established on this side. Having finally awakened to the consideration of electric traction, however, the subject is being investigated with thoroughness, and there is a possibility that eventually foreign work may bear the same relation to ours in this line as it has in electric lighting.

The trolley, the conduit and the storage battery are all being carefully investigated, and in a methodical and businesslike way which is likely to produce substantial results, while the experience gained from the work already done here will figure largely in determining the best methods to pursue.

Americans have certainly taken the lead in the practical applications of electricity, but in many respects we have been surpassed by foreign countries in the nice engineering details which go to make up the most perfect systems. Having devised an operative plan there has been a tendency here to stop at that and leave the perfecting of the details to others. The expense and trouble caused by crude engineering work are being appreciated in many cases, and the tendency is at present towards greater refinements in workmanship and engineering practice.

……o……

Through by Lightning. There have appeared several inconsistencies in the various descriptions of the Chicago-St. Louis electric railway scheme some of which were noted in ELECTRICITY of June 8, 1892, on occasion of the first official announcement of the project in a lecture by Dr. Adams before the New York Electric Club.

Quoting from the report mentioned we find the following:

"He (Dr. Adams) said that at the present time there were 1,200 through passengers carried daily between the two cities. It was estimated that 30 million people would visit the World's Fair. Ten per cent. of these would use the road for curiosity alone. At $5 per round trip this would bring in 15 million dollars. The road would cost to construct but 6 million dollars."

Apropos of this we find the following statement given by Dr. Adams to a St. Louis paper under date of July 7, 1893, just thirteen months after the lecture mentioned:

"There is one mistake that I wish you would correct," he said. "It has been reported time and time again that we expect the road to be completed in time for the World's Fair. Now you won't find a single intimation in our prospectus or any of our advertisements, that we made any such promise, and we never had any idea of it. In our contract with the General Electric Company they guarantee to put in motors which will give a maximum speed of 100 miles an hour. Everything is moving along well, but I decline to say when the road will be completed, as that is still an uncertainty."

With the conclusion of this statement we heartily agree, but a comparison of the two certainly shows a discrepancy in the utterances of a year ago and now which it will be difficult for any one not financially interested in the road to reconcile.

Another point which is apparently in need of official harmonizing is in regard to the contract with the General Electric Company for supplying all the machinery, which was closed only a few weeks ago, and the statement in the railroad's prospectus, printed a year ago, that "the construction of motors has already been commenced."

Has the aspect of this scheme changed so materially that the plans and promises of a year ago have been not only ignored but forgotten?

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Sunday. The decision of the World's Fair management that hereafter the entire Fair shall be closed on Sundays marks the end of what was in the beginning an entirely unnecessary controversy.

It is to be noted that no religious or moral awakening has struck the rulers of the Fair, either in their individual or corporate capacity. They have simply learned that it does not pay in dollars and cents to open the gates on Sunday.

The fact that it would not pay to run an enterprise of this nature in this country on Sunday had already been well demonstrated, but the management seems to have ignored the lessons of past experience. They knew that Sunday theatrical entertainments paid in Chicago, and doubtless thought that out of the hundred thousand visitors in town enough could be added to local patronage to make a success of Sunday opening. But it seems that a stay of a week or two in the city has not proved enough to Chicagoize any great number of visitors.

The most potent factor, of course, in the failure of the experiment has been the action of the exhibitors themselves, hundreds of whom have refused to uncover or show their exhibits on Sunday. And it is worthy of special notice that a large number of the exhibitors who have taken this action, if not indeed a majority, are representatives of Continental Europe, where a great many people would have us believe there is no such day as Sunday as we understand it.

It is one of the strongest arguments in favor of the Christian religion that the lives, habits, and thoughts of all of us, whatever be our professions, are molded and shaped to a considerable extent by the teachings of that religion.

Probably not 50 per cent. of the exhibitors who have refused to open their booths would claim that Sunday opening was a moral wrong; it was simply their habit to make Sunday a day of rest, and they believed it to be a correct habit.

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We note with pleasure that the Detroit Lighting Commission has adopted the suggestion made by Electricity and appointed Mr. F. B. Rae and Prof. H. S. Carhart as consulting engineers, to assist Mr. Alexander Dow in the work of locating and installing the municipal lighting plant. The suggestion was dictated by wisdom and common sense.

No Time To Be Asleep. Electricity has already pointed out the desirability of securing an investigation by a Congressional Committee of the plan of organization and methods of doing business of the Electric Trust. Some of the paragraphs we have printed on this subject have been regarded by the officers of the Trust as *prima facie* evidence of malice.

We are willing to let the charge of malice go undefended for the time being, but we again urge the investigation.

Congress will soon be in session, and though an Investigating Committee might not get to work before late in the fall, there is no time to lose; and every independent manufacturer will use good judgment in presenting the facts in the situation to his Representative in Congress.

Immediate action is all the more imperative because of the plans of the Trust to begin work at once, through the recognized channels for such work, to secure an extension for the Edison lamp patent.

Although the price of Trust shares may point to an early dissolution of the illegitimate enterprise, independent manufacturers should not be caught napping, and we urge the wide circulation of petitions to the various Representatives, asking for immediate attention to this subject.

Blank forms, ready to fill out, will be found on the last page of this issue, and extra blanks will be supplied in any number upon request.

……

Put On a New Driver. Roguery in horse racing is proverbial. In running races it is almost impossible of prevention, chiefly because the condition of the horse is not a demonstrable fact. You cannot tell whether he is fit or not.

But in the trotting races as conducted on the Grand Circuit crooked work has been well nigh eliminated. A dishonest driver may pull his horse for a single heat, but the mere suspicion that he is doing so usually results in a new driver being put on by the judges, who are experienced men and rarely make a mistake.

This rule of trotting horse racing could be well applied just now to the General Electric Company.

The public were led to put a good deal of money on this company in its race against the field, and were largely influenced in so doing by the high standing of the gentlemen who compose the Board of Directors. They are now almost universally convinced that the race is not being properly driven. Some charge crookedness, but a great many believe it is only lack of ability.

The company has declared its regular quarterly dividend of two per cent., and published a statement claiming that it has earned it and a small surplus besides. Still the common stock lingers around 60, and both preferred stock and bonds are away below par.

If the public had any degree of confidence that these statements were correct and honest, not even a stringent money market could prevent a boom in the stock.

The Directors should yield to public opinon, and put on a new driver—a man who has no interest whatever in the stock market, either in keeping it down or putting it up.

If the company can win, the public wants to know it before it sacrifices any more stock at a loss of $55 per share. And nothing can convince the public except a report made up by a committee of stockholders—a report on volume of business done, on the value of assets and the actual liabilities—such a report as the present management has never dared to print.

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The following may be understood as an open letter, and the answer to our inquiry, if any, will be printed in these columns:

To Captain Eugene Griffin,
Vice-President of the General Electric Co.

Dear Sir: Were you not endowed (temporarily, at least,) some months ago with prophetic vision, and did you not dispose of the greater part of your holdings of General Electric stock at about 109?

An early reply would no doubt interest other, and perhaps less perspicacious, stockholders.

Yours, with commendations,
Electricity.

……

Nothing would so quickly restore confidence in Electric Trust stock as an authentic and bona fide statement showing that the volume of business has been more than, or equal to, the combined business of the Edison and Thomson-Houston Companies for the last year previous to the consolidation, and that selling expenses have been reduced. It is our belief that such a statement cannot be honestly made or else it would have been given out long ago.

……

Several months ago a gentleman well known to Electricity invested a little over $50,000 in General Electric at 101. He did so on the advice of the strongest banking house represented on the Board of Directors. The money belonged to an estate of whose funds this gentleman was the guardian, and he is one of the many people who have an acute interest in learning whether the respectable members of this Board knew what they were talking about or whether they also were deceived.

……

Any statements of profits given out by the Electric Trust are absolutely valueless until it is known how those statements were made up. The rule in vogue with the Thomson-Houston Company was to take the difference between shop cost and selling price and call the amount profit, ignoring the cost of doing business. Large profits are possible in any manufacturing business when computed in this manner.

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All visitors to the World's Fair will be welcome at the booth of Electricity, Section Y, Northwest Gallery, Electricity Building.

The Canal Electrical Experiments.

Supt. Hannan has given notice that all experiments with electricity on the canals must be completed before the first of October next. All traction systems must be operated on the berme bank and the experiments will not be permitted to interfere with navigation. That portion of the Erie Canal from the Monroe avenue lock, in Rochester, east to Fairport; and also that portion of the Erie Canal between lock No. 2, at North street, in Albany, and a point three miles north, have been designated for the preliminary tests.

Electrical Congress Programme.

Resumé of Opinions and Suggestions Expressed in Reference to the Report of the Sub-Committee on Provisional Programme and to the Decisions of the Forthcoming Congress at Chicago.

Opinions have been unanimous in favor of leaving unchanged the values of existing practical electrical units as already adopted by past Congresses.

It has been pointed out that the definition of the mean intensity of an alternating current adopted by the Paris Congress of 1889 is incorrect as stated and calls for a slight amendment by way of explanatory addition.

It is generally admitted that an international unit of illumination is in practical demand. The unit proposed in the report, namely, the illumination of a bougie-decimale at the distance of a metre, has been well received, except in Germany, where a sub-standard unit of illumination based upon the Hefner-Alteneck lamp has been favored.

The definition of the concrete standards of the practical units, as recommended in the report, and taken from the Report of the British Board of Trade Committee on Electrical Standards, has met with general satisfaction. In regard to the ohm it has been suggested that the definition shall be regarded as final from a practical point of view, and that whatever slight discrepancy may be discovered in the future between this and the best known approximation to the true ohm shall not affect the practical concrete standard, whose formal specification might be worded and denoted accordingly.

The retention of the terms ampere-hour and kilowatt-hour has been universally favored.

The introduction of a practical unit of conductance has met with favor, and the name mho for this unit has only met with opposition in Germany on the plea of unclassical treatment of a name held in universal respect, the name "thomson" being advocated as a substitute.

The recommendations of the report in reference to the new practical magnetic units has given rise to considerable discussion and difference of opinion. It has long been contended in English technical journals that the practical computations of electro-magnetic machines based upon C. G. S. magnetic units, introduce burdensome coefficients, such as 10^8, with inconvenient frequency, while to fill the needs of a system of nomenclature, names for magnetic units in such computations have been improvised and employed provisionally. The German proposals, have, however, been to retain the C. G. S. units and without names for them. In France the same difficulty of framing a practical system of magnetic units into a thoroughly convenient and harmonious series has elicited a dissension as to whether any or all of the units recommended in the report should be adopted. A Canadian suggestion has been made to adopt the units of flux and flux density as proposed, but to make the ampere-turn the practical unit of M. M. F. and alter the unit of reluctance in the ratio of $\frac{1}{4}\pi$ to correspond. Aside from the difficulty in agreeing upon the values of these magnetic units, the names recommended for them in the report have been generally well received, the term oersted perhaps excepted.

The adoption of the term henry for the unit of self or mutual induction has met with general consent. Difference of opinion has, however, been manifested with regard to the name of the quantity whose unit it denotes, the term inductance having been employed in France to denote product of a self induction by an angular velocity, while in England and in America writers have been divided, some employing it in this sense, and others, perhaps a majority, with the meaning given in the report, of a coefficient of self induction, or mutual induction, simply.

The suggested definition and introduction of the term inductivity has been disfavored, and the definition for "impressed E. M. F." has been generally considered unnecessary.

The definition of the value of Matthiessen's standard of conductivity has met with opposition in France and Germany as being of national rather than international importance.

The definition of the north pole of a magnet has not been opposed, but it has been pointed out that in the definition recommended in the report the word "terrestrial" might replace the word "geographic" with less danger of ambiguity.

The definition of alternating current systems as simple, diphase, triphase, or polyphase, has been favorably considered in all but the wording of the proposal. It has been suggested, however, to consider any non-simple alternating system as a polyphase system.

The use of the term voltage has met with favor in England, but with disfavor in France and Germany.

The terms "transformer" and "dynamotor" in place of "convertor" and "continuous-current-transformer" have not been opposed, except as being somewhat beyond the scope of an International Congress. The more universal use of the term kilowatt in place of the term horse-power has only met with disapprobation in England.

In France and Germany objections were made to some of the terms suggested, on the ground that they were specifically English.

The more universal introduction of the metric system of weights and measures has met with general favor.

Strong recommendations have appeared in favor of an international system of symbols and notation for electric, magnetic and physical quantities generally, with a corresponding revision of the existing system of electrical and physical nomenclature. The system of notation advocated by M. Hospitalier, and generally recommended in the report, has not elicited adverse criticisms except in the case of a few of the symbols suggested.

In conclusion your Committee submits the view that considering the very debatable nature of the subjects forming its report, the variety of opinions formed in different countries and expressed under different interests, the reception of the report has been remarkably favorable, and appears to have attained the desired object, namely a concentration of general opinion toward a consensus in aid of the forthcoming Electrical Congress.

Carl Hering, Chairman.
A. E. Kennelly.

Aerial Navigation Congress.

There will be a conference at Chicago on aerial navigation August 1 to 3. The local committee is composed of engineers and scientists who have made an effort to elicit papers from scientific writers and experimenters throughout the world. The secretary, Prof. A. F. Zahn, of Notre Dame, Ind., has received valuable papers describing the recent experiments of inventors in several countries. Among the contributions are photographs and descriptions of several successful steam flying machines and of the great military balloons of twelve different nations.

Business Troubles.

The Giant Electric Motor Company of Portland, Me., has gone into insolvency.

Jerome Redding & Company, electrical engineers, 48 Hanover street, Boston, have assigned to Ralph W. Foster.

BOOK REVIEWS.

The Law of Incorporated Companies. By Allen R. Foote and Charles E. Everett. Published by Robert Clarke & Company, Cincinnati, O. Three volumes, octavo; 3,000 pp. Price, $15.00.

The discussion of the basic principles of economic legislation in regard to franchise companies, such as gas, electric, telephone, railway, etc., is deduced in this book from the fundamental relations existing between the individual, the municipality and the State, the aim of the authors being to establish a general and clearly defined policy for the regulation and control of industrial corporations which shall protect public rights without unnecessarily checking the growth and privileges of corporations. In addition to this the work also contains a very complete resumé of the laws governing corporations in each of the States, with over 4,000 citations of cases and decisions, each State being represented by a resident attorney. The scope of the book has required an editorial staff of forty-eight writers whose work has extended over three years. A very full analytical index of the entire work is arranged with special reference to the ready comparison of the provisions of law of each State upon any given point, and brief sketches of the attorneys engaged in the preparation of the work are given.

The plan of the book is unique in many respects and the discussion of the economic principles which are involved in the operation of franchised companies supplying public services must be considered original and ingenious even by those who question the authors' conclusions, which are certainly radical enough to provoke the discussion on this subject which the book invites.

In outlining a general policy for the government of the class of corporations mentioned above Mr. Foote commences with natural laws and the physical and moral standards which are universally recognized as the ideals upon which legal enactments are based, and proceeds to define the rights of the individual, municipality, State, etc., and their relations to property and industrial corporations.

The author concludes that as the State is the creator of the corporation it should therefore exercise sovereign power over it, and this control should be entirely out of the hands of the municipality in which the corporation is doing business as control by interested parties must be incapable or unjust.

In regard to franchises for companies supplying public services, it is claimed that to most effectively supply such services under the most economical conditions franchises should be exclusive, perpetual and untaxed, but should contain stipulations as to charges for services, method of keeping accounts, rate of dividends, disposition of surplus or deficit, etc., all to be under State supervision. The issue of stocks and bonds is also to be under State supervision and the amounts issued to be limited to the actual investment, the object being to make such stocks equal to Government bonds as securities. The right of the State to prescribe the apparatus to be used or to specify the best apparatus of its kind known is also advocated.

Municipal plants are condemned as being the most effective barrier to the progress of manufacture and invention, although aside from the actual investment corporations under this plan would practically be run by the State, which would assume the greater part of the duties of the companies' officers as they generally exist to-day.

The plan outlined as ideal seems rather too utopian to be easily put in practice, and if attempted would require an additional State Department of most unwieldy proportions.

Following this general discussion comes the resumé of the laws of each State arranged under the same sub-divisions as in the general discussion, and this part of the work is not only a very complete digest of the law of each State, but furnishes an excellent method of comparison of the laws of the different States on these subjects.

The book therefore constitutes a standard work on the laws of franchise companies, and suggests a useful field of study in the direction of a general policy for their regulation.

It is the intention of the editors to keep the work abreast of the times by issuing annual volumes in which all changes in State constitutions, Legislative enactments, court decisions and municipal policy regarding the class of subjects dealt with will be fully reported in a section or each State, covering the year of issue.

THE ELECTRIC TRANSMISSION OF INTELLIGENCE, AND OTHER ADVANCED PRIMERS OF ELECTRICITY. BY EDWIN J. HOUSTON, A.M. New York: THE W. J. JOHNSTON COMPANY, LIMITED, 41 Park Row. London: WHITTAKER & COMPANY. 1893. 330 pages. 83 illustrations. Price, $1.00.

The third and concluding volume of Prof. Houston's "Advanced Primers of Electricity" is devoted to the telegraph, the telephone, electrolysis, electro-metallurgy, the storage battery, electric welding, electricity in warfare, electrotherapeutics, electric annunciators and alarms and several miscellaneous applications of electricity.

The primers on multiple and cable telegraphy and telephony will be particularly appreciated by those who have had no previous knowledge in electricity, as the author places these subjects in such a light as to make them easily understood by any reader. The quadruplex and other systems of multiple telegraphy, as well as the principles of cable and time telegraphy, need not remain mysteries to the general public.

The other subjects are handled in the admirable and lucid manner that characterizes the writings of Prof. Houston, and his recent election as President of the American Institute of Electrical Engineers shows that his electrical attainments are appreciated by the electrical profession.

The extracts from standard authors at the end of each primer form a feature that has been highly praised in the preceding volumes and has been retained in the present one.

Each primer is, as far as possible, complete in itself, and there is no necessary connection between the several volumes of the series, of which the present one is the third and last.

One Trust a Failure.

How the Archer & Pancoast Company Was Wrecked.

(G. Wilfred Pearce, in American Industries.)

"Have you noticed that Mr. Clement M. Biddle, of Philadelphia, who is a prominent member of the Manufacturers' Club of that city, has made an inglorious failure of the Gas and Electric Fixture Trust which he organized in 1889. The trust included nearly every fixture factory in the United States, and its first act, after completing its organization, was a new price list, which advanced goods 40 per cent., and no dealers were permitted to buy trust goods unless they would swear not to buy of the three firms not members of the trust. The salaries paid to the principal officers, none of whom were practical fixture makers, were extravagantly high. . . .

"The wages of workmen were not advanced in any case, and in many departments of the factories highly paid labor was supplanted by cheap labor taken from the cotton mills of New England. Many small factories were forced to suspend because the trust people threatened to boycott makers of supplies who sold to the small manufacturers. Plumbers who sold goods at less than prices regulated by the trust were black-listed for one year after offending. A number of alleged patents without which the trust said goods could not be made were bought up by the trust, and dealers or makers who did not understand that the patents were worthless were induced to sign the trust agreement for a fixed period.

"For two years all went well, and then many makers of brass goods who had not made fixtures went into that line, simply because at trust prices there was a large profit to be made. When this competition became powerful, the trust lowered prices and bankrupted several firms in its own ranks, and did not hurt the outsiders, who were not weighted down by enormous fixed charges and assessments which trust firms were compelled to pay. A few weeks ago the Archer & Pancoast Manufacturing Company, New York, an old established firm and members of the trust, assigned, and their statement to creditors is a remarkable one, as it shows that its factory has been run full time for years on goods which averaged 25 per cent. profit. It has made no bad debts. Its business has been well managed by men of character and ability, yet it owes $500,000. This whole sum is debts to banks, floated by Mr. Biddle of the Manufacturers' Club in a vain attempt to raise money to crush out rivals in trade and spent in buying out competitors at high prices."

Personal.

Mr. J. H. Rhotehamel, President of the Columbia Lamp Company of St. Louis, who is in New York this week, wishes it to be thoroughly understood that the bond filed by his company furnishes absolute protection to New York purchasers of Columbia lamps.

He Had the "Idee," but the Lesson Was Lost on Him.

It is perhaps natural that people who are unacquainted with "electric propulsion" should feel curiosity as to how the trolley pushes the car, and it is just as natural for a good many persons to find their curiosity about electricity remain unrelieved after the thing is explained to them, as was the case with the elderly person who figures as "an anxious inquirer" in the following dialogue which the Chicago *Tribune* furnishes:

An old man from somewhere beyond the suburbs stood yesterday on a Forty-seventh street corner watching a trolley car moving swiftly eastward with a heavy load of passengers.

"That's one of these 'lectric cars, ain't it?" he said turning to a bored-looking man who was leaning against a telegraph pole.

"Yes."

"I don't see how 'lectricity can make a car full o' people flip along over the ground like that."

"You don't?" exclaimed the other, becoming interested. "Why, it's easy enough to see through when you once understand it."

"I 'xpect so, but I've never heard enough about it to understand it."

"It is all a matter of watts. A watt, don't you see, is a fraction of a horse power, expressed in the technical language of electrical engineering. You know what an ampere is, don't you?"

"A what?"

"An ampere. It is a quantity of electricity that goes through the wire and develops the watt. The electricity comes from the central dynamo through that wire you see running along overhead, runs down through that iron pole and goes to the motor, which is an ingenious but perfectly simple arrangement of wire coils with a revolving frame acted upon by the current which sets it to spinning, and thus puts in motion a small cog-wheel that engages another cog-wheel that communicates the rotary movement to a third cog-wheel fastened to the axle of the car. It is as plain as day when you get the idea."

"Yes, but how"——

"Don't you understand it yet? There's a sort of wire brush that presses against a copper plate connected with the motor, and the wire is wound on the frame I was telling you about, so that when the current enters the motor it can go either way, and part of it goes one way and part the other, so that the pressure is applied in opposite directions and that's what makes the jigger revolve and sets the wheels in motion. The current goes back through an underground wire. See through it now?"

"Y-yes, I think I kind o' get the idee."

The affable stranger strolled down the street and the old man took another look at the overhead wire, gazed earnestly in the direction in which the car had gone, took off his hat and wiped his forehead.

"What I'd like to know," he muttered, "is how in thunder the electricity makes the car go!"

In Canada tests are being made in operating lock gates on the Soulanges Canal by electrical power. If successful there the plan will be generally adopted on the canals.

Mr. Edison says there is more money made out of little discoveries than big ones, and that it is better to keep the secret of an invention than to have it patented.

Current Items.

At Brewsters, N. Y., an apparatus has been set up for disposing of sewage by the aid of electricity. The plant comprises a fifteen horse power engine, a twenty horse power boiler, a dynamo and two vats, one holding 1,000 gallons and the other 3,000 gallons. The frame structure in which the concern is placed covers an area of 23 by 30 feet. An iron cistern outside the building stores the water demanded for the steam boiler and other purposes. The vats in that building are used for the electro-chemical treatment of the sewage. One receptacle serves for the mixing of the chemicals with the deposit, from which a pipe conveys the compound to the other, in which there is a combination of electrodes that agitates the mass and also conducts a current through the solution with the immediate effect of deodorizing, disinfecting and vaporizing the offensive accumulation. The action in the vat is similar to a violently effervescing spring.

The second assistant examiner in the Electrical Division of the Patent Office is a former Connecticut school teacher, Mrs. Sarah J. Noyes. Appointed in 1881 she has witnessed an enormous growth in the science of electricity, and has become so proficient in her duties that it would be difficult to fill her place were she to retire. In the examination of patents she brings to bear a remarkable general and technical knowledge of all the inventions in which electricity is a feature.

The telegraph operators have become such a numerous body in this country that there is at the present time a large surplus of idle help in the business.

Since the electrical cars in Brooklyn have driven the horse cars into retirement and dispersed the horses, the rats that were so luxuriously domiciled in the forage and rationed from the grain stored in the immense stables are seeking new habitations among the dwellings in the neighborhood and the trade in traps has become lively.

One of the most remarkable illustrations of progress in electrical appliances is electrolytic painting. Hitherto, if copper or other metal had to be deposited electrically, a bath of solution was needed. Now all this is changed, and a ship's hull can be plated as easily as a spoon or teapot. Instead of a bath, insoluble salts, ground to a fine powder and mixed with water, are used. This mixture is painted on the metal to be plated by a fine wire brush, to which one pole of a dynamo conductor is attached, the other pole being connected with a plate. Not only pure metal but all sorts of alloys can be used.

Among the proposals for constructing a submarine boat opened recently by the Navy Department at Washington, one of the two that seemed to meet most fully the requirements of the department treated of the invention known as the Baker boat, which uses steam as the propelling power when on the surface and electricity, supplied by storage battery, when submerged. The essential feature of the Baker boat is the propelling apparatus, which also serves to submerge her. This consists of two screw propellers, one on either side, so arranged on a transverse shaft passing through the middle of the boat at the centre of gravity that they can be turned at different angles. When the boat is to be submerged these propellers are turned upward and drive the hull under water, and when the desired depth has been reached the angle is adjusted so as to drive the boat along in a horizontal line. The boat is designed to make a speed of twelve knots an hour above and ten knots under water.

The Pennsylvania Railroad Company intends to increase its facilities of communication by the the addition of a long-distance telephone to its already superior system. The important points on the lines will be brought into close call by the new scheme, and a great saving of time will be the result. The long-distance line is intended for the exclusive use of the high officials of the Pennsylvania Company's system.

Brussels and Antwerp are both to have international exhibitions in 1895, and expect to be connected by electric trains running 110 miles an hour. These cities are twenty-five miles apart.

In a recent interview, Secretary Rankine of the Cataract Construction Company, Niagara Falls, explained the delay in letting the contracts for the machinery as follows: "We are as anxious as anyone to push the work along," said Mr. Rankine, "and we are doing so. The letting of contracts for electrical machinery is not a matter that can be done in a day. It is a big work and an expensive work. In a measure, the building of such large machines is experimental, and it is but natural that the company should want to be absolutely certain that each step it takes is the wisest."

In one branch of the London Post Office last year the absences through sickness diminished two days per employee. This is attributed by the chief engineer, Mr. Preece, to the purer air caused by the substitution of electricity for gas for lighting purposes.

The four countries in the world which possess the smallest telegraphic facilities are Peru, Paraguay, Uruguay and Persia. In Paraguay only 510 miles of wire are in operation, requiring the services of but twenty-eight persons. Peru has thirty-six offices and 1,600 miles of wire.

The Astronomer Royal (W. H. M. Christie) gave evidence before the Parliament Commission of Inquiry at London as to the disturbance caused to the instruments at Greenwich Observatory by the City and South London Railway. He said that the Observatory was about five miles from the railway. Two circuits of wires at right angles to each other and connected with earth plates had been established for recording the electric currents passing through the earth. The plate nearest to the railway was two and a half miles distant. Towards the end of 1890 certain anomalous disturbances were noticed on the recording instrument. They all occurred between 7 A. M. and 11 P. M. on week days and ceased on Sundays. In March, 1891, the disturbances began on Sundays also, but not till 1:30 o'clock. It was ultimately found that the disturbances corresponded with the hours of the passage of trains on the electric railway. They amounted to from one-third to half a volt in difference of potential between the two earth plates of the circuit. The disturbances in the two circuits, one of which was nearly parallel to the railway, were approximately the same. Owing to these disturbances it was no longer possible to trace by the Greenwich instruments the diurnal variations of the earth currents.

Boston Notes.

The subject of electric cars continues to agitate the public mind a good deal in the city of Cambridge. Now that the State Legislature has declined to grant the petition or pass the bill recently introduced by the promoters of a storage battery railway project, the West End Railroad Company is seeking to extend its electric system in the University City. Prejudice, however, is strong out there, and a good deal of work is having to be put in by the city aldermen and other local bodies having in mind the conciliation of all parties in interest. So exclusive are the residents of some of the streets in the vicinity of Harvard University that on no account will they listen to any proposition for the laying of tracks on those particular thoroughfares.

Through the munificence of an eccentric man of wealth, who died many years ago, Tufts College, Mass., is to have a new scientific and manual training school for students of both sexes. The property left for this purpose has appreciated in value, so that it will be possible to erect and equip a very fine building for the above purpose. Some of the ablest and most successful engineers in this country have been educated at Tufts College, Professor Dolbeare, the accomplished and widely known scientist, being a member of the faculty.

The sudden drop in General Electric stock last Tuesday, the same falling from 70 to 58½, with a slight rally, set the financial world in and around Boston by the ears. The report that several hundred men had been laid off at the Lynn factories, coupled with the rumor that the executive offices are to be removed from Boston to New York, evidently caused a scare, which was not unreasonable seeing that there was some truth in both reports.

Work on the electrical equipment of the Lynn and Boston Railroad is being energetically pushed all over the system, the Marblehead section being expected to be in full running order by August 1. The company is introducing an air brake on its cars which gives great satisfaction. Other novelties are also being introduced on all new cars as they are built and put into service. High class concerts under the auspices of the company are given at Nahant Beach every evening which draw large crowds and so furnish good traffic for the road. The Thomson-Houston Electric Band is a great attraction, being composed of first-class musicians, all of whom are employed in the factories of the General Electric Company.

An exciting piece of business is under way at Manchester, N. H. The city council is confronted with a suit in the Supreme Court, instituted by some of the most prominent citizens and heaviest taxpayers in the city. The city council peremptorily broke a three years' contract that it had made with the Manchester Electric Light Company at a special meeting called ostensibly for another purpose, and made a new contract for ten years without giving any other company an opportunity to bid or issuing the customary call for bidders. The electric company, also a local concern, complains that if given a chance to bid it could save the city $100,000, upon which information a strong petition was prepared asking for an injunction to prevent the first named company from executing any part of its new contract. The ablest counsel in the State have been engaged to fight for the citizens, excitement runs high, and a bitter contest is fully expected.

The Boston Light Company and the Edison Illuminating Company are seeking to restrain Mr. A. W. Perry, who owns a private electric lighting plant with which he does commercial lighting, he having leased the plant for that purpose from the first named company, from extending his business. It is contended that Perry's contract forbids his doing any more business than a specified amount, yet he has suspended additional wires for purposes of extension. The Edison Illuminating Company's complaint is that Perry's lease is of no account as the Boston Electric Light Company had no right to farm out or lease part of its franchise. Perry contends that he is being made the victim of a conspiracy and he is to prove it in his defense which he is now preparing. The State Board of Gas and Electric Commissioners has the case in hand.

General News.

What is Going on in the Electrical World.

Baltimore.—The John Street line of the City Suburban road is being changed into an electric line.

Hartford, Conn.—Both branches of the city council have authorized the Horse Railway Company to use the storage battery.

Plainfield, N. J.—Work on the electric road to North Plainfield has been resumed and will be pushed so as to complete the road as soon as possible.

Kansas City, Kan.—The Consolidated Electric Light and Power Company has sued the city for $22,019, the amount due for electric light service from May, 1892, to July, 1893.

Amsterdam, N. Y.—The Amsterdam Street Railway Company has been granted a franchise to build and operate an electric railway along the Mohawk turnpike to Fort Johnson.

Lansingburgh, N. Y.—This village is still groping its way in the meagre light of gas lamps, but the more enterprising citizens are promoting a movement in favor of electric lighting.

Chatham, N. Y.—The electric light plant has been sold at sheriff's sale to satisfy a judgment of $11,732 held by the General Electric Company of New York. The purchaser paid $4,000 for the plant.

Staten Island, N. Y.—The trustees of the village of Edgewater have awarded the contract for lighting the streets to the Electric Power Company of Staten Island at the rate of $17.50 per lamp. This is an increase of $2.50 per light per annum.

Sioux City, Iowa.—A. M. Coffman has sold his controlling interest in the Leeds Electric Railway to Otley Darlington, of Philadelphia, who was elected president of the company on the resignation of Mr. Coffman as soon as the sale was effected.

Frederick, Md.—The managers of the Chesapeake and Ohio Canal propose to abandon the mule and adopt electricity as a motive power on their waterway if the experiments on the Erie Canal result in the discovery of a practical electrical system.

Indianapolis, Ind.—The Chicago and Central Indiana Electric Railway Company has placed an order for 500 miles of steel rails. The road seems to be an assured fact, and will run through Noblesville, Frankfort and Lafayette. The main shop will be at Noblesville.

Atlanta, Ga.—The proposed electric line from Atlanta to Salt Springs will be built as speedly as possible. It will be twenty miles long. The officers are: Henry Camp, of Covington, Ga., president; Thomas Camp, secretary and treasurer, and B. F. Curtis, general manager.

Bar Mills, Me.—Bids for building the roadbed, overhead construction and electrical equipment for the proposed electric railroad from Bar Mills to Bonney Eagle, along the eastern shore of the Saco River, will be called for as soon as the specifications, now in preparation, are finished.

St. Augustine, Fla.—The electric lighting equipment of the Ponce de Leon Hotel has been completed. Over 40,000 feet of wire was used, supplying 1,000 incandescent lights. The Alcazar, the Casino and the Royal Ponciana will also be fitted with the latest improvements in electric lighting.

Montreal, Can.—The municipal council of Coteau St. Louis has passed a by-law granting a franchise for thirty years to the Montreal Street Railway Company. Work will be begun at once and the company expects to have electric cars running to Amherst park, via Carriere road, within thirty days.

Montgomery, Ala.—Judge Arrington has confirmed the sale of the Cloverdale Electric Street Railroad, and the consolidation of the Cloverdale and Terminal lines followed. There will not be any change for the present, but before long the entire Terminal line will be equipped with electricity.

Denver, Col.—All of the cable lines on the Tramway system have been transformed into electric lines. As the cables wore out, the company have been substituting electricity rather than purchase new cable material. They found electricity to be more economical and at the same time to give a better service to their patrons.

Paterson, N. J.—The Paterson and Little Falls Railroad Company and the People's Park Road Company have united under the name of the Paterson and Little Falls Railway Company, with the following officers: F. C. Van Dyk, president; Charles A. Johnson, of Brooklyn, vice-president; James A. Morrisse, treasurer; John J. Scanlan, secretary.

Niagara Falls.—The electric railway line of the Niagara Falls Park and River Railway Company, between Chippewa and Queenston, has been completed. The power house from which this line is operated is the first of its kind run with Niagara power.—The Pittsburg Reduction Company, the only manufacturer of aluminum on a commercial scale in the United States, intends to establish its works at Niagara Falls, and has executed a lease with the Niagara Falls Power Company for 6,500 electrical horse power for the operation of its machinery.

Brooklyn, N. Y.—The State Railroad Commission will give a hearing in the Common Council chamber in Brooklyn on July 25 on the application of the Kings County Electric Railroad Company, the Nassau Electric Railroad Company, the Broadway Railroad Company, the

Coney Island, Fort Hamilton and Brooklyn Railroad Company and the Broadway Ferry and Metropolitan Avenue Railroad Company, all of Brooklyn, for permission to use electricity as a motive power; on the application of the Brooklyn City Railroad Company for permission to use electricity on proposed new routes, and on the application of the Montauk Extension Railroad Company for permission to construct its proposed road.

New York.—The Broadway Railroad Company intended to use its cable conduits to run wires in for a telegraph system, to be used in case of accidents such as occurred recently, but the Empire City Subway Company has obtained a temporary injunction restraining the railway company from using the cable conduits on the ground that the law forbids the use of any conduits but those owned by the subway company. —Several members of the Bridgeport, Conn., boards of aldermen and councilmen have been officially investigating the Waddell-Entz storage battery system now in operation on the Second Avenue Street Railway line in this city, with a view to its use on the Bridgeport lines if the committees were convinced of its superiority over the trolley for city railway service. Their decision is not yet made public.

Philadelphia.—The minority stockholders of the Penn Electric Company have petitioned the Chancellor of New Jersey for the appointment of a receiver to protect their interests. This is the outcome of the recent stockholders' meeting in Camden. The conduits of the company in Philadelphia are used exclusively by the Edison Company, in which the majority of the Penn stockholders are interested. The Edison Company pays only $7,000 annual rental for this exclusive franchise, and the Penn Company barely pays expenses. The minority stockholders claim that if the conduits were open to all competing companies they would receive dividends on their stock.

Chicago. — The Chicago City Council has passed an ordinance granting a franchise to the Jefferson Electric Street Railway Company to construct an electric railway on Lawrence Avenue. The road will connect several of the suburban towns, including Mayfair and Irving Park. The survey is nearly completed and construction work is to begin immediately. It is expected that the road will be in operation before September.—The Great Western Manufacturing Company of Chicago and Duluth gave notice to the stockholders last week that the directors had declared a semi-annual dividend of 4 per cent. The company was recently organized by the combination of several electrical concerns, including the Great Western Electrical Supply Company and the Fare-Bain Electric Company.—The managers of the Lake Street Elevated Railroad, who are about ready to start their trains running through the west division of the city, have decided to equip the Lake street bridge with electrical apparatus and install an electric light and power plant so as to turn the bridge and light the road from the same station.

Lundell Fan Motor Outfit.

The building at the corner of Fifty-fifth street and Seventh avenue is now occupied by Tattersall, and is used as an auction market for horses. Lundell fan motors, depending from the gallery into the ring, are arranged in such a manner that the spectators are unconsciously cooled into a "buying mood."

Taylor, Goodhue & Ames's Catalogue.

The catalogue recently issued by Taylor, Goodhue & Ames, of Chicago, is receiving the well merited attention that it deserves by the public interested in electrical supplies, as is shown by the large demand for it from central station men. The book, although brief in its descriptions, contains a full list of all the supplies necessary around a central station or a contractor's warehouse.

The catalogue contains 212 pages, including an alphabetical and general index of seven pages. The extent of the index affords a ready reference to any article or class of supplies mentioned. The merits of the specialties handled by the firm, such as the Wagner Motors and Dynamos, Century Insulated Wires, Columbia Incandescent Lamps, Burton Electric Heater, etc., are particularly well set forth and will afford interesting and profitable reading to all portions of the electrical fraternity.

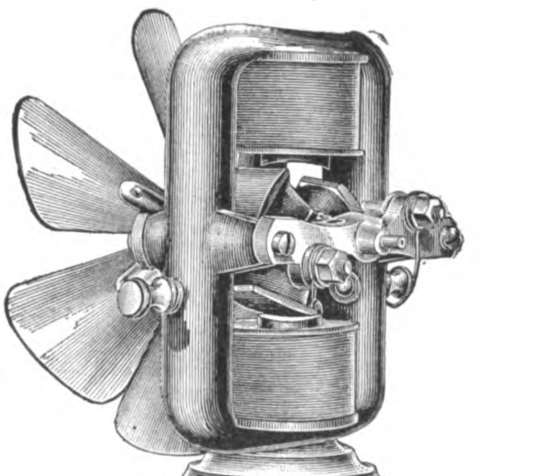
Day's Kerite Insulated Wires and Cables.

The Price List of Day's Kerite Insulated Wires and Cables is a very neat little work and gives a great deal of tabulated information in regard to the Kerite goods and to cognate matters that is calculated to make it serviceable as a guide to every purchaser of such materials and to all who are concerned in telegraph, telephone or signal construction work. The book contains some excellent hints in the prefatory notes, and a number of tables are given showing the different sizes and capacities of wire, with the amount and kind of insulation used, to which the price (f. o. b. at the factory) is affixed in each case. Other tables show the dimensions and resistances of pure copper wires, wire gauges in decimal parts of an inch, weight of copper wire, etc. The illustrations are numerous and exhibit the different kinds of Kerite insulation and the many forms in which it is applied to single wires and to aerial, submarine and underground cables. The Price List can be obtained by application at the office of W. R. Brixley, manufacturer, 203 Broadway, New York.

The Palmer Fan Motor.

The use of fan motors has become so general that these machines are to be classed among the necessities rather than the luxuries, and they are now manufactured at a price which easily puts them within the reach of everyone. The motor shown below is manufactured by Palmer Bros., Mianus, Conn., and is designed to run a 6-inch blade fan or a sewing machine or other small tools requiring from 1-12 to 1-16 H. P. They are wound for 110 volt circuits, or for batteries, thus making them applicable for localities without electric light service.

The fans are readily removed and a grooved pulley substituted when wanted for running machinery. The parts of the motor are also furnished in the rough, or finished and fitted for those who desire themselves to wind them. Directions for doing this are supplied with the parts. The complete motor or the separate parts are sold at a low price, and will be found not only highly conducive to comfort, but instructive to those who undertake the winding and finishing of the parts.



THE PALMER FAN MOTOR.

Catalogue of Railway Apparatus.

The Westinghouse Electric and Manufacturing Company's descriptive catalogue of Railway Apparatus manufactured by the company at Pittsburg is an exceedingly handsome book, with the title on the cover page printed in raised gold bronze letters partly overlapping an attractive engraving showing a Westinghouse trolley car and wiring equipment. The book is splendidly printed in large, clear-cut type on heavy calendered paper, and is embellished with beautiful electrotype illustrations of railway apparatus manufactured by the company, as follows:

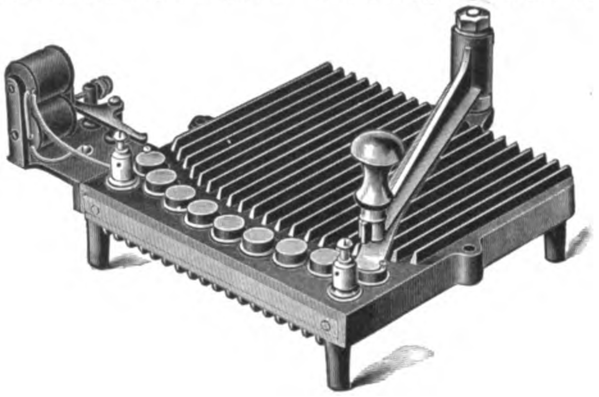
No. 3 Single Reduction Railway Motor.
No. 3 Single Reduction Railway Motor, Open.
No. 3 Single Reduction Railway Motor Castings.
No. 3 Single Reduction Railway Motor Armatures in Construction.
Street Car Diverter.
Series Multiple Controlling Stand, with and without Cover.
100 H. P. Multipolar Belt Driven Railway Generator.
Winding of Multipolar Railway Generator Armature.
Multipolar Railway Generator Armature, Complete.
700 H. P. Multipolar Belt Driven Railway Generator.
Multipolar Railway Generator Direct Connected to Westinghouse Engine.

The descriptions accompanying the illustrations have evidently been prepared by a writer thoroughly conversant with all the details of the apparatus he treats of, and are conveyed in a clear and incisive style that leaves nothing misunderstood. The book should be on the desk of every man interested in electrical railways and their effective and economical equipment.

Climax Ironclad Rheostats.

These rheostats are made on the principle that the carrying capacity of a wire not only depends upon its diameter but also on its ability to dissipate the heat generated by the passage of the current through it. It is obvious that if a wire be encased in an electrical non-conductor which doubles the diameter of the original wire its resistance per foot would not be decreased, but the surface exposed to the air for radiating purposes would be twice as great as that of the wire itself.

In the Climax ironclad rheostats the wire is wholly imbedded in a solid plate of insulating material which is completely encased by and in intimate contact with an iron covering. The heat is readily conducted from the resistance wires (as they are only one-sixteenth of an inch from the iron), and rapidly dissipated by the iron shell, which has a radiating surface many times greater than the wire. The entire shell, top, bottom and sides, being of metal insures the greatest possible radiating surface for the cubic space taken up, and gives a device that will stand rough usage and wear unharmed.



CLIMAX IRONCLAD RHEOSTAT.

The contact points, binding posts and lever are firmly attached to the iron covering and insulated by mica, connections between them and the resistance wires being made within the plate of insulating material while it is in a plastic condition, so that no portion of the wires or connections is exposed to the air. This feature enables the wires to be subjected to high heat if necessary, without danger of oxidation, and as they are completely imbedded in a solid mass, they are not liable to mechanical injury.

Motor speed regulating rheostats, as well as starting boxes for motors made in this type, are very compact; the latter are made with or without an automatic release. This release, illustrated in the accompanying cut, takes very little power, the magnets merely operating a latch, instead of holding the lever directly against the pull of a spring as in ordinary practice. This difference in construction will tell in the efficiency of the motor in the small sizes.

Dimmers for theatre use are also made in this type. The resistance, switch and contact points are all made in one case which is placed in the wings, exactly the same as the old style switch and taking up no more space. One of the principal advantages of the device is the simplicity of installation—the two mains only having to be run to the two binding posts—as contrasted with the old method of placing the switch in the wings and the resistance off in some distant place, running wires from it to each separate contact on the switch, at a cost for installation greater in many cases than the original cost of the rheostat.

These goods, as well as all kinds of special resistance devices, are sold by McDougall & Cummings, Unity Building, Chicago, and the Knapp Electrical Works, Chicago.

The Queen Conductivity Bridge.

Probably one of the most difficult and at the same time important measurements to make is that of conductivity. As usually conducted long lengths of wire or cable are required and extraordinary precautions taken as to temperature, while a number of expensive instruments, perhaps not adjusted to each other, form the testing outfit. Under these conditions accurate results are only obtainable at the hands of skillful operators.

The accompanying figures show in perspective and in diagram a "Conductivity Bridge" designed by Queen & Company, of Philadelphia, by means of which the measurement of minute resistances is greatly simplified and freed from many of the errors to which it is commonly subject

Referring to Fig. 2, R1 and R2 are two approximately equal resistances (not necessarily known); S1 and S2 represent two *groups* of resistances, each group consisting of a fundamental resistance connecting together two copper bars, as b and b′, and six accessory resistances arranged so that any one can be placed in parallel with the fundamental. One end of each accessory resistance is joined to a mercury cup between the two outside bars; a small copper connector, C, joins the mercury cap to the lower bar as shown in the diagram. These fundamental resistances are initially adjusted very accurately, so that the two groups will differ in resistance by the decimal engraved below whatever cup the connector, C, is bridged into. A, A, A, A are heavy copper connectors making connections between the various copper bars as shown. These connectors are carried by a heavy rubber plate as shown in Fig. 1.

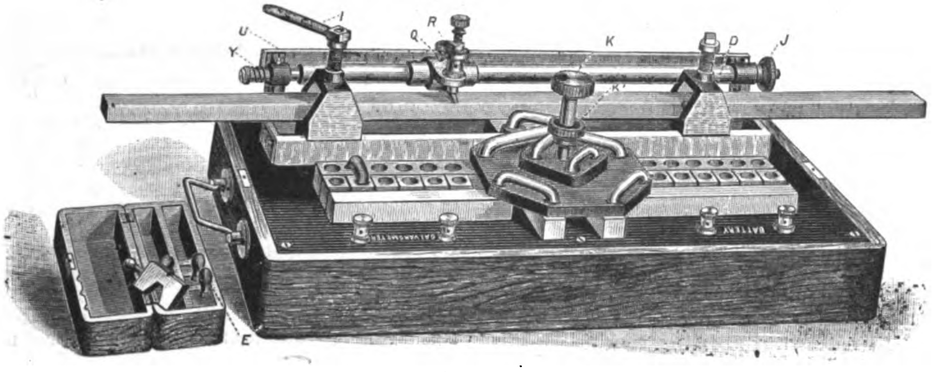


FIG. 1.

In the front of the apparatus is a massive pair of ways, G, upon which slide heavy clamps, D; each of these ways is joined to one of the groups S1 and S2. The connector to be tested, H (Fig. 2), seen as a square bar in Fig. 1, is slipped into the heavy clamps, D, and clamped down by means of the screw nut H and wrench I. A scale, U, 50 cms. long and divided to millimetres, is supported in front of the test piece as shown in Fig. 1. Upon a rod behind this scale moves a slider by which galvanometer contact is made upon the test piece. A fine adjustment of the slider may be obtained by means of the micrometer screw, T. The bernier, V, allows setting to be made to 1-20 mm.

This method of operation is very simple. The test piece being in position, connector C is placed in such a cup as will make S1 and S2 differ by *about* the resistance of the test piece. A few trials will determine this, or the resistance of the test piece as given by any wire table will be close enough. Battery and galvanometer circuits being connected as shown, the slider is moved along until no deflection of the galvanometer is produced, when the circuits are closed. The heavy connectors A, A, A, A are now rotated through 180 degrees: this is accomplished by merely lifting the head, K, of the plate which supports them and turning it through the above angle. The smallest plate carrying connectors L, L will thus be rotated so as to leave L, L in the same relative position. The effect of rotating A, A, A, A will be, as is evident on tracing out the connectors, to exchange S1 and S2, and this obviously will push the position of the slider contact corresponding to zero galvanometer deflection along the test piece until the amount of test piece moved over equals in resistance the difference between S1 and S2. All that must be done, therefore, is to take two balance readings; the length of test piece moves over equals in resistance whatever difference may be originally established between S1 and S2.

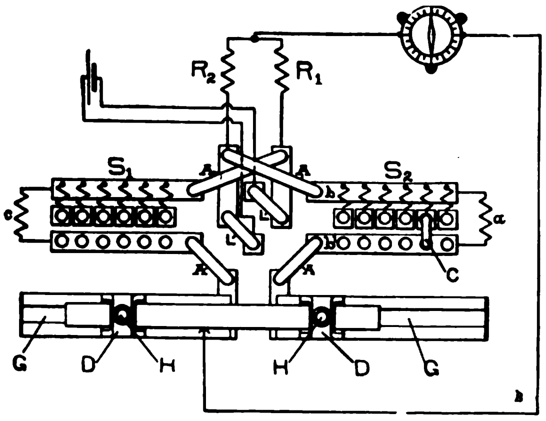


FIG. 2.

All contact errors, where the test piece is clamped in, are eliminated in this apparatus, e. g., any contact resistance in the left hand clamp merely operates to throw *both* balance readings to the right, leaving their difference unchanged.

The entire apparatus being constructed of copper, thermal currents will not usually be of any appreciable moment. They may be eliminated, however, by reversing the battery and taking the mean of two readings as the true slider readings. That is easily accomplished by lifting head K and rotating connectors L, L through 90 degs.

To accommodate conductors of different sizes and shapes, a number of little adjusting blocks, E, are provided; these blocks fit into the clamps, D, and hold the axis of the test piece whether round, square or otherwise shaped in cross section exactly in the axis of the clamp. With this apparatus the conductivity of copper bars up to ¾ inch in diameter, less than 12 inches long, may be measured with an accuracy of 1-50 of one per cent. The resistances R1 and R2, S1 and S2 are standards, permanently a part of the apparatus and guaranteed accurate to 1-100 of one per cent.

This method and apparatus are the result of long continued study and experiment in the laboratory of Queen & Company. The set is handsomely and substantially made, and occupies a rectangular case 22⅝ by 11⅛ by 8⅝ inches deep. Wire manufacturers will see in this apparatus a means of saving much time and expense as well as of raising the standard of their goods. Manufacturers of dynamos, motors, also will find the set extremely valuable in determining whether their armature conductors are up to the proper standard of conductivity. A sample set now in the Queen exhibit at the World's Fair attracts great attention, and has been purchased for installation in the testing department of the Armour Institute, Chicago.

Slate for Electrical Uses.

Mr. Edward Bonville, of Fair Haven, Vt., whose advertisement may be found elsewhere in this paper, carries on a very extensive business in the manufacture of slates for various electrical purposes. He finishes his slates to meet the requirements of all fancies in form, color and finish, such as round turned slates, slates with square edges, rounded edges, bevelled edges, slate bases for jackknife switches, finished in several colors to suit—imitation Tennessee marble, imitation onyx, etc., etc. There is a large demand among electrical men for his switchboards, which he finishes in any desired marbleized colors, or in deep black with highly polished surfaces, and we have reason to believe that Mr. Bonville's materials and workmanship fully deserve the increasing custom that he is enjoying.

COMMERCIAL PARAGRAPHS.

The Ansonia Electric Company were recently awarded the contract for the entire equipment of Stanley Transformers, Helios Arc Lamps for street lighting, Shield Brand Moisture Proof Wire for line wire, and other line supplies by the Hillsdale Common Council. This plant will have a capacity of about 2,000 lights in converters and about 50 arc lamps. The Hillsdale Council decided on using Helios lamps and Stanley transformers after most carefully investigating practically all other systems on the market and the contract was awarded by a unanimous vote.

The Ansonia Electric Company are making large sales in the Wirt Dynamo Brush, one good sized order coming from the National Metal and Electrical Company, Cleveland, Ohio.

The Maquoketa electric light plant, recently equipped with Helios Arc Lamps furnished by the Ansonia Electric Company, is to begin operating its street circuits this week.

The Imperial Music Hall is completely equipped with Lundell Fan Motors. This is another instance of an installation in a place of amusement after a thorough trial of many fan motors, the choice being for the Lundell. The Hotel de Logerot, the New Amsterdam, and many private residences have them.

The Eddy Electric Manufacturing Company of Windsor, Conn., have recently sold to the Whitman & Barnes Manufacturing Company, of Chicago, one 65 K. W. direct connected generator, one of 200 K. W., same type, and motors of various sizes aggregating 389 H. P. The sale was made by Mr. B. M. Barr, of the company's Cleveland office.

The Electrical Engineering Company, E. G. Bruckman Manager, of St. Louis, has been awarded the contract for the installation of the electric light work on the new Union Depot in that city, being one of the largest of its kind in the world, 600 by 700 feet. They have also been awarded the contract for 6,000 incandescent lights on the Union Trust Company's fourteen-story building, now in course of construction.

The Electrical Engineering and Supply Company, which has recently removed from St. Paul to Minneapolis, has already secured a number of nice orders, among them the electrical equipment of the department store of S. E. Olson & Company. This plant will be the largest isolated plant in the Northwest, consisting of Standard arc light machines of 180 lamps capacity and an incandescent plant of 800 light capacity. The contract includes wiring and installing the machines complete. They have also closed a contract for wiring a store and office building for 430 lights, in which Paranite Rubber Covered Wire will be used. Orders are coming in more freely than in June, the business depression having apparently run its course.

A neat pamphlet containing a detailed presentation of the construction, uses and merits of the Kolon Primary Battery has been published by Bryan, Marsh & Company, Electrical Exchange, 1[illegible]6 Liberty street, New York. Numerous cuts are given in the book of the several types of the Kolon Battery manufactured by the company and of electrical apparatus and appliances which they have on sale, among which are Kolon Battery lamps, lamp outfits and accessories, sewing machine outfits, medical outfits, dental outfits, etc. Prices of the articles are given in each instance. A number of testimonials are appended in which the Kolon Battery and Cells are highly extolled.

INCORPORATIONS.

The Excelsior Electric Light Company of Tarrytown—to manufacture and use electricity for light, heat and power. Capital stock, $50,000. Directors: S. Dana Green and George W. Davenport, of New York City, and Frank P. Slade, of Brooklyn.

The York and Wrightsville Electric Railway Company, York, Pa.—to construct and operate an electric railway in York County, Pa. Capital stock, $75,000. Promoters: Grier Hersh, L. A. Marshall, Chas. H. Mayer, York, Pa.

The York and Manchester Electric Railway Company, York, Pa.—to construct and operate an electric railway in York County, Pa. Capital stock, $50,000. Promoters: Chas. H. Meyer, Geo. P. Smyser, Geo. S. Billmyer, York, Pa.

The York and Dover Electric Railway Company, York, Pa.—to construct and operate an electric railway in York County, Pa. Capital stock, $50,000. Promoters: Grier Hersh, L. A. Marshall, Chas. Mayer, York, Pa.

The Electric Burglar Alarm Company, Chicago. Capital stock, $250,000. Incorporators: Jacob Lindheimer, George D. Hoffman, Jacob S. Hoffman.

Charters have been granted at Harrisburg, Pa., to Crystal Lake Street Railway Company, of Carbondale, capital $50,000, and the Alleghany and Kiskiminitas Electric Railway Company, capital $100,000.

The Milwaukee Electric Street Railway Company, Milwaukee, Wis.—to operate a street railway in the city of Milwaukee. Capital stock, $800,000. Promoters: Chas. F. Pfister, Chas. Landree and Chas. Quarles.

The Enosburg Falls Electric Light and Power Company, Enosburg, Vt.—to furnish electric light, heat and power to the inhabitants of Enosburg and vicinity. Capital stock, $10,000. Promoters: Henry F. Holland, Clarence F. Eldridge, Boston, Mass.; H. D. Kendall, Ira H. Kendall, John Fish, Enosburg, Vt.

The Elwell Parker Electric Company of America (incorporated in West Virginia), Cleveland, Ohio—to manufacture, buy, sell, etc., electric dynamos, motors, machines and all material, apparatus, etc., appertaining thereto. Capital stock, $500,000. Promoters: Elbert H. Phillips, Frederick C. Phillips, Alex. E. Brown, all of Cleveland.

The Macomb Electric Company, Macomb, Ill.—to supply light, heat and power from electricity. Capital stock, $30,000. Promoters: J. H. Cummings, H. W. Cummings and Chas. Kettron.

The Chicago and Central Indiana Electric Railway Company, Chicago—to organize, build, equip and operate, buy and sell street and dummy railroads for carrying freight and passengers. Capital stock, $5,700,000. Promoters: George A. W. Kintz, Nevin D. Pontius and George S. Foster.

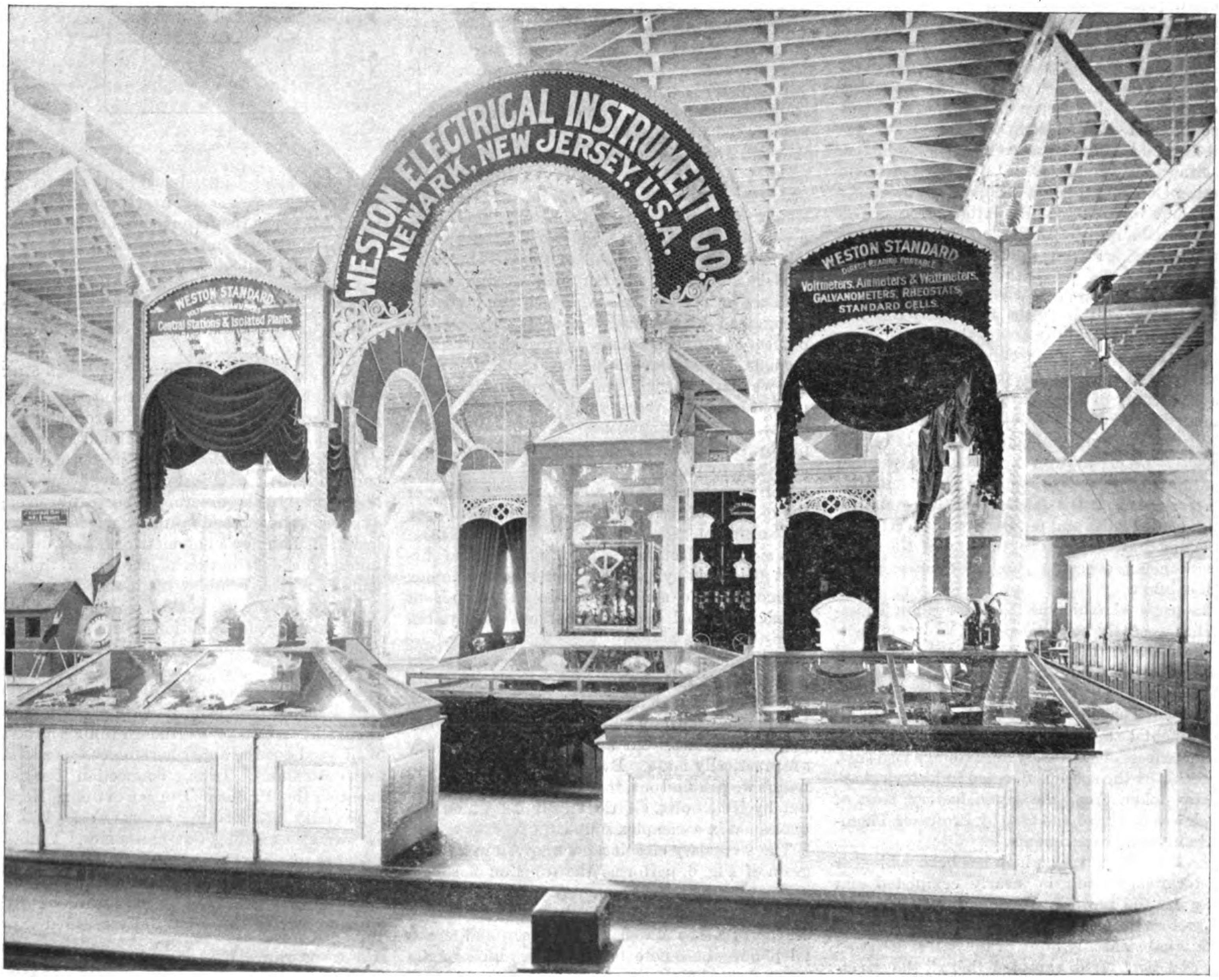
The Hightstown Electric Light and Power Company, Hightstown, N. J.—to erect, maintain and operate an electric plant to supply light and power in the borough of Hightstown. Capital stock, $50,000. Promoters: J. Shields, Flemington, N. J.; N. W. Bindsell, R. H. McCarter, Newark, N. J.

The Military Electric Land Company, of Buffalo, N. Y. Capital stock, $85,000. Directors: Wilson Sherk, Phillip J. Kieffer, George E. Cross and others of Buffalo.

The Chestertown Telephone Company—to operate telephone lines between the towns and villages in Warren, Essex and Hamilton Counties, N. Y. Capital stock, $3,000. Directors: Fred. K. Vetter, Stanley H. Bevins, Charles H. Burge, Max S. Bevins, Jennie Vetter, Florence Burge and Winifred M. Bevins.

ELECTRICITY.

VOL. V. NEW YORK. JULY 26, 1893. CHICAGO. NO. 2


WESTON ELECTRICAL INSTRUMENT CO.
NEWARK, NEW JERSEY, U.S.A.
WESTON STANDARD
Central Stations & Isolated Plants
WESTON STANDARD
DIRECT READING PORTABLE
Voltmeters, Ammeters & Wattmeters,
GALVANOMETERS, RHEOSTATS,
STANDARD CELLS.

WESTON ELECTRICAL INSTRUMENT COMPANY'S WORLD'S FAIR EXHIBIT. (SEE PAGE 14.)

World's Fair News.

The Weston Electrical Instrument Company's Exhibit.

The display of electrical measuring instruments made by the Weston Electrical Instrument Company in the Electricity Building at the World's Fair is shown in our Frontispiece, and is one of the most interesting exhibits to be found in the building. It is located on the gallery floor near the southeast corner, and is very handsomely constructed and decorated.

The instruments are placed in a number of show-cases, arranged in the form of a square, the whole being surmounted by large signs bearing the company's name. To the rear of the show-case the company have fitted up an elegantly furnished office in which friends and visitors are entertained by Messrs. R. O. Heinrich and Fred. O. Runyon.

Over two hundred and fifty instruments of various kinds are shown in the exhibit. Among these may be mentioned the ordinary station voltmeters and ammeters, portable standard voltmeters and ammeters, millivoltmeters and milliammeters. Several types of the same instrument, but standardized for different readings, are shown. Numerous special instruments are on exhibition, among which may be mentioned the portable standard wattmeter, isolated plant voltmeter, static voltmeter, lamp-testing instrument, tangent galvanometer, vertical scale instrument and a ground detector. Nearly all of the instruments exhibited are connected to a circuit, so as to show them in actual operation. Visiting central station men or persons interested in electric lighting in any way will find that an hour spent under the guidance of either Mr. Heinrich or Mr. Runyon in the Weston Company's booth will not only be interesting but valuable. The gentlemen in charge have placed a register in the booth for all visitors desiring catalogues sent to their address.

The committee appointed last week to judge the electrical exhibits in the Electricity Building and Machinery Hall met in their temporary quarters, which is near Chief Barrett's headquarters, and elected Professor H. S. Carhart, of the University of Michigan, as president of the committee. Professor William E. Anderson, of the Virginia Agricultural and Mechanical College, was elected secretary. Very little business other than the routine of organizing the committee was transacted. It is expected that the committee will have the rules and regulations governing its decisions drawn up before the end of the week. It will then proceed to pass upon the merits of each exhibit.

The personal exhibit of Professor Elihu Thomson has recently been completed, and is attracting its share of the crowd which is always found in the Electricity Building. The exhibit is located in a space a little to the east of the central tower of light. The exhibit consists principally of experimental apparatus used in showing the various effects of extremely high voltage currents. A portion of the space is devoted to historical apparatus taken from the Lynn factory, most of which was designed and used by Professor Thomson in his early experiments.

The temporary track which has been laid near the terminal station is nearly completed and ready for the reception of different street cars and motors which are to be exhibited on it. The track is substantially built, of the latest designed rails and ties. It is expected that all the street-car manufacturing companies will have cars on the track for the judges to test. The General Electric Company has signified its intention of placing one of its new electric locomotives on the track.

The Standard Electric Company have a very interesting piece of apparatus in the centre of their exhibit in the Electricity Building. It consists of an arc lamp placed so that the arc is in the focus of a large lens which projects an image of the arc on a canvas stretched across the end of a small room. By this arrangement the movements of the arc can be readily followed.

Practical Aspects of Low Frequency Electrical Resonance.—II.*

BY M. I. PUPIN, PH.D.

5. RESONANCE IN CIRCUITS WITH AN IMPRESSED COMPLEX HARMONIC ELECTROMOTIVE FORCE.

If the impressed E. M. F. is a complex harmonic, then the circuit may be brought into resonance with any of the component harmonics. I have an apparatus here which is capable of producing E. M. F. of almost any complexity. I call it an *electro-dynamic current interrupter*, for want of a better name. It consists of a phosphor-bronze wire, the vibrator, a, b, e (Fig. 6), stretched between the poles of a Weston horseshoe magnet d. A short, thin, amalgamated copper wire b, the dipper, is soldered on the vibrator. The vibrator is stretched like the wire of a monochord, over two hard rubber bridges a e, and its tension can be varied by a screw and lever f. The dipper c whenever it dips into the mercury cup closes an electrical circuit $F f e b c g A$, and the vibrator is then repelled upward by the force of repulsion between the magnet and the current flowing through the vibrator. One gravity cell f is sufficient to work this apparatus. It is evident that the fundamental period of the interrupted current will be equal to the period of the vibrator. To change this period, say to make it equal to the period of this tuning fork, which is 256 complete vibrations per second, I simply strike the tuning fork, hold it then near my ear and by turning the screw f of the stretching lever I vary the tension of the vibrator until the rate of the vibrator and that of the tuning fork are in perfect unison, which can be easily recognized by watching the beats. This whole process of tuning takes up, as you see, only a few seconds. In series with the cell F and the vibrator we have a small coil A, containing a well packed bundle of very thin iron wire, and in shunt with A is a condenser D. This condenser performs the function of bringing this primary circuit into partial resonance with the vibrator, which is recognized by the circumstance that at the moment of resonance the spark at the dipper is a minimum.

A simple reflection will show you that the current generated by this interrupter is a complex harmonic. To analyze it into its component harmonics I shall adopt the methods employed in acoustics.

A complex sound is analyzed by the well-known resonators of Helmholtz. These resonators are constructed in such a way that they will respond to one vibration only, and also in a measure to its upper harmonics. To any other vibration they are practically mute. By a number of such resonators we can find out, in the manner first pointed out by Helmholtz, all the vibrations which are contained in a complex sound.

The secondary circuit B C T E, given in the diagram of Fig. 6, performs the function of such a resonator—it is in fact *an adjustable electrical resonator;* C is a small auxiliary coil which you see here; E is a Marshall condenser, and T is a telephone whose note tells me to which of the component harmonics the electrical resonator responds. The telephone is silent now, at any rate as far as you can tell, because the condenser plugs are all out. Now, with this plug I insert a small capacity. The note which you hear is evidently much higher than even the octave of the vibrator. The electrical flow in the resonating circuit is approximately the same as if we had in it a simple harmonic E. M. F. of the same frequency as this note. I insert another plug, so as to increase the capacity. The note which you now hear is deeper. The difference between the two notes is rendered very striking by making and breaking the contact of the second plug in rapid successions, as I do now. The sound of the two notes, succeeding each other at regular intervals, resembles very much the sound of bagpipes. I insert another plug, so as to increase the capacity still more. The note which you now hear is still deeper. It is the note of the fundamental electrical vibration, which is the same as the vibration of the vibrator. I know that, because as I continue inserting more and more plugs you do not perceive any further change in the sound. The capacities which I introduced by the three plugs are to each other very nearly in the ratio of 1 : 9 : 25, hence the frequencies of the three harmonics contained in the impressed E. M. F., and which I have detected by the resonating secondary circuit, are to each other in the ratio of 1 : 3 : 5.

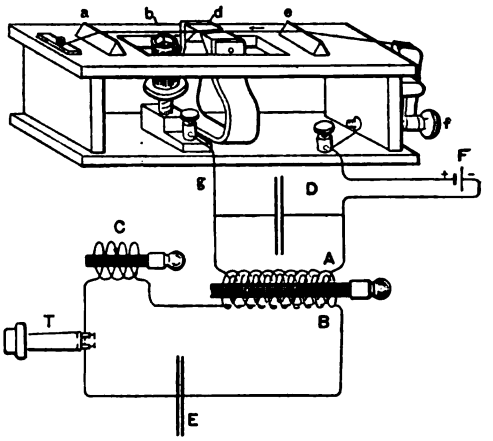


FIG. 6.

The impressed E. M. F. can therefore be written

$$E = E_1 \sin pt + E_3 \sin 3\,pt + E_5 \sin 5\,pt.$$

Still higher harmonics are present, but they are too weak to be heard all over this room.

I shall presently discuss a method by means of which we not only detect the presence of these harmonics, as I have just done by means of this telephone, but also determine the relative strength of each. The method imitates in a certain measure Prof. Langley's bolometric method of determining the distribution of energy in the spectrum of a given complex luminous vibration.

Before making the next step in my discourse I wish to call your attention to an application of resonant circuits (in connection with the electro-dynamic interrupter) to a method of producing simple harmonic currents of constant and easily determinable frequency.* I simply tune the vibrator by means of a standard tuning fork, and then weed out the upper harmonics by successive transformations. In this connection I ought to mention that Professor Duncan of Johns Hopkins University informed me several weeks ago that he was also weeding out harmonics. I now remember that I got the expression "weeding out" from him, but I have used it in my papers on "Low Frequency Resonance" without giving him credit for this beautifully selected expression.

6. ON THE RESONANT RISE OF POTENTIAL.

The question arises now, how are we to tell experimentally whether a circuit is in resonance to an impressed E. M. F. or not? Several methods suggested themselves to my mind in the course of my work. I selected the one which appeared to me to be the most sensitive and most interesting. *It also suggests a new way of transforming electrical energy which some day may perhaps be of some practical importance.* I wish to discuss this method now, but only very briefly.

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* A lecture delivered at the Tenth General Meeting of the American Institute of Electrical Engineers, Columbia College, New York.

* Pupin, "Electrical Oscillations of Low Frequency and their Resonance."—*American Journal of Science*, April, 1893.

As I observed before in the discussion of the motion of the torsional pendulum, represented in Fig. 5, when the moving force and the pendulum are in resonance then both the amplitude of oscillation and the amplitude of the velocity reach their maximum value. And so it is also with a circuit possessing self-induction and capacity. By varying gradually the one or the other, the current (which corresponds to the velocity of the pendulum) will continually increase. But the difference of potential in the condenser (which corresponds to the elastic reaction of the suspension wire) will also increase continually. When the point of resonance has been reached then evidently both the current and the difference of potential in the condenser have reached their maximum values. This maximum difference of potential in the condenser can be many times greater than the impressed E. M. F., because just as in the case of the torsional pendulum the elastic reaction of the suspension wire is an accumulative effect of the moving force, so in the electrical circuit the potential difference in the condenser is an accumulative effect of the impressed E. M. F. Now, since a resonant electrical flow, which we have just considered, consists simply of a transformation of electrokinetic into into electrostatic energy, and *vice versa*, during each half period, accompanied by a frictional loss due to ohmic resistance, it is evident that the amplitudes of these two kinds of energies must be equal to each other, that is, we shall have in the usual notation

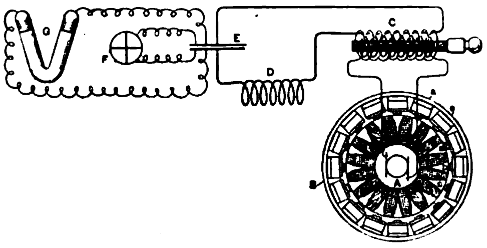

FIG. 7.

$$\tfrac{1}{2} P^2 C = \tfrac{1}{2} L \frac{E^2}{R^2}.$$

But since owing to resonance we have $p^2 L C = 1$, the preceding relation reduces to

$$P^2 = p^2 L^2 \frac{E^2}{R^2} \text{ or } P = p L \frac{E}{R}.^*$$

It is evident, therefore, that with a little more than ordinary frequency, say 350 periods per second, and an inertia coil of considerable self-induction and small resistance, high potentials can be obtained in the condenser by bringing the circuit in resonance with the impressed E. M. F. *Connecting, therefore, the condenser to a voltmeter we can tell very accurately when in the course of our tuning of the circuit we have reached the point of resonance, because, as I shall presently show you, the voltage goes up very rapidly when the condenser capacity or the self-induction are near the point of resonance. It is this electrometric method which I have employed in my investigations on ' Low Frequency Resonance."* †

The same method can be and has been employed by several investigators in the study of Herzian oscillations.

To show you how strong this resonant rise of potential can be I have within the last few days wound these two inertia coils (see coil *a′ b′* in Fig. 8) and borrowed this most excellent mica condenser from our well-known electrician, Mr. Wm. Marshall, for which kindness I feel very grateful to him. The impressed E. M. F. is obtained in the following way: A small 16-pole alternator running at about 2,800 revolutions per minute and generating an E. M. F. of about 600 volts feeds the primary of this small transformer (*c d*, Fig. 8). Diagram Fig. 7 gives the form of armature A and field B of the machine. Coils *a b c d e* show how the machine is wound. The transformer consists of a hard rubber spool wound with about 3,000 turns (Fig. 8) of No. 20 A. W. G. wire for the primary. The secondary *h k* consists of about 500 turns of No. 16 wire. A well packed bundle *e* of very fine iron wire is the iron core. This transformer is indicated by C in Fig. 7. In series with the secondary we have inertia coils D and the above mentioned mica condenser E of 0.2 M. F. capacity. The inertia coils consist of hard rubber spools like *a′ b′*, Fig. 8, wound with No. 14 wire. The total self-induction of the secondary circuit is about one henry, *without iron in the inertia coils*. The poles of the condenser E are connected to a Sir William Thomson electrostatic voltmeter F and also to a vacuum tube G with condenser electrodes, that is to say, tinfoil coatings on the outside of the tube. (Indicated by the shaded parts in the diagram.) I now start the machine and by weakening the field of the driving motor I gradually increase the speed of the machine. As you see, the voltmeter needle is steadily advancing with the speed. To get the greatest deflection of the needle I ought to have about 350 periods per second. Now I shall advance to very near this speed. The voltmeter indicates now 2,000 volts. The impressed E. M. F. in this secondary resonating circuit is only about 100 volts. Instead of increasing the speed so as to reach the point of perfect resonance I prefer to leave the speed constant, and by gradually inserting these five iron wires to increase the coefficient of self-induction until that value is reached which with the given speed and capacity brings the circuit in resonance with the impressed E. M. F. I am doing this now and watching the voltmeter needle at the same time. Now the voltmeter indicates 3,000 volts, which is 30 times the value of the original E. M. F. This is the point of resonance, because if I push the iron wire lower the needle goes back. The point of resonance is very sharply defined, because the slightest motion of the iron wire one way or the other makes quite considerable difference in the reading of the voltmeter. The point of resonance can be shown to a large audience like this much more easily by connecting the poles of the condenser to the tinfoil electrodes of the vacuum tube G. A discharge starts in this tube at about 2,000 volts. Now, as I insert these iron wires into the inertia coil you see the intensity of the discharge increases. [The room was darkened.] The point of maximum resonance is clearly marked by the intensity of the discharge, as you see. Now I insert the iron wire too far; as you see, the discharge is stopped. I can start it again by raising the iron and stop it again by taking the iron wire entirely out, as you see.

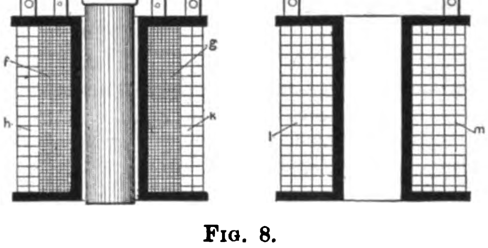

FIG. 8.

By working with high frequencies and small ohmic resistance any voltage within practical limits can be obtained. Ohmic resistance, however, is not the only thing which limits the resonant rise of potential. *Dielectric hysteresis* and the *peculiar behavior of iron under the inductive action of a rapidly alternating current* modify that rise very much. The other day I employed this home-made condenser in parallel with that Marshall mica condenser. I obtained only 2,000 volts rise, whereas preliminary calculation led me to expect at least 4,000 volts. *But the smell of melting wax reminded me forcibly of the cause of this discrepancy. The home-made condenser got so hot in about two minutes that all the wax* (which when boiling hot was compressed between its mica plates to drive out the air and moisture) *between its plates was melted.* The energy which was thus used up in overcoming the dielectric hysteresis of the wax had prevented the resonant rise from reaching that value which it ought to have reached according to calculation. Taking this condenser out and using the mica condenser alone the rise went right up to a point considerably above 3,000 volts. Paraffin and glass behave in a similar way. *So that owing to dielectric hysteresis alone the resonant current* (which takes place when capacity and self-induction neutralize each other) *is never equal to the electromotive force divided by the ohmic resistance, and it can be very much less. The presence of iron is incomparably more powerful in destroying the resonant rise of current and potential, as will be seen presently. This is very unfortunate in view of the brilliant expectations which not a few electricians hoped to realize from the employment of condensers in the running of alternating current machinery.*

It is well to observe here that if we substitute a Weston voltmeter for the Thomson electrostatic voltmeter F, Fig. 7, then we shall have practically the condenser in parallel with the inertia coils. It is easy to see from purely theoretical considerations that the resonant rise will be less in this case. Experiments show that the rise can be then very much less if the resistance of the voltmeter circuit is reduced. *The bearing of this observation on the so-called Ferranti effect with and without a load in the mains needs, I venture to suggest, no further discussion.*

(*To be continued.*)

Compressed Air and Electricity.

The economy of electricity over compressed air for long distance transmission of power has been pretty thoroughly established, but Mr. Cox, director of the electro-technical department of the Esslinger-Cannstatt Works, has given some figures which still further point to the conclusion. In a paper before the Association of Engineers of Würtenburg, Mr. Cox gives some interesting figures in regard to the cost of equipment and operation of a plant of 217 H. P. for transmission of power to a distance of 5.500 km. both by compressed air and by electricity.

The cost of the equipment of the former method includes the dam for the water fall, the turbines, the compressors, the piping and the air motors, and for the electric plant and generators, underground wiring and the motors. The cost for compressed air amounts to $87,500 and for electricity $27,500, while with the former the guaranteed efficiency is 46 per cent., and in the latter case 69 per cent. including a loss of 15 per cent. in the wiring. The cost of operation is practically the same for both systems, but only 100 H. P. is actually available with the compressed air while 150 is delivered by the electric system. This makes the cost per horse power delivered in the one case $37.50 and in the other case $18.85, and as the charges for depreciation are somewhat less for electricity than compressed air this still further favors its economy.

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[*] This relation was first obtained, I believe, by Prof. Oliver Lodge. (See a letter by Prof. O. Lodge, London *Electrician*, April 24, 1891.)

[†] *American Journal of Science*, April, May and June, 1893.

Judge Seaman's Decision.

He Grants the Injunction Against the Oconto Company.

In the U. S. Circuit Court at Milwaukee, on Thursday, July 20, Judge Seaman handed down his decision for the plaintiffs in the case of the Edison Electric Light Company et al. vs. The Electric Manufacturing Company et al. Following is the full text of the decision :

This is a motion for a preliminary injunction. The complaint alleges infringement by defendants, manufacturers of electric lamps at Oconto, Wis., of the second claim of Letters Patent No. 222,398, issued to Thomas A. Edison, January 27th, 1880, and adjudged valid after protracted contests in the Circuit Court for the Southern District of New York, affirmed by the Circuit Court of the Second Circuit. The defendants have answered, the original answer admitting infringement of said second claim as construed in said decisions, but by an amended answer (allowed at the hearing) take issue upon such infringement, avowedly upon their proposed new showing as to the prior state of the art through the alleged Goebel invention, and the narrower construction which should thereby be placed upon said second claim ; and further setting up prior invention by one Henry Goebel, not litigated in the New York case. For and against the motion, voluminous records, affidavits and depositions, with sundry exhibits, are presented, to which reference will be made.

It is shown that litigation in behalf of this patent has been actively carried on since May, 1885, both directly and collaterally ; that after obtaining favorable decisions in other cases wherein issues under this patent were involved, and defending successfully against the Sawyer & Man patent (40 Fed. Rep., 21), judgment was obtained in July, 1891, in its action in the Southern District of New York against the United States Electric Lighting Company sustaining the second claim of this patent, and decreeing injunction (47 Fed. Rep., 454), which was affirmed by the Circuit Court of Appeals for the Second Circuit in October, 1892 (52 Fed. Rep., 300). The defendants in that case having turned over to the Sawyer & Man Electric Company the business of manufacturing, suit was brought against the latter. and injunction granted, and affirmed by the same Circuit Court of Appeals in December, 1892 (53 Fed. Rep., 592).

It further appears that injunctions have been granted against other infringers in this circuit and in other circuits without serious contest, and that in the District of Massachusetts, in complainants' suit against the Beacon Vacuum Pump and Electrical Company, the motion for preliminary injunction was vigorously contested, upon the grounds presented here, and in an exhaustive opinion handed down by Judge Colt, January 18, 1893, the injunction was ordered (54 Fed. Rep., 678). On the other hand, in a suit by complainants against the Columbia Incandescent Lamp Company, in the Eastern District of Missouri, upon similar motion and additional affidavits, an opinion was rendered April 21st, 1893, by Judge Hallett, refusing the injunction if the defendants should give a bond.

All of the records and affidavits before the courts respectively in the Beacon case and in the Columbia case are here, and much additional testimony—that upon the part of the defendants, taken since such hearing, in rebuttal, under an order of this court, being in the form of depositions and with cross-examination of witnesses.

Therefore this court has the benefit of the opinions handed down at those hearings, and the embarrassment as well of deciding here between apparent differences in views as to the measure of proof demanded.

In the opinion in the Beacon case, the rule applicable to this defense against the motion is stated, citing a number of authorities, as follows: "The burden is on the defendant to establish this, and every reasonable doubt must be resolved against him;" also, that "the presumption of novelty is not to be overcome except upon clear and convincing proof." The showing there made is reviewed at length and found insufficient to meet the requirements of the rule.

The opinion in the Columbia case is not yet reported, but in a copy furnished for this hearing the views which control the decision are stated as follows : "There is not the measure of proof demanded by complainants' counsel, who maintain that the court should require proof of the fact beyond reasonable doubt. This degree of certainty is not often attained upon testimony in the form of affidavit when the issue is contested, and it is not reasonable to demand such certainty as to the defense. Complainants must show a clear right in support of a preliminary writ, and a defense which puts the case in doubt is sufficient to defeat the application," and for its conclusion against the injunction, hold : "It is enough to say that there is a fair preponderance of testimony in support of the Goebel claim."

Decisions of the Supreme Court have settled beyond controversy that for the defense of anticipation and prior use against a patent the proofs must be "clear, satisfactory and beyond a reasonable doubt." The Barbed Wire Patent, 143 U.S., 276, 284; Cantrell vs. Wallick, 117 U. S., 689; Coffin vs. Ogden, 18 Wall., 120. And that has been the constant rule in this circuit. Smith vs. Davis, 34 Fed. Rep., 783; Washburn & Moen Mfg. Co. vs. Haish, 4 Fed. Rep., 900, 10 Biss., 65; American Bell Telephone Co. vs. Cushman Telephone Co., 35 Fed. Rep., 739.

The decisions and text books agree upon the general rule stated in the opinion of Judge Colt (p. 679) that an adjudication of the validity of his patent after bona fide contest entitles the complainant to a preliminary injunction and especially after long and expensive litigation in a suit against other infringers, and that the only question open upon his motion therefore is that of actual infringement by the defendant of the claim so adjudged valid. Other defenses are then reserved to final hearing, and injunction issues as of course in the same court and by comity in other courts. One exception to this rule is sometimes allowed, and that is where there is clear showing of a meritorous defense which was not before the court in the original suit, and which, had it entered into consideration, would probably have defeated the patent or claim. It is under this exception that the defendants assert their right to oppose this motion, and their affidavits are directed to proving an invention and use by Henry Goebel prior to that of Edison. Although sundry other claims of priority have been set aside by the court in the course of the litigation, this one was not presented, and the defendants have a right to their day in court for its hearing. The question here is whether there is such clear showing of merit for this claim now asserted that the defendants should be relieved from the general rule by denying in their case the usual injunctional order; and the primary inquiry is, what must be the measure of proof demanded. Must it be of the quality and quantity required to defeat the patent at final hearing—"clear, convincing and beyond reasonable doubt"—as held by Judge Colt; or will it suffice, for denial of the motion, that it show "a defense which puts the case in doubt," as held by Judge Hallett. It is clear that the presumption must be in favor of the patent, and that it cannot be overthrown by a mere doubt. I think the true test for proof upon the motion is that it shall be sufficient to raise a presumption that it would have defeated the patent had it been produced at the trial. This would demand at least the full measure required to overcome the presumptive force of the patent, and that every reasonable doubt be dissolved against the defense, here as it would be there as held by Judge Colt. In the eyes of the law, at this stage, the complainants stand upon their rights with their letters patent, confirmed after arduous contest, and entitled to preliminary injunctions against infringers; and the defendants must place themselves entirely within the exception to the rule if they invoke the privileges of that exception and would deprive the complainants of the fruits of their hard-earned victories. The rule held by Judge Colt will therefore be adopted here, and the following additional authorities are cited as supporting it : McBeth vs. Braddock Glass Co., 54 Fed. Rep., 173; Accumulator Co. vs. Consolidated Co., 58 Fed. Rep., 795; American Bell Tel. Co. vs. Southern Tel. Co., 34 Fed. Rep., 795; Siebert Cylinder Co. vs. Michigan Co., 34 Fed Rep., 33; Ladd vs. Cameron, 25 Fed. Rep., 37; Hussey vs. Whitley, 2 Fish., P. C., 120; Jones vs. Merrill, 8 O. G., 401; Potter vs. Fuller, 2 Fish., P. C., 262.

I have examined with care each of the authorities cited in the opinion of Judge Hallett, and others noted by defendants' counsel, but they do not impress me as supporting the rule held in that opinion, or as opposed to the rule pronounced in the cases above cited.

With the adoption of this rule, it is not necessary to review in this opinion the affidavits and exhibits which were before the court in Massachusetts, in the Beacon case, as a careful examination has fully satisfied me with the review and criticisms contained in the opinion of Judge Colt, and the conclusions reached by him at that stage. And of the additional evidence introduced at St. Louis, in the Columbia case, it might be sufficient to hold, in accordance with the view stated in the opinion of Judge Hallett, with which I agree, that "there is not the measure of proof demanded" by this rule. Resting upon these conclusions, it would only be necessary to consider the new testimony which has been presented here, and determine whether it has cleared the doubts which have come from the former hearings; but an understanding of the conclusions reached requires for preface a statement of some of the doubts which have been impressed upon my mind by these records.

Edison's discovery was published late in 1879. It promised an incandescent electric lamp which would supply the great want of an operative commercial light suitable for domestic uses, cheap and practical, and aroused great interest and excitement in commercial and scientific circles. Lighting by electricity had long been an accomplished fact, in arc lamps and various single burners, but the problem which had remained unsolved was a method of subdivision of the light, for which scientists in Europe and America were seeking, and which many of them pronounced impossible—an ignis fatuus. It was the solution of this problem that Edison thus announced. As stated by Mr. Justice Bradley in the McKeesport case, 40 Fed. Rep., pp. 29-31, "This was the real, the grand discovery in the art of electric lighting, without which it could not have become a practical art for the purpose of general use in houses and cities. . . We think we are not mistaken in saying that but for this discovery electric lighting would never have become a fact."

The invention claimed by Edison was a lamp which is "the embryo of the best lamps now in commercial use." The second claim of his patent here involved described it as follows: "The combination of carbon filaments with a receiver made entirely of glass and conductors passing through the glass, and from which receiver the air is exhausted, for the purpose set forth."

The thread or filament of carbon for a burner was the fundamental discovery to obtain this subdivision of electric light, for by its use he obtained the high resistance which was essential to the multiple arc system and saved from the use of enormous conductors of the electric current, the cost of which were otherwise prohibitive of subdivision. He found that for stability of this thin carbon it was necessary to have a high vacuum and remove all gases to prevent what he calls "air-washing." This led to the entire glass receiver or chamber for the lamp, and finally to platinum leading-in wires sealed into the glass, because "the coefficient of expansion of glass and platinum was the same" and the high vacuum would be retained, while iron or copper wires would destroy it. This discovery was therefore in successive steps and only as essentials for the great object of subdivision of light.

Each of these steps is claimed to have been discovered or taken by Henry Goebel many years before Edison. Against all the improbabilities of this claim, the story as related by Goebel in his several affidavits, with detailed confirmations by many witnesses, is interesting, circumstantial, and in many respects plausible, and I do not wonder that it has attracted such earnest advocacy by able counsel contesting this patent.

Henry Goebel is now seventy-five years of age, a German, came to this country in 1848, and has ever since resided in the city of New York. He appears to have been an excellent and ingenious mechanic, engaged in watchmaking, manufacturing barometers and thermometers and delicate instruments, and has shown much interest and aptitude in electrical appliances and experiments. He claims to have made incandescent electrical lamps, identical with the Edison claim in all particulars, from about 1854, and that these lamps were operated by primary batteries of his own construction, and used at his store for show and lighting in various ways, and for some time had such lamps on a wagon traveling about the streets of New York with a telescope, also of his own construction. He said he made many of these lamps each year prior to Edison's patent, and all for his own use or gratification, but not so many after 1872 as before. In 1880, and later, he was engaged in making electric lamps for the American Electric Light Company, a rival of Edison's and making similar lamps. This meagre statement cannot fairly present his story, but must suffice with mention that he was before leaving Germany very intimate with Prof. Moenighausen, who had experimented with the production of arc and incandescent electric lights, and gave him the ideas which he carried out here. Goebel does not claim that he ever worked or thought in the line of subdivision of electric lights, and the history of that art presents strong grounds for doubt.

As to the improbabilities of this discovery so long undiscovered, it is sufficient to refer to the comments in the opinions in the Telephone cases, 126 U. S.,556 ; in American Company vs. American Cushman Company, 35 Fed. Rep., 735 ; and American Company vs. People's Company, 22 Fed. Rep., 309, as well applicable here. I will refer to some of the doubts raised upon the defendants' showing as to the actual components of these alleged Goebel lamps, remarking that the testimony of the numerous witnesses, however honest, speaking of such delicate structures seen by them many years ago cannot justly be accepted as absolute verity :

1. The fundamental thread-like carbon burner of Edison only became necessary as a means to subdivision of electric light, which was not contemplated by Goebel. The latter operated with a primary battery, for which the larger "pencil" form of carbon or other material would answer as well, would be more stable and more easily made. This filament is most delicate and difficult to make, and must have a high vacuum or it will be instantly consumed. It seems unnecessary and undesirable for his purpose, and no satisfactory reason is given for its adoption by him.

2. The Goebel lamps are not shown to have had the high vacuum required for anticipation His principal statement must be taken that he exhausted his lamps by the Torricellian method in the years prior to 1879, and I think it is abundantly shown, although not without some contradiction, that such a method could not produce the vacuum necessary to prevent disintegration of the carbon ; and it seems doubtful whether it could be employed at all with this delicate carbon in the receiver. If that vacuum was wanting, the claim fails.

3. No motive is shown for such constant manufacture of these lamps throughout the years from 1854 to 1880, involving so much of time and expense, and especially of great expense in maintaining the batteries for their use, and no attempt to dispose of even one, or to utilize them for domestic purposes, excepting in a few stray instances. It seems improbable that the constant practice here asserted, and so useful for the purposes of this defense, would have been kept up without clear object.

4. Why did he not apply for a patent ? He was not ignorant of the patent laws, for in 1865 he is shown to have applied for a patent on a sewing machine hemmer, and in 1881 he is found applying for some minor improvements, one of them being a coil shown in his exhibit lamps.

5. The lamps which Goebel produced at Boston as original lamps, made in the early years, were four, called Exhibits 1, 2, 3 and 4. The first three only were produced at the hearing, with his original affidavit, the fourth being in the hands of counsel for defendants, but withheld because of doubt as to its authenticity—which doubts were afterwards cleared to their satisfaction, and this lamp then introduced by leave of court, with additional and explanatory proofs. The first three had copper and iron leading-in wires, were of what Goebel calls "meat saw" pattern, and show no vacuum now, and if fairly proved would not constitute anticipation of Edison. No. 4, called the "hair-pin" pattern, has the requisities, including a vacuum, although probably not the high vacuum. It is not now operative by reason of some defect. Goebel swears that it was operated, but experts who have examined the defect swear that it has existed from its manufacture, and it could not have operated. This lamp shows the highest excellence of the glassblower's art, is stated by experts to be beyond the ability of an amateur, and many peculiarities are pointed out in the perfect shape of the carbon, the glass bridge and position of the leading-in wires, which seem to show adoption of methods which have been produced and developed from the experience of commercial manufacture with Edison's invention. The statement as to its make, its keeping or its having been operated are not clear or convincing to the court, if they have been made so to counsel. Exhibit lamps Nos. 9 and 11, brought to St. Louis, are no more satisfactory than No. 4.

6. After Goebel's employment in lamp making by the American Company his claim of anticipation received some attention, and he had negotiations with one Dreyer in 1882 for arranging a company to exploit the claim. It failed because he was then, apparently, unable to produce an original lamp. Later it was investigated by eminent patent lawyers at various times, and apparently with great care and interest, to employ it in defenses against this patent, and also by one in behalf of complainants, and all rejected it as not well founded. Prof. Thomson, of the Thomson-Houston Company, investigated it in 1882, when it would have been of vital interest to his company to make use of it against his patent, if tenable, and after visiting Goebel he rejected its consideration. Dr. O. A. Moses, an inventor, with a similar object, visited Goebel frequently, but came to the same conclusion, and says he was unable to produce any lamp. These are potent circumstances to raise doubt.

Coming to the new testimony produced for this hearing, and which I have carefully considered, I find that the depositions of defendants are mostly cumulative, or in rebuttal of certain new affidavits produced by the complainants and not here considered, but I cannot find that they remove any of the doubts above noted.

On the other hand, affidavits now produced by complainants tend to show an admission by defendants' witness, Henry Goebel, Jr. (a son of the claimant), that he manufactured exhibit lamps Nos. 1, 2 and 3, in 1892, for the purpose of this case. There is no denial of this, but it is claimed that this son is venal and has deserted the defense to favor the complainants. One Heger, a glass blower, swears that he made for Goebel, while working with him, "in the early eighties" lamps similar to No. 4, and he thinks he made this one at that time. As to a planer which was produced by Goebel as made by him at an early day to cut bamboo for his carbon burners, one Korwan and Heger swear that it was actually made by the former in 1883. This is contradicted as to date by an affidavit produced by defendants.

Upon the whole showing, I am satisfied that the complainants are legally entitled to preliminary injunction, and that it is the duty of the court to grant it without evasion. As stated by Judge Colt, and often held, a bond by defendant is not the equivalent of the injunction which the law gives for the protection of the inventor in the exclusive privileges promised by his patent.

Injunction will therefore issue, but with leave to defendants to move for requirement of a bond by complainants to indemnify the defendants for any damages they may suffer if it shall be finally held that the patent is invalid.

Another Transmission Scheme.

Plans are well under way for the establishment of an electrical plant at Eden Falls in the Neversink River, for the transmission of power to the city of Middletown, N. Y., a distance of fourteen miles.

The line will pass through Westbrookville, New Vernon, a little north of Howells, and thence to Middletown.

The successful completion of the enterprise will enable Middletown to offer special advantages to manufacturing establishments excelled by no town in the State, and a boom should soon be apparent.

Two thousand horse power will be furnished, which can be largely increased from time to time when needed.

The name of the company backing the enterprise is the Middletown Pipe Line and Power Company, and the incorporators are W. D. Stratton, Horace W. Corey, E. A. Brown, Leander Brink, Charles H. Brink, Chester Belding, J. B. Hulett, I. C. Jordan, George S. Belding, Robert O. Lewis, H. S. Pound, George Smith, of Middletown; E. M. Willis, of New York, and Eber L. Brown, of Unionville.

Twenty-five thousand dollars of the capital stock has already been paid in.

Death of C. F. Washburn.

Hundreds if not thousands of business men in all parts of the country will learn with regret of the death of Mr. C. F. Washburn, Vice-President and Secretary of the Washburn-Moen Manufacturing Company, Worcester, Mass., which occurred a few days ago at his residence in that city, from a stroke of apoplexy. Mr. Washburn was a gentleman of great culture and refinement, interested in many public movements having for their object the bettering of society, and will long be missed. Upright and conscientious in business, he was a man with whom it was a pleasure to have dealings, while socially he was most genial in his manners and a thorough gentleman of the old type whom to know was to respect.

An Admission Fee.

New Way to Replenish the Treasury.

Large Amounts can be Raised by Extending the Rule to all Departments.

From the "Evening Telegram."

Another fact has come to my attention, and that is that General Electric is charging an admission fee of $100 in their shops at Lynn.

College men who want to get practical training have been taking a course in these shops with the idea of eventually going into the company's service. They are only paid five cents an hour for their services, which is considered very little.

Now, in addition they have to pay $100 in order to be admitted. As there is really very little chance of getting into the company through any other source, there is no way of avoiding this tax.

The revenue thus derived will make good the company's loss on a good many construction contracts.

THE CORRECT VIEW.

From the "Brooklyn Eagle."

Stocks were active and strong about 11, but soon after there was a decline under the lead of General Electric, which seemed to be affected by a movement to prevent the extension of one of the expiring patents and to bring about a prosecution of the company under the anti-trust law. The fall in this property had an unsettling effect upon the rest of the market.

Northwestern Electrical Association.

The Northwestern Electrical Association held their annual convention at Madison, Wis., last week. A large number of well-known electricians were present and the proceedings included the reading of a number of interesting papers. The following officers were elected: President, Carroll Collins, of Green Bay, Wis. ; vice-president, C. C. Page, of Oshkosh; secretary and treasurer, T. A. Pamperin, of Oconto.

Investigating the Storage Battery.

A party of city and street railroad officials of Bridgeport, Conn., came to New York a few days ago to inspect the Waddell-Enz storage battery system on Second Avenue. The new Bridgeport system will very likely be an electrical one, and the Waddell-Enz Company have expressed their willingness to file a bond for the successful operation of their storage batteries if they are awarded the contract.

The New York Board of Public Works, by advice of the Health Department, have ordered two new plants for applying Albert E. Woolf's new electrolyzing process to the purification of the Croton water. The plants will be located at the Sodom storage reservoir, which supplies thirty or forty millions of gallons daily to New York. The cost of the plants will be about $6,000. Experiments with the Woolf system have proved it a success in destroying noxious germs in water and also in its purifying action upon sewage.

ALL VISITORS to the World's Fair will be welcome at the booth of ELECTRICITY, Section Y, Northwest Gallery, Electricity Building.

Pawtucket, R. I.—The common councillors are considering the matter of establishing a municipal electric lighting plant.

ELECTRICITY.

The Popular Electrical Journal.

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R. H. WILLOUGHBY, - - ASSOCIATE EDITOR.

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The Present Condition of the Electric Trust.

No industrial stock listed on the New York Stock Exchange has been the subject from first to last of so much comment as General Electric. We print elsewhere a resumé of the comments of last week; they are all interesting, but it will be noted there is quite a variety of opinion as to the causes of the slump of 14 points net for the week, which makes General Electric a 16½ per cent. stock at the price.

The Brooklyn *Eagle's* opinion that the fear of a Congressional investigation has led some of the large holders to unload is no doubt correct, as far as it goes. When ELECTRICITY first suggested this action, it became at once apparent that we had struck a sore spot in the anatomy of the Trust. They used it as evidence of malice in their statement before the Grand Jury. The insiders well know that such an investigation would be the death-knell of the Trust.

But, as before noted in these columns, it is idle to inquire why a stock worth only $30 or $40 a share does not sell continuously for $100.

To obtain a correct understanding of the situation, it is necessary to consider the facts of history. From these facts, and from the few actual pointers which appeared among the volumes of chaff of last week's statements and comments, ELECTRICITY has constructed a theory upon which we are willing to stake our reputation, viz: That Messrs. Drexel, Morgan & Company have reached the conclusion that the management of the company is in improper hands, and that a freeze-out game is in progress on a large scale, which will result sooner or later in an entirely new management, and the relegation of the T.-H. element to private life.

It is good opinion in Wall Street that the New York bankers have become disgusted with their treatment by the Boston contingent, and that the present condition of affairs cannot last.

The facts which made the formation of the General Electric Company possible are well known to the trade. The Edison General Company had reached an unfortunate end, and could go no further. Henry Villard's foreign friends had withdrawn their support, and Drexel & Morgan, the largest American stockholders, were tired. The purchase of the Sprague railway apparatus, which had been looked to to keep the Edison Company abreast of its greatest rival, had proved a failure, because of the ousting of Mr. Frank J. Sprague, the inventor, and the ill-advised attempt to Edisonize the apparatus.

There was trouble on every hand; money could not be raised, and something had to be done to prevent the company from going into bankruptcy.

For two or three years previously the subject of consolidation had been discussed. At one time Mr. Villard had made overtures looking to a purchase of a controlling interest in the T.-H. Company by the Edison Company.

It has been stated on high authority that the professional accountants who at that time spent a week in going over the books of the T.-H. Company reported that there was no showing on the books to warrant the purchase, and that it was doubtful whether the T.-H. Company themselves knew just where they stood.

Now Mr. Villard saw an opportunity to "break even," and Messrs. Drexel & Morgan were favorably impressed with the showing made by Mr. Coffin for his company. The deal was made chiefly on this showing. And one of the first, if not the first, official acts after the consolidation was assured was the loaning of about $200,000 by the T.-H. Company to the Edison Company, part of which it is believed went to pay the last dividend of the latter company.

We believe that Drexel, Morgan & Company were deceived, not only by the showing made, but in the men they were dealing with. The unloading of stock by a Boston pool of which Mr. Coffin was a member at about 115 was perhaps not the first object lesson of the rules of conduct which seem to have governed the T.-H. contingent. Certain it is that the friction between the New York banking house and Mr. Coffin has been a matter of common gossip.

Ever since the stock began to go off, *until last week*, Mr. Coster, of Drexel, Morgan & Company, a member of the Board of Directors, has been free in his statements that the condition of the company was sound and healthy, and that New York ideas of business rather than T.-H. ideas were controlling the policy of the company. Mr. Coster assured a representative of ELECTRICITY some months ago that the stock would not be allowed to go below par, and that his house would consider the stock a bargain at par.

Nothing has done more to bolster up the stock on its various declines than these statements from the representative of Drexel, Morgan & Co. Signs have not been wanting, however, that Mr. Coster has protected himself, and that if an unhealthy condition of affairs should be developed, reaching back not only one year but six or seven years, he can place the burden of misrepresentation upon the Boston clique.

The now famous letter written some time ago by Mr. Coster to Mr. Coffin, and Mr. Coffin's answer thereto, for the innocent publication of an erroneous version of which the publisher of ELECTRICITY was indicted, were perhaps one move in this direction.

At any rate the end seems to have been reached. Both Messrs. Pierpont Morgan and Coster refused last week to say anything to reassure the company's stockholders, and referred inquirers to the officers of the company. Both gentlemen made the superfluous statement that they were still members of the Board of Directors. We say superfluous. It is thoroughly well known that they are Directors. Are we to infer that the time is near at hand when they will not be? We think not.

The only reasonable interpretation of the statement from the *Evening Post* (published in another column) is that Drexel, Morgan & Company refuse further to lend their name to the support of the stock while the company is under its present management, and while they are in position to be damaged more than any one else by the possible revelation of a condition of affairs of which they were ignorant.

It is our belief that Messrs. Drexel, Morgan & Co. were hypnotized a year and a half ago, and that their knowledge of the actual condition of affairs has been acquired by degrees; that they have reason to regret the connection of their name with the Electric Trust scheme, and that that connection, in its present form, will soon come to an end.

Upon this hypothesis it will not be long before Mr. J. Pierpont Morgan will go a-gunning in Wall Street for Mr. Charles A. Coffin; and if he fails to bag his game it will be the first failure of the kind in Mr. Morgan's history.

It is not the customary thing for a company in which Drexel, Morgan & Co. are strongly interested to go to pieces without an effort being made to save it; and we have the best of reasons for believing that after the smoke of the present battle has cleared away it will be found that Drexel, Morgan & Co. are in actual control of General Electric. Meantime the price of shares may possibly go lower still.

Now let us look at last week's developments. The debenture 5s opened at 79 and touched 68 flat, closing at 70, on sales of $122,000 for the week.

The common stock opened at 63½, touched 46, and closed at 49¼ on sales for the week of 108,502 shares.

This state of affairs shows a conspicuous lack of public confidence, but it is not alone the actual condition of the company's finances which has brought it about. Large blocks of the stock have been held as collateral on the basis of 50 by Boston banks for loans to certain members of the Board of Directors. There was a leak in these banking institutions, and the bear element in Wall Street learned of the fact. When the stock went below 50 these loans were called, and the stock was thrown on the market. It is believed that Drexel, Morgan & Co. were buyers to a considerable extent.

Rumors of a receivership have been persistent; but it is our opinion that factional squabbles between the Edison and T.-H. stockholders are doing more to render a receivership probable than the actual condition of the company at present. We believe the company to-day is solvent as to all its liabilities beyond the stock and bonds, but we do not wish to be understood as assuming that it will continue so under its present management. Meantime it is openly asserted in Wall Street that the money to pay the August dividend was borrowed, and that most of the receipts from the sale of the stock of New York and other Edison companies went to pay loans.

It is to be noted that most of the bull statements put forth by the company this year have been made by officials who know absolutely nothing about the actual condition of the company, notably Capt. Eugene Griffin, Counsellor John S. Wise and Mr. Herrick. If a reassuring statement were possible, it could be made within five hours' time over Mr. Coffin's own signature. It does not seem likely now that such a statement will ever appear, and the question arises: Is Mr. Coffin afraid to make a specific statement of actual business done, and of running expenses for the year? also that he and the other large New England stockholders have not practically unloaded?

Taking all things into consideration, ELECTRICITY sees no reason to change its views. As early as last September we asserted that the Trust scheme must go to pieces. It has already lasted longer than we anticipated. Our reasons for thinking the end is near are just what they were at that time, with some additions.

In the first place, the company never had plants or earning capacity to justify such an enormous capitalization; $12,000,000 is a fair estimate of the value of its plants, and $8,000,000 more would be ample for patents and good will; in other words, the stock and bonds of the company to-day, provided it was under capable management, would be worth an average of about 40. Further reasons for expecting an early breaking up of the enterprise were found in the fact that the company's selling expenses were extravagant, rendering it unable to compete on an even basis with its chief rivals, and that the old Edison business would naturally dissolve and scatter to the four winds before the year was over. Such has proved to be the fact. Instead of doing as much business as the combined companies did last year, they have done a great deal less. This was rendered inevitable from the fact that every man's hand has been against them; the field is full of their enemies, and their friends are limited to those who are working for revenue only. The only hope they ever had of success was in bottling up the electrical business, and competition is more active to-day than when the Trust was organized. Margins of profit are continually being pared down, and much of the apparatus of the Trust's sub-companies is out of date.

The chief additional reason which we now have for expecting a general break-up is the probable action of Mr. R. T. McDonald and the Fort Wayne Company. That they will continue much longer to work in Mr. Coffin's interest is said by those who ought to know to be impossible. The withdrawal, either of Mr. McDonald himself or of his company, would precipitate the inevitable collapse, but could only work to the benefit of the Fort Wayne stockholders.

We neither know nor care what the cash on hand of the Trust is, or what its pressing obligations are.

We do know that the formation of the Trust has proved a flat failure, and that a reorganization, a change in management and in policy is inevitable.

The utter demoralization of the Trust's securities in Wall Street, with the attendant evil effects upon the company's legitimate selling business, arousing suspicions even in the minds of its own employees, is an unanswerable argument in favor of ELECTRICITY'S *main contention for the past year, that stock-jobbing has no place in the conduct of a legitimate manufacturing enterprise.*

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THE mills of the gods grind slowly, but they are grinding Trusts exceeding fine.

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ELECTRICITY is feeling quite well, thank you.

The Milwaukee Case. The decision of Judge Seaman granting an injunction against the Oconto lamp company is printed in full elsewhere and is practically a repetition of Judge Colt's decision in February last. The principal point of difference between this and Judge Hallett's opinion in St. Louis is in the question of the amount of evidence and the conclusiveness which is necessary to establish defendants' case in a suit of this nature. The decision states that the Supreme Court has settled beyond dispute that for the defense of anticipation and prior use against a patent the proof must be clear, satisfactory and beyond reasonable doubt, and Judge Seaman, contrary to Judge Hallett, requires this same measure of proof in the case of a preliminary injunction.

The doubts which are raised in the decision, however, concerning the Goebel lamps will be found open to considerable criticism in the opinion of most electricians. The section of the carbon filament, it is declared, must be thread-like in order to effect the practical subdivision of the electric light, while Goebel's filaments were run on batteries for which a larger carbon would be better adapted. The degree of the vacuum in Goebel's lamps is also a question of doubt, yet neither of these points would make a lamp so made inoperative, but simply less efficient. The reason for its not being patented by Goebel seems plausible enough, as the dynamo was not invented or at least was not a commercial article, and without this the incandescent lamp would be a laboratory toy to-day.

The other objections cited are equally open to argument, and it is understood that the final hearing on this case is to come off within a few weeks. In the meantime the General Electric Company, it is understood, will proceed against some of the other companies.

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Lamp Workers' Strike. Work in the fibre room of the General Electric lamp works at Harrison, N. J., was brought to a standstill owing to a reduction in the prices for piece work which were announced last week. Practically, the whole force of girls in this department, amounting to about 75, left the factory declaring it was impossible to earn a living under the new rates as only from five to seven dollars could be earned under the old prices. The reductions were from 35 cents to 25 cents on one grade, and from 25 cents to 16 and 12 cents on other grades.

While these reductions are in line with the retrenchments in the running expenses in all the departments of the company, and were to be expected, the explanation of Manager Upton of the lamp works for the new prices is worthy of attention. He is reported as saying that the move was made necessary by the competition of other lamp makers who have adopted new processes by which lamps can be made cheaper than at the Edison Works.

It appears at first sight rather strange that this company after closing nearly all its competitors' factories by injunctions should find itself so pressed by competition that it is unable to maintain its old scale of wages, yet this is undoubtedly a fact, and this part of Mr. Upton's explanation contains a compliment, probably unintended, to the enterprise of the outside manufacturers.

The fact that any standard lamps are manufactured cheaper than the Edison lamp is not evident to the consumers of these goods, as the Edison lamp has proved itself in practical use to be of about the least value of any lamp on the market, and would not be in the race at all in central station work if put in open competition with those of other makers. It is not conceivable that such lamps are produced at a greater cost than much more efficient ones, and a more probable explanation of the present reduction is the company's straitened circumstances, which condition has called for retrenchment throughout all its departments.

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Storage Battery Patents. The decision of Judge Coxe filed July 18, 1893, affirming the expiration of the Faure storage battery patent in the United States, will not make the manufacture of this type of accumulator in this country entirely free, as the courts have already construed the scope of this patent to include only the application of the active materials in the form of paste, paint or cement, while the Brush patent, which is yet in force, is broader and covers all forms of active material applied to the plates except where it is in the form of paint, paste or cement, or is formed from the material of the plate itself as in the Planté type of cell.

The decision, however, opens a field in this line of business in which considerable progress may be expected, and it will doubtless be taken advantage of by the maunfacturers against whom injunctions have been procured by the company which controlled the Faure patent.

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THE *Western Electrician's* extra announcing Judge Seaman's decision at Milwaukee is a bad example of the errors and inaccuracies which result from too hurried "enterprise." A careful reading of the decision furnishes no basis of fact for such remarks as these: "Goebel Defense Rejected;" "The defendant introduced the celebrated Goebel defense, and the court completely knocked it out." This sort of editorial work is either malicious or careless; we prefer to think it is the latter, as the typographical and other errors in the text of the decision itself indicate that it had not been read by any one in the office of our esteemed contemporary, not even by the office boy.

If the Goebel defense is "knocked out," it is not a "celebrated" defense. In the latter part of the report appears the following: "As to a flamer which was produced by Goebel as made by him at an early day, he cut bamboo for his carbon burners." We believe that Goebel's lamps were all good and satisfactory "flamers," but this is not what His Honor had in mind. He was talking about a planer.

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NO BUILDING in this city contains half so many electric fans as the Edison Building, at 44 Broad street. They are mostly of the Lundell type, and are known to be efficient and to produce cooling breezes. Yet it is a fact that last week the officers of the General Electric Company failed utterly in keeping cool. We do not think, however, it was the fault of the fans.

General Electric.

What is Said of it Nowadays.

The Football of Wall Street, and its Friends Seem to be Dead.

New York "World."

General Electric, which in January sold at over 114, was down to 46¾ yesterday, with nearly a quarter of the sales of the day devoted to this particular stock.

Report had it that the Trust was to go into the hands of a receiver, that it was to be reorganized and that the securities in its treasury in the shape of bonds of subsidiary companies and of stock of companies which it had supplied with material were largely overrated, and that any attempt to market them would result in failure.

A leading officer of the company, to whom directors sent inquiries, said that there was no truth in the rumor that the company was going into the hands of a receiver, nor was there any reason for a receivership. Neither was there any project afoot for a reorganization. The condition of the company to-day, he asserted, is substantially the same as it has been in the past. The denial of the rumors referred to was positive and emphatic.

Boston "Advertiser."

The break in General Electric was accompanied by reports of the discharge of more men and other evidences of a falling off in the business of the company.

Russell Sage, it is said, has had 100,000 shares of stock "put" to him.

New York "Sun."

No news was obtainable either from the officers of the company or from other sources explanatory of this movement. The decline in the price of General Electric from 114 during the last six months has been accompanied from time to time by reports reflecting upon the financial condition of the company. These have been persistently denied by its officers and directors, which include a number of the wealthiest capitalists in the country. Those reports were revived yesterday and were again denied, but the denials had no perceptible effect upon the market. The judgment, as well as the instinct, of the Street is to accept the stock tape as an almost infallible guide; consequently the fact that an 8 per cent. stock sells at less than half of its par value without attracting sufficient good buying to check the decline, outweighs all that may be said in favor of the property, whether officially or by friends of the enterprise.

New York "Mercury."

Failures were reported from Milwaukee, and one prominent banking institution in New England that was said to be long of 4,000 shares of General Electric went to the wall. The question is how many firms in Massachusetts have been hurt by the rapid declines in General Electric. The stock opened at 46. It sold at 117 five months ago, so the decline has just been 71 points. The loss, assuming that the purchases were made at the high figures and closed out at the low prices, on 4,000 shares of stock, would be $284,000 in this one specialty alone.

All reports to the contrary notwithstanding, the Drexel-Morgan people are not interested in the market nor have they bought any large lines of General Electric, as was commonly reported after the close of business. The position of the Company is one of some solicitude, in thats it contracted liabilities are open to attack.

N. Y. "Morning Advertiser."

The movement was shrouded in mystery, and the officials of the company declared they could give no legitimate reason for the decline. On the Street the story was current that the company was in such condition that a receiver would be appointed. Officials say the story is absurd, and that the company has four dollars of quick assets for every one dollar that it owes.

A Bad Sign.

"Wall Street Daily News."

The General Electric Company's literary bureau has been revived, and all the news agencies are circulating the most sickening bullish guff regarding the company and its affairs. This is the same kind of stuff that was put out when the stock sold 70 points higher, and its appearance now would indicate that the insiders are not yet through selling.

New York "Evening Post."

A large part of the selling of General Electric was believed to be for the account of Boston holders, who received the stock in exchange for Thomson-Houston stock.

In the last hour there were reports that a receiver might be appointed for General Electric, and with these rumors came large selling orders. The officers of the company denied the reports and said there was not the slightest reason to anticipate a receivership.

Boston "Commercial Bulletin."

On Tuesday, while General Electric stock was declining seven or eight points, this paragraph appeared in the news slips. In fact, it is remarked by brokers on the Street that on all weak days the following kind of stuff is sent out:

> "The General Electric Company has now nearly 5,000 stockholders, and there is a steady buying of the shares for cash. The stock list shows a net gain of about 400 the past six weeks.
>
> "Orders received last week aggregated $250,000, mostly for small supplies, on which the profit is larger than upon big orders.
>
> "President Coffin says: 'If we do not fall off more than 20 per cent. in these times on our gross business, I shall be satisfied.'"

It must strike the average banker, broker or operator as a piece of exquisite irony to talk about the net gain of stockholders in any company during the past six weeks. The person responsible for these statements should come into the Street and stay there long enough to become acquainted with its ways, so that he could understand how that sort of silly-billy talk is received in panicky times like the present.

New York "Herald."

Many people were led to invest in the stock by the unusually strong Board of Directors the company possesses—men of the highest standing, and nearly all millionaires. These are Mr. H. McK. Twombly, chairman of the Board, and Messrs. J. Pierpont Morgan, D. O. Mills, C. H. Coster (of Drexel, Morgan & Co.), Thomas A. Edison, T. Jefferson Coolidge, Jr., F. L. Ames, H. L. Higginson, Eugene Griffin and C. A. Coffin. Investors, in view of constant assurances that the company is all right, are asking why some of these rich men have not hastened to buy the shares at the enormous decline represented by current prices. At these figures the stock pays sixteen per cent. on the investment, and investors argue that this should look tempting to capitalists even with money stringent as it is at present. Men who hold shares for which they paid are frightened by the fall, and fear that there must be something wrong with the company. "Is it a second Cordage Company?" is the disquieting query circulated yesterday by the bears.

The Officers of the Company Must Make the Statements Hereafter.

New York "Evening Post."

Interest on the Stock Exchange centred largely this morning in the General Electric stock, which fluctuated widely. No further information had been obtained about the affairs of the company except official reiterations of the statement that nothing was the matter with the company's affairs. A story gained credence this morning which it was said was authentic. It was to the effect that the big drop in the price of the company's stock this week was simply the result of a freeze-out. A certain clique in the company desired to get rid of some large holders of the stock and the game, it was said, was secured yesterday.

At the office of Drexel, Morgan & Company this morning it was said that Mr. Coster and Mr. Morgan were still directors of the General Electric Company. Both gentlemen, however, declined to say anything to reassure the company's security holders. They both referred the reporter for the *Evening Post* to the officers of the company for official statements about it, declining themselves to say anything personally on the subject.

The Daily "American."

The possible developments in General Electric were awaited with a good deal of interest. There is a theory in Wall Street that if a dividend stock shows persistent weakness there must be something inherently wrong with the property. If General Electric, therefore, sells below 50, Wall Street naturally argues that some of the wealthy men in the Street would be attracted to so remunerative an investment. In other words, they would buy enough of the stock to support the price in the market. In the absence of such support Wall Street feels itself privileged to hold any opinion about the property it chooses, and nobody can blame Wall Street for taking such a position.

The Faure Patent Expires.

The case of the Electrical Accumulator Company vs. the Julien Electric Company was recently admitted for rehearing upon the issue of the expiration of the Spanish patent taken out about six months previous to the United States patent.

The question in controversy was the identity of the claims of the Spanish and American patents and Judge Coxe, of the United States Circuit Court, has handed down a decision affirming this identity. The first patent taken out by Faure was in France and the subsequent patents in Spain and in the United States were translated from the French.

The decision states that "the longer the record is studied the more settled becomes the conviction that the invention which Faure patented in Spain and in the United States was the invention which he made and patented in France; that, so far as the inventor was concerned, the language was substantially identical, and that the changes in phraseology made by the translators and Patent Office officials, of which changes the inventor was ignorant, did not and could not operate to change the invention."

Electrotherapeutic Course.

A strong tide of progress in electrotherapeutics has set in during the last two years in this country, and many medical men of acknowledged standing have become so convinced of the importance of electricity in the medical practice of the future that they have undertaken a course of special study in the subject, and so been enabled to place themselves abreast of the newest and most approved practice. Many practitioners, however, are unable to avail themselves of the regular post-graduate college course, and will gladly welcome such an opportunity for tuition as is afforded by the private clinic of Dr. Robert Newman, in this city. After many solicitations from practitioners to give private lectures in electrotherapeutics, and particularly in surgical electrolysis, Dr. Newman decided to give such a course. The instruction is given in the same manner as that in post graduate colleges, except that it is private and limited strictly to a small number of students. The course consists of twelve lectures, in which clinical instruction is predominant, the modus operandi of all operations being shown. The past course has been eminently successful, and the class for the next course, which will begin on November 1, is already made up. Dr. Newman has been prominently identified with medical electrolysis, and his labors in this field for the last quarter of a century have been abundantly recognized. He has designed many of the most effective electrodes now in use, and has contributed in marked degree to the placing of electrolytic practice in medicine on its modern basis. Dr. Newman has been invited to deliver clinical lectures in electrolysis in Chicago by the Post-Graduate Medical School during the course which begins September 1.

Business Troubles.

The inventory and schedule of the assets and liabilities of Edward T. Pardee, agent of the Fort Wayne Electric Company for the State of Iowa, have been filed. The assignee is Edward C. Wright, of Syracuse. The schedule shows twenty-four creditors, among whom are Pass & Seymour for $294.38, and the Electric Engineering and Supply Company of Syracuse for $1,028.55. The amount of liabilities is $5,817.78 and the assets are $618.23, stock on hand.

Elgin, Ill.—The Dundee Rapid Transit Company expect to begin the construction of their proposed line from Dundee to this city at an early day.

Trust Methods.

The Joliet Prison Matter Causes Comment in Chicago.

How to Get a Sure Thing on a Contract.

The last Illinois Legislature appropriated $140,000 to build a modern power plant at the Joliet Penitentiary. It was intended to erect a central station, which was to furnish power to different shops by motor and steam for heating and everything else needed, and also to make provision for water power. The usual course of requiring competitive bids from various manufacturers was to be followed. In compliance with the policy pursued by all corporations when large contracts are awarded it was supposed that bids would be advertised for. Many supposed that the specifications would be advertised, as is often done. Warden Allen says they have been advertised, and he adds with refreshing innocence that they were advertised in a *Joliet paper and a weekly paper in Chicago*. It is very surprising that the advertisement in the Joliet paper escaped the notice of the manufacturers, as it is a well-known fact that the Joliet papers are on file everywhere in the civilized world, especially in Joliet!

The following abstract of the situation is gleaned from the Chicago *Tribune*, which recently devoted three columns to the matter:

Several weeks ago manufacturers began to write letters of inquiry to the Commissioners and to Warden Allen. Not until June 27 were they able to procure plans and specifications, or much information outside of these as to the character of the work to be done. Several manufacturers who wrote to Commissioners requesting interviews and an opportunity to explain their devices failed to receive replies to their letters. On visiting Joliet they found their letters in the hands of Warden Allen. On the date above mentioned typewritten specifications were delivered to them, and some of them received plans of the building and its equipments.

The blue prints furnished them bear the mark of the General Electric Company. The plans and specifications have been gone over in detail by experts of wide reputation. The specifications taken at the beginning call for four power generators of multipolar type, each 100,080 kilowatt capacity, compound wound, and guaranteed to maintain a constant potential within 2 per cent. between full load and no load, and wound so as to develop 240 volts at the brushes. The General Electric Company, or its allies, it is stated, alone makes this size generator. It cannot be made by other companies save at a large expenditure for new patterns and new machinery. It consequently would not pay any company competing with the General Electric Company to make the required changes in its plant which would be necessary if it attempted to meet this specification.

The instruments for power generators, such as switchboard, voltmeter, ammeter, are so specified as to practically cut off competition. One direct reading voltmeter is required, which is to be either the Weston or General Electric make. The Weston instruments, as is well known, sell for three times the price of those of the General Electric Company. Such being the case there could be but one result if the Weston Company put in a bid against the General Electric, as it is not probable that the Warden or the Commissioners are seeking the best in anything. Appearances indicate that they are more anxious about the margins than the quality of the apparatus. The specifications for the lighting dynamos call for two belted dynamos. The figures given are those of a General Electric machine. Two direct coupled machines are required for all night lighting, operated under one independent engine, to be either of the Sturtevant or Lake Erie Engineering Works make.

These generators are to be of fifteen kilowatts capacity, and the speed of the engine and dynamos is not to exceed 550 revolutions a minute. No maker of dynamos, it is stated, manufactures a direct connected machine of such small capacity, owing to the extreme cost if made properly. It is a machine extremely expensive to keep in proper condition, owing to its great speed. The maximum speed of ordinary dynamos is 300 to 350 revolutions a minute, but the General Electric Company manufactures a machine which makes 550 revolutions a minute.

The shafting, pulleys, details, etc., are specified, it is stated, to correspond with the manufactures of one company. Their steel plate clutches, it is stated, are alone referred to. Their work is on exhibition at the World's Fair, and in their catalogue is contained a eulogy of the General Electric Company. No bids, it is stated, are asked for shop motors, but nobody is dense enough to believe that after the General Electric Company secures the contract, motors manufactured by anybody else will be put in the shops. It is argued that after they have done the rest of the work those details will be carried out by them.

The engine called for is the exact formula, it is said, of an engine manufactured by a concern whose work is favored by the General Electric Company. An experienced engineer has said that he knew of no other engine that exactly filled the specification.

The specifications for boilers limit bidders to one of three styles, made by three separate concerns; but the plans, it is said, show conditions that fit only one make of boiler, said to be the Heine boiler. They contain just space enough for that boiler and it is drawn into the plans.

The general plans, it is stated by engineers, provide for a plant which is ten years behind the times, where the intention of the law was to provide a plant modern in every respect. As before stated, the plans bear the name of the General Electric Company. Various details of the plans are criticised. It is said while the State has plenty of room for as large a building as is needed, the space is cramped without any reason that is discernible save in following out the theory that everything has been made to fit the General Electric Company's ideas and apparatus.

One feature of the mechanical arrangement is criticised severely. The power is belted from the engine to a jack in a pit and from there to the dynamo. This arrangement, it is stated, calls for the services of an extra man, places a most important part of the machinery out of the sight of the engineer, and will, it is claimed, result in a loss of 20 per cent. to the power.

The buildings to contain the machinery, it is said, have already been started, and on plans, it is claimed, furnished by the General Electric Company.

"Such is the fact," said an engineer, "although I have not been able to ascertain what warrant of law there is for it. There can be only one inference drawn from the facts and the plans and the specifications. If I were going to erect a plant, the machinery in which was made by a comparatively few manufacturers, all of whose devices differed in certain particulars, and should draw my plans and specifications around the machinery made by one man, and then should ask for competitive bids, what sort of a reception would my invitations to manufacturers meet? They would send my papers back with notes informing me that they sought their fun on the Midway Plaisance, and had no time during business hours to pay attention to jokes. That is practically what the large electrical manufacturers throughout the country, outside of the General Electric Company, will say to the State of Illinois in this alleged competition for work. They will not bid.

" Next Tuesday, I have no doubt, there will be a number of bids there. They will be sent in by the various arms of the General Electric Company, or in compliance with understandings between that concern and others. The General Electric Company will get the work. I do not pretend to say whether or not any influences have been at work in this remarkable transaction. I will let any curious citizen guess for himself after he has examined the plans and specifications. They have been sent to many manufacturers; some of them keep them as curiosities."

A representative of one of the largest electrical concerns in the country is quoted as follows by the Chicago representative of ELECTRICITY. He said: " I wrote to the warden of the penitentiary several weeks ago in regard to the plans and specifications, but received no answer. I wrote again and then telegraphed him twice, but could get no reply. I called on him personally and found that he had received my letters and also telegram, but gave no excuse why he did not answer them. He promised to send me plans and specifications as soon as they were ready, but I have not received them up to date. On my arrival in Joliet, I was confidentially informed by an employé that I was too late (this was two weeks before the date set for opening the bids) to get in a bid. The warden could not have gone to much trouble to find an engineer that would fill the position he wanted. I suggested the following men: Frank B. Rae, of Detroit; D. L. Barnes, of Chicago; C. G. Armstrong and Gustave Monrath, also of Chicago. These men are not connected in any way with electrical companies. I would bid on specifications furnished by any of the above men, but would not bid on specifications furnished by the General Electric Company."

We are informed that Warden Allen was formerly the manager of the Thomson-Houston station at Joliet. In his own defense, Mr. Allen says:

" I went to Chicago and looked for an engineer to draw plans for the plant. *I could not find a man whom I thought was absolutely independent.* I called on the General Electric people in Chicago, and spoke of my difficulty in finding an engineer. They suggested that the plans be drawn by their engineering department, and I agreed."

The italics are ours.

On Tuesday, the 18th, the bids, twenty in number, were opened in the presence of representatives of the various manufacturers. Most of the bids were on different parts of the plant only.

Mr. C. A. Daigh, representing Siemens & Halske, made the following remarks to the Commissioners :

" I am here, representing a large concern, and taxpayers besides, who are not satisfied with the method of letting this contract. We propose to have something to say before this plant is installed. I saw the plans for the first time to-day. They do not provide for the cheapest plant that can be put in. Our company, one of the largest in the world, will guarantee to save the State from 12 to 20 per cent. in a plant properly planned. I protest against the methods which have been used. I have written and wired the Warden and the Commissioners concerning the work without securing information, and did not know until a day or two ago that you would open the plans to-day. I ask that these specifications and plans be set aside and that five or six engineers be selected to make plans. Our company will undertake to pay them if the engineers are independent."

The Commissioners then sent to Chicago for an expert to analyze the bids.

The three bids on the complete plant were as follows : Westinghouse Company, $56,300 ; Waddell-Enz Company, $56,552 ; General Electric Company, $58,458.

The Philadelphia Trust in Trouble.

The minority stockholders have filed an application with the Chancellor of New Jersey for a receiver for the Penn Electric Light Company of Philadelphia.

The Chancellor is asked to declare the trust under which it is claimed the stock is voted illegal, and to restrain the Guarantee Trust and Safe Deposit Company from voting the deposited stock, and to restrain the Electric Trust of Philadelphia from voting the stock alleged to be held by it.

The bill also asks to have the Electric Trust of Philadelphia pay the stockholders of the Penn Electric Company what they should have received for the use of their conduits had they been rented to other companies besides the Edison Company.

Electric Plant for Cape Town.

An important electrical project is to be undertaken in Cape Town by Siemens & Halske, of Berlin. Three tenders were made by this company, one proposing alternating currents with transformers, the second, accumulator substations with three-wire system, and third, an accumulator substation with the five-wire system, which latter was accepted owing to its strong recommendation by the company. The power will be supplied from a neighboring river from which a pipe line 4½ miles in length will convey the water to the power house, a fall of 1,350 feet being available. The dynamo will be directly connected to two turbines running at 250 revolutions per minute. The current is then to be led to the substation in the town from which the distributing system is supplied. There will be 22½ miles of underground conductors and 152 miles of overhead wires. The system is to be in operation by December of next year.

An Electrical Railway Switch.

In a former issue we published a paragraph announcing the invention of an electric railway switch, a fuller description of which we are now able to furnish our readers. The purpose of this apparatus is to place the control of the switch tongue in care of the motorman on every electric car, thereby allowing both motorman and conductor to remain at their posts on the car when approaching switches. As is well known, the cost to railway companies of keeping men at important switches in large cities is very great. There are about eighty men so employed in Boston alone. This new device is operated by electricity taken from the trolley circuit. The entire mechanism is placed in a water-tight box beneath the road bed. On the approach of a car contact between the car and the device is obtained by means of brushes that are lowered from the platform of the car by a motion of the foot of the motorman. It consists of electro-magnets arranged in the box and attached to the switch tongue. Elongated strips are connected by an insulated cable or wire with these electro-magnets, and sufficiently in advance of the switch to be in sight of the motorman. These strips are placed between the rails of the track and insulated from the ground and from each other. As the car approaches, should the switch tongue need to be thrown, the motorman simply presses his foot, makes the connection between the car and the electro-magnets, and instantly the switch is thrown and held in position until the car has passed the switch. This device has been invented and patented by Mr. Edward Stone, of Hyde Park, Mass., who is in correspondence with several railway companies with a view to its adoption by them.

Rockford, Ill.—The Strowger Automatic Telephone Company have been granted a franchise to place a system in Rockford.

Electric Light at the Krupp Works.

The electric light plant at the Krupp works, in Essen, which was commenced in 1876, has recently received considerable extension. The generating station is situated near the centre of the works, and includes six dynamos and steam engines of an aggregate of 650 H. P. There are two separate systems of distribution ; one at 100 volts, continuous-current, for the glow lamps in the offices and workshops ; and the other at 700 volts, continuous-current, for the arc lighting circuits and, by means of continuous-current transformers, for the more remote glow lamps. The low-pressure circuit consists of 3,200 metres of underground cable, feeding 1,400 glow lamps. The high-pressure cables are conveyed from the central station to three distributing stations at a distance of 4,900 metres, whence they radiate to the numerous arc lamp circuits which are carried overhead. Each of the arc lamp circuits consists of 16 lamps in series, and supplies 10 amperes. There are 384 arc lamps on all the circuits.—*Electrician*, London.

Long-Distance Telephones.

It has been decided by the Pennsylvania Railroad Company, after careful consideration, to adopt the long-distance telephone for communication between its principal executive offices in place of the telegraph system. The new system is to be used, however, exclusively by officers of the company, and will be of especial value in transacting confidential business. Mr. Chas. E. Pugh, third vice-president, has developed the system and arranged for its installation, which will connect the offices in New York, Jersey City, Baltimore, Chicago, St. Louis and other important points.

No one will have access to these telephones except the higher officials, not even for the purpose of communicating with an officer.

Boston Notes.

Mr. Frederick S. Minott, the enterprising general manager of the National India Rubber Company—whose factory at Bristol, R. I., is the largest of its kind in the world and employs over 1,300 hands—is to be congratulated on the prosperous condition of the gigantic business that he so ably manages. He reports that trade could not be much better with his firm, for they are working every department full blast and have orders ahead already that will last them well into fall, and they keep rolling in every mail. Founded in 1825 the works were never in better order than now nor the goods manufactured in greater demand, and this notwithstanding the competition in their special line.

A sad case of poisoning from an overdose of what is known as wintergreen—the essential oil of Gaultheria—was that which occurred in Lynn, Mass., last Thursday afternoon, the victim being Arthur Thaddeus Woodward, inventor and patentee of the Woodward Underground Electric Light and Cable Company of New England. Mr. Woodward was quite an inventor and is said to have been the first manufacturer of wooden toothpicks in this country, out of which he made a large fortune which he got through in double quick time. His system of underground conduits for electric wires and cables had excited much interest at times in different parts of the country, and had the inventor himself taken care he might have achieved success with it. Unfortunately, he had long been addicted to excessive drinking, and it was during a fit of temporary insanity that he committed the rash act that ended his life as stated above.

Mr. Henry Kaliske, general manager of the Beacon Vacuum Pump and Electrical Company, of Boston, is taking a brief rest, accompanied by his wife, at Long Branch, N. J. Mr. Kaliske is an indomitable and successful worker, and being somewhat under the weather, or as he is accustomed to say " no better," has hied himself away for a brief respite.

Mr. A. D. Claflin, of the firm of Claflin & Kimball, who represent the Mather Electric Company and the Waring Electric Company, has just returned home after several weeks' sojourn in Chicago. He has done the World's Fair pretty thoroughly, and like everyone else who has been there considers it "the biggest show on earth."

The New England Electric Heating Company, Boston, has just issued catalogue No. 1, in which appears cuts of its various devices. This company is now doing quite an extensive business in the manufacture of almost every conceivable article, utensil, tool or appliance that requires heat for its use.

The monster electric locomotive which has just been built by the General Electric Company has this week been shipped to Chicago, and will on arrival be put on regular service. It weighs thirty tons and is expected to develop a speed of thirty miles an hour.

There has been a misunderstanding or a disagreement between the Lynn and Boston Railroad Company and the Selectmen of Melrose for some time past which has prevented the electrical equipment of the road between Saugus and Melrose. An agreement has at last been reached between the two bodies and the road will be proceeded with at once. When the road is completed it will prove a great boon to residents en route, and open up a wide and attractive suburban district which hitherto has been lacking first class traveling facilities.

A novel race meeting is being arranged by the Malden Bicycle Club to take place on Monday evening at the race track in Waltham. The entire bill of sports will be gone through in a brilliant manner after dark, and will be an electric race meeting. Arc lights are being installed all round the track in a similar manner to that adopted some year or so ago in St. Louis. A large gathering of spectators and flyers is expected, and without doubt it will prove to be a great occasion with brilliant results to all parties in interest.

What with the extraordinary fall in the price of its common stock, the same having touched 48½ on Thursday, the closing of its extensive new foundry because of the cost of production being found to be more than castings can be purchased for from outside firms, and the reported laying off of nearly 1,000 employes hitherto engaged in its Lynn factories, the General Electric Company is moving through troubled waters at present, and people are anxiously asking, "What is the matter?" Of course the general demoralization that prevails in the stock market is simply being shared in by the General Electric Company, but the other facts to which we have above alluded induce outsiders to believe that there is something the matter that doesn't quite appear on the surface. Just what that is, is what many would like to know. The favorable decision handed down on Thursday at Milwaukee, sustaining the validity of the Edison Incandescent Lamp patents in the suit against the Oconto Manufacturing Company, ought to assist the Trust somewhat, as ought also the despatch received in Boston Friday from Mr. C. A. Coffin, stating that the liabilities of the Trust are only 23 per cent. of its quick assets. Still it is generally doubted hereabouts whether public confidence will be permanently restored. The general feeling is that the company ought to come right out with a full and explicit statement of its exact standing, such a statement as everybody can understand, and so place itself squarely before the stockholders and the public generally. Until that is done, rumors, suspicions and fears will abound.

So rapidly is the business of the Edison Illuminating Company of this city growing—and already the volume of business done is colossal—that the directors are asking authority to increase its capital stock by $500,000—it is now $3,000,000—to enable it to increase its plants and to extend its underground system. As soon as the authority is obtained the company will go ahead, and complete what it has in contemplation to do.

Notwithstanding the general depression that prevails, there are several electrical firms in Boston that report more business than ever, one or two even declaring that collections are as good as ever they were.

General News.

What is Going on in the Electrical World.

New Orleans.—The St. Charles Street Railroad Company intend to change their line into an electric system.

Xenia, Ohio.—Mr. Neff has applied to the city council for right of way for an electric railway on Detroit street in this city.

New Albany, Ind.—The city council has given the Glenview Electric Railway Company one year longer time in which to build their road.

Jersey City, N. J.—The New York and New Jersey Telephone Company have begun putting their wires underground in this city.

Knoxville, Tenn.—The West End Street Railroad Company is showing commendable energy in replacing the old horse cars on its road by electric cars.

Oneida, N. Y.—The Oneida Railway Company's application for change of motive power on its line to electricity has been approved by the State Railroad Commission.

San Francisco.—The creditors of the San Francisco and San Mateo Railway propose to take immediate steps to liquidate the company's indebtedness and complete the road.

Cincinnati, O.—The Fort Thomas Electric road will be extended one mile beyond the fort, thus making fifty miles of track the Cleveland syndicate has laid at a cost of $1,972,000.

Niagara Falls.—The local Brush Electric Light Company has sold its plant to the Buffalo and Niagara Falls Electric Light and Power Company. The latter takes possession Oct. 1.

Toledo, O.—The city council committee on gas and light have made a recommendation that the city should provide its own plant for public lighting. The suggestion meets with approval.

Philadelphia.—The stockholders of the Frankford and Southwark Passenger Railway Company have voted to lease the property and franchises of the company to the Electric Traction Company.

Springfield, Ohio.—An electric line is being constructed from Magnetic Springs, north of Springfield to Columbus, by E. R. Hotzenpiler, of this city. He intends furnishing power and light to towns on the route.

Lockport, N. Y.—The proposed electric railroad between this city and Buffalo by way of Williamsville and Swarmsville is receiving much encouragement. At the first meeting held in its interest here about $12,000 was subscribed.

Columbus, Ohio.—The new Columbus and Westerville Electric Railway Company have begun work in earnest, and will push the work of building the road. The double pole system will be used, power being furnished from Columbus.

Oakland, Cal.—The East Oakland Street Railway Company has been granted a fifty years' franchise for an electric railway line extending through a number of streets near the city limits, with the right to carry freight as well as passengers.

Newark, N. J.—The force of the Westinghouse Electric Manufacturing Company has been materially reduced at the works here on account of over production. The men discharged were assured by the manager of the works that they would be re-employed in a short time.

Rochester, N. Y.—The water pipes in the vicinity of the Rochester Railway Company's power house on Centre street were recently found rotted at one end. Chief Engineer Kuichling ascribes this to the action of electric currents from the power house.

Albany, N. Y.—The Hudson River Telephone Company and the Union Telephone Company of Saratoga County have consolidated, the former company having purchased all the shares in the Union Company that were not already owned by the directors of the Hudson River Company.

Findlay, Ohio.—The contracts for city lighting for five years have been let. The arc contract was let to the Hancock Electric and Power Company for supplying the 135 arc lights used, while the incandescent contract was awarded to the Findlay Company.

Schaghticoke, N. Y.—The Schaghticoke Powder Company has entered into a large contract with New York parties for erecting an electric plant for light and motive power at the works. Five mills will be fitted at once with machines for that purpose. It is expected to have the plant in operation by November 15.

Utica, N.Y.—An electric road from this city to Sylvan Beach on Oneida Lake is a scheme that is meeting with much favor among the people along the route. It will probably be built. The entire length of road to be constructed under the proposed plan would be sixteen miles for a total length of twenty-six miles.

Bridgeport, Conn.—The Bridgeport Railway Company, the Bridgeport Horse Railroad Company, and the East End Railroad Company have consolidated under the name of the Bridgeport Traction Company. The capital of the new corporation is $2,000,000. The roads will be operathe by electricity.

Pueblo, Col.—The city council has granted right of way for poles, wires, etc., to the Land, Water and Power Company, the franchise to run twenty years. The company will give a $25,000 bond for the completion of its water power electric generating plant at Rock Canon and its readiness within a year to furnish power within the city.

Frederick, Md.—The construction of the electric road from Middletown to this city is, according to the terms of the contract, to be completed by October 10. The road will afterward probably be extended north by way of Mechanicstown and Emmittsburg, to connect with the electric road in course of construction on the battlefield of Gettysburg.

Drifton, Pa.—Coxe Brothers & Company are having an electric railway built from Buck Mountain, where a 40-foot vein of coal has been discovered, to Eckley, a distance of four miles. The same company, it is stated, intend fitting some of its collieries with electrical appliances for pumping, ventilating and other work, doing away entirely with steam power.

Duluth, Minn.—The Hartman Company's proposition to reduce the price charged the city for street lights about 15 per cent. on condition that its present contract be vacated and a new one executed to run for a period of five years from July 1, 1893, has been agreed to by the city council. The provisions of the contract will extend to West Duluth when that village becomes a part of the city.

Orange, N. J.—The Newark *Call* states that the Essex County Electric Company of Orange, which has had a practical monopoly of electric lighting in the Oranges, has just got ready to make an important change in its system for incandescent lights. It is the abandonment of the Heisler system of electric lighting and the substitution therefor of the Westinghouse multiple system.

Pottsville, Pa.—The building of the Beaver Meadow, Hazelton and Mahanoy City Electric Railway, one of the longest electric roads in the State, will again be prosecuted. The preliminary injunction against it for occupying or infringing on public roads of Schuylkill County has been discharged. The road will be run from Beaver Meadow to Mahanoy City, and thence probably to Pottsville, a distance of about forty miles.

Brattleboro, Vt.—The electric light company have just finished and will soon occupy their new power station. The building is of brick, one story high, with a large basement, and is 50 feet square. It will be furnished with five dynamos, a Rollins engine of 150 horse power, a Fitchburg engine of 150 horse-power and two large boilers. In addition there is a 21-inch wheel, which, as there is abundant water power, can be used to run the machinery.

St. Joseph, Mo.—The deed conveying the property of the People's Street Railway, Electric Light and Power Company from Master in Chancery Crandall to Frederick P. Olcott, chairman of the reorganization committee, thence to the St. Joseph Traction and Lighting Company, has been filed in the county recorder's office. The new company will issue $1,100,000 worth of 5 per cent. ten-year gold bonds, and have placed a mortgage on the property with the Central Trust Company of New York for that amount.

Sharpsburg, Pa.—The charter granted to the Allegheny and Kiskiminetas Electric Railway Company is for a road fifteen miles long, from Etna Borough to Sharpsburg, and connecting Aspinwall Borough and Hites Station in Deer township. The capital stock is $700 000. T. H. Hicks of Philadelphia, is the president, and the directors are Ezra Lukens, A. P. White and F. A. Phillips, of Philadelphia, and J. R. Davis of New York City.

Toronto, Can.—The Toronto Street Railway Company has had considerable trouble with its motors, and has decided to change them. The result is that Messrs. Ahearn & Soper, of Ottawa, have received orders during the past thirty days from the Montreal and Toronto companies for $150 000 worth of electric motors, dynamos, street cars, etc., the work on the main portion of which has been done in Ottawa. The new system of motors used by Toronto will be the Westinghouse.

Brooklyn, N. Y.—The effect of the competition of the trolley cars on the elevated roads of Brooklyn is plainly disclosed by the statistics of travel on the latter during the period of the operation of the trolley on the surface lines. During the last 23 days of June and the first 13 days of July there were 126,750 less passengers carried on the Kings County Elevated than in the corresponding period of last year. This is an average loss of 3,520 passengers a day. On the Brooklyn Elevated Railroad there was a corresponding loss.

Harrison, N. J.—Seventy-five girls employed in the fibre department of the Edison General Electric Light Works in Harrison struck last week against a material reduction of wages. The girls work piece work. It was understood that the company, after careful consideration, agreed upon the necessity of the reduction because of competition with other lamp makers, who had adopted new processes by which lamps could be made cheaper than at the Edison works.

Milwaukee, Wis.—The Milwaukee Electric Power and Lighting Company, according to the *Sentinel*, is to be reorganized. George Hiles holds a mortgage of $25,000 on the property of the company. It is proposed by reorganizing to lift this mortgage. The company has a capital stock of $150,000, only $60,000 worth of which has been sold. This stock will be assessed 50 per cent., and new stock will be issued to those who will subscribe to the assessment. Those who subscribe to the assessment will be kept in the company and those who do not will be dropped.

Duluth, Minn.—The new power station of the Hartman Electric Company is completed. It has some features worth noting. The building is 125x105 feet. The boiler, shaft and engine rooms are all isolated. There is an aggregate of 1,900 horse power generated by five engines. There are three classes of dynamos. The stack is of steel lined with brick for 200 feet above the foundation and tapers from 18 to 8 feet in diameter. The cost of the building was $60,000 and the machinery cost as much more.

Harrisburg, Pa.—A proposition has been made to the city authorities by a firm dealing in electric supplies to build an electric plant, erect poles, string all the wires and in fact equip an entire plant, if the city will pay to the company $36,000 per year, the sum it now pays annually for its electric light, for five years, at the end of which time the company will turn it over to the city to be run and controlled as city property. This company also proposes to build and equip a plant and turn it over to the city for $150,000 as soon as completed.

Hartford, Conn.—The *Post* of the 12th inst. draws this comparison of the two methods of electric propulsion which have been proposed for adoption on the lines referred to, and caused much discussion in official quarters: "Suppose the storage cars could run even on the Parkville line or the Farmington avenue line, they cannot draw 'trailers.' It takes two tons of cells to propel an ordinary car. Yesterday a trolley car left the city with five loaded cars attached to accommodate picknickers. It would have taken twelve tons of Usher cells to take the same load by storage with no open cars at that."

Lancaster, Pa.—A mortgage for $700,000, given by the Pennsylvania Traction Company to the Provident Life and Trust Company of Philadelphia has been filed here. The mortgage states that the Pennsylvania Traction Company proposes to include in its line the Lancaster and Philadelphia Electric Railway line, which will extend from Philadelphia to Harrisburg via Malvern, Downingtown, Coatesville, Parkesburg, Lancaster, Mount Joy, Elizabethtown and Middletown. The mortgage is given on all the electric and motor power and passenger railways contained in the company's system in Dauphin, Lancaster, Chester, Delaware and adjacent counties of Pennsylvania.

A Great Building With a Strange Name.

The term rookery suggests to the imagination a structure with yawning gables and a roof line as uneven as the back of a Bactrian camel—a tenement deserted by human occupants, and given over to the winds of heaven and the fowls of the air—a place such as Dickens delighted to invest with a weird and romantic interest for the edification of his Christmas readers;—but the building known by that name and situated in the heart of Chicago effaces such a fancy as soon as seen. It belies its title and presents no incongruous aspect amid the majestic piles that rear their fronts in its neighborhood. The present Rookery occupies the site where ten years ago stood the old and ricketty City Hall, at that time aptly named the Rookery, not only because of its general uncouth appearance, but as being the "forum," or jaw-shop, where in shiny broadcloth the "city fathers" and other crafty politicians assembled to expound their views on the sublunary concerns of the rapidly expanding municipality or to discuss ward problems which they could not solve "individually by thimselves alone" (as some of them may have remarked).

The Rookery of to-day as described in a neat brochure by George Cutter is one of the finest edifices in Chicago, although a pioneer among the modern office buildings. "Its construction, arrangement and careful management," Mr. Cutter says, "all suggest the opposite of its historic name." Its location gives it pre-eminence as a business building, being near the Post-Office, Custom House, Board of Trade and Grand Pacific Hotel. It is the centre of a circuit formed by the railway passenger depots, and is convenient to the prominent hotels, stores and warehouses. Several street car lines pass its doors, and others are nearby. "It is," says the writer of the pamphlet, "a nucleus for engineering and commercial work—a little business world in itself. The four thousand occupants, representing a hundred different lines, make the building quite a city. Ten swift passenger elevators give ready access to all its floors, while four hundred telephones and two telegraph offices keep up close connection with the outer world." The building is 175 feet square, with 900 rooms. In it are four banks, large safety deposit vaults, four express companies, the offices of a dozen railroads, several street car lines, lunch rooms, cigar stands, barber shops and other conveniences; but it is, perhaps, as an electrical headquarters that the great building more particularly commands the interest of our readers, and well it may, for in it are the offices of firms that control the lighting of a score of cities with a total of 5,000 arc lights, and 150,000 incandescents. Scores of electrical engineers, contractors, dynamo builders and dealers have offices in the building, and electrical and other trade journals have their representatives within its walls.

Among the most surprising things in connection with the building are its shipping facilities which are fully adequate to the requirements of the numerous occupants who have to send off their goods with dispatch.

Mr. Cutter well says there is considerable inspiration in being within a building animated as The Rookery is by a thousand active interests. Here he himself is congregated with his "pet specialties," devising new ones, filling orders for those already in favor, and doubtless contributing not a little to the inspiration he speaks of. The pamphlet is well worth reading, and we advise all who wish to get a fuller account of the famous building to procure a copy from its author, Mr. George Cutter, whose wide-spread trade in electrical appliances makes him one of its busiest tenants.

COMMERCIAL PARAGRAPHS.

The Railway Equipment Company, Pullman Building, Chicago, claim to be the only company in the United States making an exclusive business of manufacturing electric railway supplies. They furnish everything used in the electrical equipment of railways, and in the circular at hand call special attention to their Straight Line Insulator and Chicago Clamp, for which they have applied for a patent. Years of time and attention to the wants of *electric roads only* warrant the company in stating that they furnish "the most simple, effective and economical line devices manufactured." Their catalogue can be obtained on application to W. R. Mason, general manager, as above.

The Ansonia Electric Company are receiving orders for the V. W. Lightning Arresters and Wirt Dynamo Brushes from New Zealand, England, India and other foreign countries, which would seem to prove conclusively the sterling merits of these goods.

The Lundell Exhaust Fan Outfit for ventilating dynamo rooms, etc., can always be installed in a manner to obtain the best results by having an outfit in either end of the dynamo room, one to draw in cool air and the other to drive out the hot, thus keeping a constant change of air. Such an installation should be made so that the hot air is driven out through the street ventilators in the side walks. Hot air should not be driven into ventilating shafts. The motors are reversible so that the air can be taken from either side of the building depending upon the direction of the wind, thus insuring a perfect ventilation.

INCORPORATIONS.

The Seashore Electric Light and Power Company, Asbury Park, N. J.—to make, sell and furnish electricity for lighting, heating and power. Capital stock, $250,000.

The Miller Electric Company—to manufacture electric and mechanical appliances in New York City. Capital stock, $5,000. Directors: Sylvanus R. Miller, of Brooklyn; S. Shethar and P. Shethar, of Newcastle, Westchester County, N. Y.; E. A. Nichols, of New York City, and Charles H. Coffin, of New Rochelle.

Articles of association of the Buffalo City and Zinc Belt Telephone Company have been filed in the office of the Secretary of State at Little Rock, Ark. The business of the company is to operate and maintain a system of telephone lines through Independence, Stone, Izard, Fulton, Baxter, Marion, Searcy, Boone and Carroll Counties, Arkansas. Capital stock, $5,000. President, James Mix; secretary, Geo. Emmart, and treasurer, E. L. Hayes.

The Duplex Trolley Company—to manufacture electric machinery and appliances in New York City. Capital stock, $10,000. Directors: C. E. Chinnock and Joseph Bruns, of Brooklyn; D. E. Rose and L. Beyer, of New York.

The Schoharie Telegraph Company—to construct a line between Schoharie and Central Bridge, N. Y. Capital stock, $500. Directors: D. S. Mayham, Phillip Dey, George Taylor and others, of Schoharie.

The Santa Monica Electric and Power Company, Santa Monica, Cal.—to manufacture and deal in electricity for all purposes. Capital stock, $40,000. Promoters: H. V. Carter, Los Angeles, Cal.; F. W. Carter, Santa Monica; A. Steadman, Monrovia, Cal.; J. J. Davis and H. A. Winslow, Santa Monica.

The Hubbell Improved Battery Company, Portland, Me.—to manufacture and deal in electric batteries and machinery of all kinds. Promoters: Chas. J. Hubbell, Geo. H. Gardner, Samuel A. Fuller, James A. Riedel, Boston, Mass.

The Dubuque Light and Traction Company, Dubuque, Iowa—to construct, maintain and operate electric light and street railway plants. Capital stock, $600,000. Promoters: James S. Cummins, Walter J. Ballard, Edgar A. Duncan, Geo. K. Wheeler, John L. Martin, Dubuque, Iowa.

The Willamette Falls Company, recently incorporated, is an auxiliary of the Portland (Ore.) General Electric Company. The officers are: P. F. Morey, president; H. W. Goode, vice-president; C. H. Canfield, secretary; Chas. P. Thore, manager.

The Centralia Light and Power Company, Centralia, Ill.—to manufacture and sell gas and electricity. Capital stock, $31,000. Promoters: Seymour Andrews, F. Kohl, Geo. L. Pittinger.

The Technic Electrical Works, Camden, N. J.—to manufacture and repair electrical and other machinery, apparatus, etc. Capital stock, $20,000. Promoters: D. Pepper, Jr., A. L. Register, Philadelphia; J. J. Zimmele, Camden.

The Middletown Pipe Line and Power Company, Middletown, N. Y.—to utilize the water power of the Neversink River in generating electricity for transmission to Middletown for lighting, power and all uses to which electricity can be applied. Capital stock, $50,000. Incorporators: W. D. Stratton, H. W. Corey, E. A. Brown, Leander Brink, Charles H. Brink, Chester Belding, Geo. Smith, Eber L. Brown, of Unionville; E. M. Willis, Dr. J. B. Hulett, I. C. Jordan, Geo. S. Belding, Robert O. Lewis and H. S. Pound.

The Sioux City Electrical Supply Company, Sioux City, Iowa—to manufacture and deal in electrical machinery and supplies. Capital stock, $100,000. Promoters: H. D. Woodruff, S. G. Nelson, Sioux City.

The Nordlund Arc Lamp Company, Seattle, Wash.—to manufacture and sell arc lamps and electric appliances, own and operate plants for the purposes of furnishing electricity for lighting and other purposes. Capital stock, $15,000. Promoters: Andrew Chilberg, Robert J. Wilson, A. Amunds, L. B. N. Nordlund, Peter Wickstrom, Chas. A. White, Seattle; C. M. Nordlund.

The Baltimore, Middle River and Sparrow's Point Railroad Company, Baltimore, Md.—to construct and operate an electric railway between Baltimore and Sparrow's Point. Incorporators: Thomas B. Gatch, Levin F. Morris, Frank W. Trimble, John J. Forrester, James Sloan Hoskins and George R. Willis.

The stockholders of the recently incorporated Electric Traction Company of Philadelphia have decided to increase its capital stock from 1,000 to 50,000 shares of a par value of $50, making the capital $2,500,000.

The McMinnville and Smithville Electric Railway Company has been chartered at Nashville, Tenn., to construct and operate an electric railway from the depot of the Sparta branch at Nashville to Smithville, in DeKalb County, thence to the Nashville and Knoxville Railroad at a point near Silver Point and also to Brush Creek in Smith County, with lateral branches connecting with the main line. The incorporators are; W. G. Crowley, J. L. Calvert, A. B. Hooper, Z. P. Lee, B. M. Webb, T. B. Potter, E. J. Evans, W. A. Johnson, A. E. Potter, J. C. Webb, J. J. Smith, P. A. Pearson, John T. Potts, D. Osborn and J. L. Murphy.

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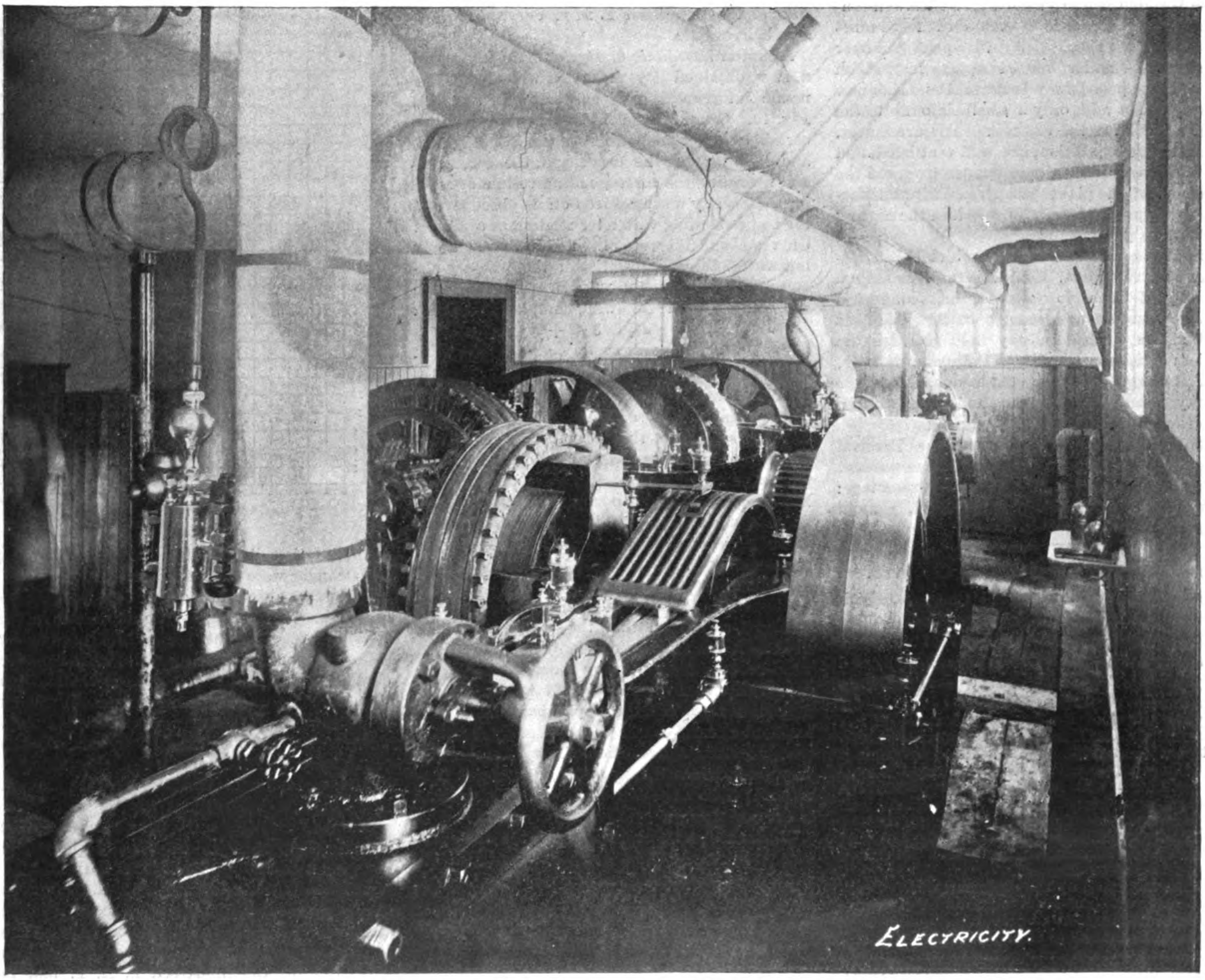

WADDELL-ENTZ PLANT, HOTEL WINDEMERE, CHICAGO. (SEE PAGE 26.)

The Hotel Windemere Plant.

The Waddell-Entz System Installed in Chicago.

The Waddell-Entz Company, which has become known as one of the successful introducers of storage battery systems, is now pushing its business in the line of dynamos, and the plant recently installed in the Windemere Hotel, Chicago, is one of the first of this kind to be used in the West, and illustrates the type of machines of which this company makes a specialty.

These machines, as will be seen in our Frontispiece, are of somewhat unusual construction, the pole-pieces being surrounded by the armature which acts as the fly-wheel of the engine, to which it is directly connected. The machine has six poles of soft cast steel, and only a single coil is used for the field winding. This coil contains both a shunt and series winding, and is placed against the yoke inside of the projections forming the poles. This frame is fixed rigidly to the engine frame, and the armature is placed upon the engine shaft, thus making a very compact and solid construction. The commutator carries six brushes which are connected in multiple.

The machines at the Windemere Hotel consist of three units, two of 50 K. W. each, and one of 30 K. W., and they are specially adapted for isolated plants on account of the small floor space they require. The dynamo room is only 30 x 14 feet in size, which, however, is ample for the three Waddell-Entz dynamos and McEwen engines which it contains, as each of the large units occupies a floor space of but 70 square feet over all, and the smaller one 54 square feet, which leaves ample passageway between the machines. The dynamos add only a small amount to the space needed for the engines. The armatures, owing to their position, are well ventilated, and run with a very small rise in temperature, and the operation of the plant has given entire satisfaction to the proprietors, who speak in the highest terms of its performance.

The Waddell-Entz Company, which has its factories at Bridgeport, Conn., is now making a specialty of these low speed direct connected dynamos, motors and storage batteries, and its work in the electric railway field includes the Harlem division of the Second Avenue Railway, N. Y., for which it has erected a complete storage battery plant, including generators, car motors, batteries, electric cranes, lighting, etc.

The officers of the company are Percival Knauth, president; M. Waddell, vice-president and general manager; J. A. Machado, secretary; A. A. Whitman, treasurer; J. B. Entz, general superintendent.

The International Electrical Congress.

The International Electrical Congress, which meets in Chicago August 21, is expected to include the most representative list of electrical men who have ever met in consultation, and every effort is being made to secure as large an attendance as possible. To this end Prof. Elisha Gray, president of the Advisory Committee, has appointed Mr. C. O. Baker as chairman of a transportation committee, and it is expected that a large Congress Special will run. A circular containing information for the benefit of Eastern members is in preparation by Mr. Baker, and will be shortly issued from his headquarters at 136 Liberty street, New York, where the National Electric Light Association has placed its offices and facilities at his disposal.

We are informed by the chairman of the Committee on Invitations that over 950 special invitations have been issued to date, besides a number of special invitations to electrical societies in different countries, and the replies received indicate that the gathering will be a notable one, especially in the number and distinction of the foreign representatives.

It is expected that the attendance will number upward of 500, and the indications point to a most interesting nad brilliant event.

Practical Aspects of Low Frequency Electrical Resonance—III.*

BY M. I. PUPIN, PH.D.

7. EFFECT OF IRON ON THE RESONANT RISE OF POTENTIAL.

I have already remarked that iron behaves in a peculiar manner when under the inductive action of a resonant flow of electricity. Allow me to call your attention to the diagram of Fig. 9. This curve was obtained with the machine and the circuits which are given in Fig. 7, except that the inertia coil D had smaller self-induction. Keeping the speed of the machine and the self-induction of the circuits constant, the difference of potential in the condenser was varied by varying gradually the capacity of the condenser. Taking then the capacities for abscissæ and the corresponding voltmeter readings for ordinates, the curve in Fig. 9 was obtained. As you see, the curve has two maxima. The corresponding capacities are to each other as 1 : 9. Hence the impressed E. M. F. can be represented by

$$E = E_1 \sin pt + E_3 \sin 3\,pt.$$

A comparison of the smaller maximum to the larger shows that E_3, the amplitude of the upper harmonic, is very small in comparison to E_1, the amplitude of the fundamental. This is surprising, because from the construction of the alternator one would expect a much stronger deviation of the impressed E. M. F. curve from the simple harmonic.

A similar *harmonic analysis* of the impressed E. M. F. obtained by means of the electro-dynamic interruptor gave curves I, II and III, Fig. 10. Curve I was obtained by inserting a certain capacity in shunt with the primary coil, and then varying the capacity in the secondary and recording the corresponding voltmeter reading. Capacity was measured off as abscissa and the corresponding voltmeter reading as ordinate. Curves II and III were obtained in the same way but with different capacities in the primary circuit. The impressed E. M. F. in each case can be represented by the following complex harmonic:

$$E = E_1, pt + E_3\ in\ 3\,pt + E_5 \sin_5 pt.$$

But the amplitudes, E_1, E_3 and E_5, are different in each case. You see, therefore, that this method of harmonic analysis by the resonant rise of potential is very sensitive in detecting upper harmonies. Hence the natural conclusion that curve Fig. 9 indicates no strongly developed harmonics, simply because they were not present. Yet it is very difficult to suppose that my alternator generates practically a simple harmonic E. M. F. when one considers the shape of its armature core.† This point evidently deserved additional investigation.

I inserted a few iron wires into the inertia coil D, Fig. 7, and found that the upper harmonic, weak as it was, disappeared entirely. The iron wires became hot in a very short time. I suspected that iron when subjected to strong magnetization wipes out the upper harmonics in a resonant circuit. With the electro-dynamic interruptor the magnetization of the iron cores is very weak, hence the persistence of upper harmonics. This suspicion was verified in subsequent experiments.

When the inertia coil D was packed with iron wire then the resonant rise was very much diminished, as is evident from the curve in diagram Fig. 11.

Various considerations led me to the conclusion that Foucault current and hysteresis losses were not the only causes of this remarkable diminution of the resonant rise due to the presence of iron. I will mention one only. In one of my experiments I used the primary coil of a small closed magnet circuit transformer for the inertia coil and found that as far as I could detect with my apparatus no resonant rise could be obtained with 100 volts of impressed E. M. F., no matter how low the frequency was which my machine could produce. About 75 periods per second was the lowest frequency which I employed. If, however, the secondary coil of this transformer was short-circuited then the resonant rise appeared, but not nearly as strong as it ought to have been, even Foucault currents and hysteresis losses taken into account. The self-induction of the primary (with secondary short-circuited) calculated from the capacity which produced resonance was far too high. There were unmistakable evidences in this, and in all my other experiments in which iron was present in the inertia coils, that the lower the frequency the stronger were the resonance effects.

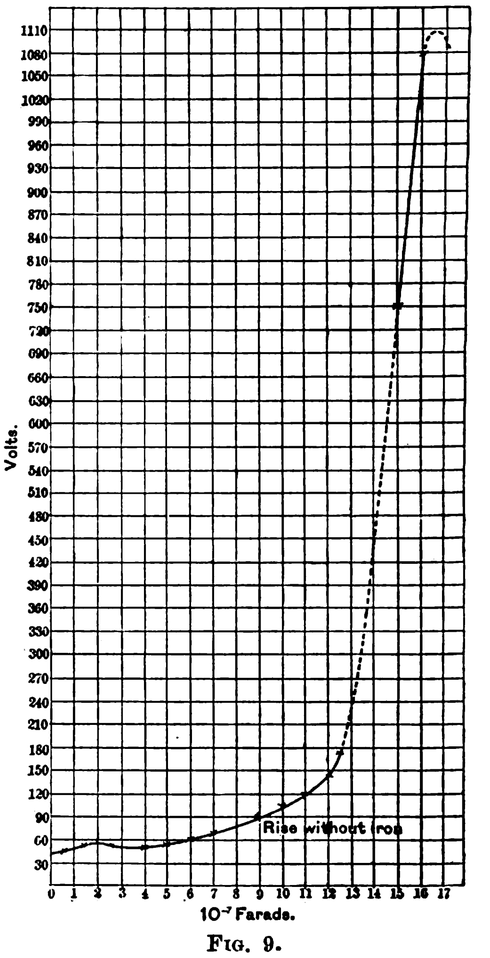

FIG. 9.

When an alternator giving 125 periods per second was substituted for the alternator in Fig. 7 (which gave about 350 to 375 periods per second), then the resonant rise with iron wire core in the inertia coil D was one-half of that when no core was used, the impressed E. M. F. being 45 volts. If, however, the impressed E.M.F. was raised, then this difference in the two cases continually diminished. When the impressed E. M. F. was 200 volts, then the resonant rise with iron was more than without it.

There seems to be in the iron a certain reluctance against getting into full swing when under the inductive action of resonant current. The higher the impressed E. M. F. and the lower the frequency the easier it is to overcome this reluctance. When the iron has once been set into full swing, then it is possible by careful manipulation to lower the impressed E. M. F. and increase the frequency without getting the iron out of this swing. In a closed magnetic circuit this reluctance seems to be exceedingly great.

With a frequency of 50 periods per second the resonant rise with iron was invariably more than without it. Two features in the peculiar behavior of iron were brought out by the resonance experiments with this low frequency machine. These two features, I venture to suggest, deserve more than ordinary attention.

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* A lecture delivered at the Tenth General Meeting of the American Institute of Electrical Engineers, Columbia College, New York.

† The armature core was a Crocker-Wheeler tooth armature.

The first peculiar feature is exhibited in the two curves, Figure 12. Curve II was obtained when the whole iron wire core (about 500 wires each 40 cm. long and 1 mm. in diameter) was inserted into the inertia coil. The other curve was obtained when only one-half of the core was employed. The frequency was maintained constant. From the critical capacity in the two cases it is evident that there was much less difference in the coefficient of self-induction in the two cases than one might expect from the difference in the quantities of iron, that is, if we suppose that in this case also the natural period of the circuit is independent of the frictional resistances due to magnetic hysteresis. But even if we drop this hypothesis, still the small difference in the capacity in the two cases appears as puzzling as ever. We have resonance in this case also as in any other case, but it is evident that the conditions of resonance are not determined by self-induction and capacity alone. The question arises then, what does resonance mean in this case? Well, it means the largest current and the highest rise of potential, but this maximum potential and current are not necessarily accompanied by zero difference in phase nor by neutralization of self-induction with capacity.[*] The practical bearing of this result needs no further comment.[†]

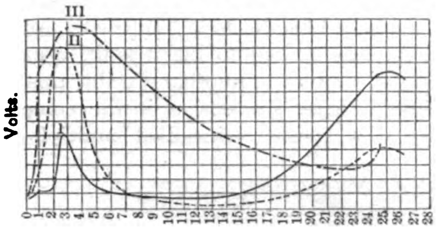

FIG. 10.

There is another point to which I wish to call your attention in connection with curves I and II of Fig. 12. It is this: Although curve II was obtained with twice the quantity of iron, and therefore with at least twice the losses due to Foucault currents and hysteresis (since the magnetizing current which circulated in the inertia coil with resonance corresponding to curve II was considerably larger than that corresponding to resonance of curve I), yet the rise of potential in curve II was larger than that in curve I. I do not wish to take up too much of your time in showing you all of the difficulties which one encounters in endeavoring to explain these matters satisfactorily. Suffice it to point out merely that these difficulties do exist, and that they deserve our most careful attention.

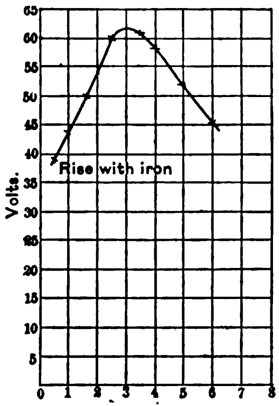

FIG. 11.

Before making the next step in my discourse I wish to remark that a circuit consisting of the armature of an alternator, a large inertia coil without iron, and a condenser, all in series, does not exhibit any of the peculiarities just mentioned, at any rate not to any considerable extent. Such a circuit can be tuned and a high resonant rise of potential can be thus produced, provided, of course, that this rise of potential is not accompanied by so heavy a current as to produce a serious armature reaction. Foucault current and hysteresis losses in the armature iron cannot, of course, influence this resonance, since they are taken care of by the motor which rotates the armature.

The second peculiar feature in the behavior of iron when it is under the inductive action of the resonant current of an inertia coil will be exhibited to you in the following experiment; the arrangement is just the same as that given in the diagram of Fig. 7, with the following exceptions: This alternating current ammeter is in the resonant circuit. The motion of its index, which I hope can be seen all over the room, will indicate to you the progress of tuning. I watch it on this side by means of a multicellular voltmeter which is denoted by F in the diagram of Fig. 7. This four-pole 1 H. P. alternator which Dr. Laudy, of Columbia College, kindly lent me, takes the place of the 16-pole alternator. Inertia coil, alternator and condenser are in the series. The driving motor can easily take care of 2 H. P., so that the speed will remain constant during all variations of the load, since, as you will presently see, the load will never be over 150 watts. The condenser has now 16 M. F. capacity plugged in. The frequency is about 50 periods per second. The impressed E. M. F. is 45 volts. To bring the circuit in resonance with the impressed E. M. F. it is necessary to insert iron wires into the inertia coil. I insert now about 400 wires. It is, as I can see from the voltmeter reading, considerably too much, and therefore there is no resonance, as you can see from the ammeter. I take the iron wire bundle and raise it slowly, and now I can feel by the pull on the bundle and also by the voltmeter reading that I have reached the point of resonance. You can see it by the ammeter deflection. The ammeter indicates 1 ampere; in reality it is about 2 amperes. [This instrument is a lecture room model and its reading must be multiplied by a large correction factor.] Now I lower slowly the iron wire bundle again; the resonance persists. I have reached now the same position from which I started and when there was hardly any resonance effect. But as you see, this time the resonance effect is very strong. But it is a resonance which resembles very much a supersaturated zinc sulphate solution. A very small crystal thrown into such a solution will cause a sudden precipitation of innumerable small crystals. So it is with this resonance. If I now bring a single iron wire near the bundle, its mere approach upsets the resonance almost completely, as you see from the sudden drop of the ammeter needle. But if I add this wire whose mere approach upsets the resonance almost completely, and even five other wires, to the bundle, and then by gently raising it start the resonant flow, I can then lower it again without disturbing resonance, as you see it from the deflection of the needle.

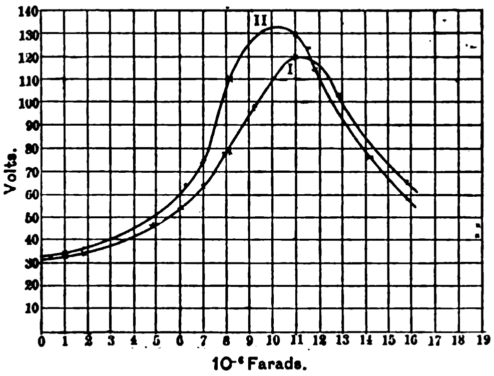

FIG. 12.

I shall vary now the capacity by taking out carefully one plug after the other. But I must take out these plugs without causing a spark. Here is one plug out, and here another, and four more. I have reduced the capacity by 1 M. F. or nearly 7 per cent. of the total capacity. There is hardly any change in the resonance effect, as you see from the ammeter needle. Now I shall carefully put back the plugs, and even more than I have taken out, but carefully avoid sparking. As you see, resonance still persists without any apparent change. Now I take out one plug and vary the capacity by only 0.1 M. F., but I take it out in such a way as to produce a strong spark by the renewal of the plug. The experiment does not succeed. But here it succeeds at the removal of a 0.3 M. F. plug. The collapse of the resonance effect is, as you see, almost complete. Generally I succeed with even less than a 0.1 M. F. plug.

The same peculiarities appear also at higher frequencies, but they are not nearly as clearly defined at frequencies over 100 as they are at those of less than 50 periods per second. They are certainly not due to any change in the speed of the machine produced by the variation of the load due to the rise of the resonant current. Nor is it probable that they are due to armature reactions. This last point, however, deserves a closer examination than I have been able to give it as yet.

One more point I feel that I ought to mention before I end my discourse. It is a point which I think may have some practical importance sooner or later. When a large inertia coil without iron is joined in series with the armature of the alternator and also with a condenser and then the circuit is tuned, so as to analyze harmonically the shape of the impressed E. M. F. curve, I find in all the machines that I have tried so far that this curve is almost perfectly free from upper harmonics, even with frequencies of 50 periods per second. If, however, the armature is closed by the primary of a transformer, then upper harmonics will appear, as for instance in the arrangement in Fig. 7. I do not think that these upper harmonics are entirely due to the variation of the permeability of the transformer core during each complete cycle, as has been suggested by very competent authority.[*] A different interpretation of the phenomenon is possible. My experience in this matter favors the view that the upper harmonics are due to the interference between the electromotive forces generated in the alternator and the transformer. I prefer, however, to devote more time to the examination of this exceedingly important subject before venturing to discuss the validity of this possible new interpretation.

Allow me now to sum up briefly the main points of this discourse.

The practical bearing of "Low Frequency Electrical Resonance" in so far as I have worked out the subject seems to rest on the following characteristic features:

It brings out very prominently the purely mechanical character of the phenomena of electricity, and it does that, not by referring to carefully prepared delicate experiments of a skilled physicist, but by referring to phenomena which every electrical engineer can observe every day in the testing room, telegraph and telephone station, and in central stations for power and lighting. A full appreciation of this purely mechanical character of the phenomena of electricity is of the greatest practical importance, for we must remember that the founder of this mechanical view, the immortal Maxwell, in opening this new view of electrical phenomena contributed to the advance of this science as much as, if not more than, any other investigator of this century.

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[*] Professor Duncan informed me yesterday that he arrived at this conclusion in a somewhat different way. See paper already referred to.

[†] Especially when Dr. Duncan's more definite conclusions on this point are taken into account.

[*] See Professor Duncan's paper already cited; also H. A. Rowland—"Notes on the Theory of the Transformer," *Phil. Mag.*, July, 1892.

It offers a new, simple and exceedingly convenient method of transforming electrical energy from low to high potential.

It enables us to observe very accurately the behavior of dielectrics and of iron when under the inductive action of resonant currents, and thus to determine the exact limits within which condensers can be employed in the solution of electrical engineering problems.

It offers a new and exceedingly simple method (the method of harmonic analysis mentioned above) of studying the working of alternating current machinery under various conditions of load.

It points out a new and apparently very promising direction in which the difficult but exceedingly important study of the magnetic properties of iron can be pushed ahead.

In closing my remarks I wish to thank my pupil, Mr. Milton C. Canfield, for the very efficient assistance he has given me in the preparation of this lecture.

(Concluded.)

World's Fair News.

Among the exhibits made by foreign firms none will be found more interesting than that made by Felton & Guilleaume, of Carlswerk, Mulheim-on-Rhine, Germany. The exhibit is in the section devoted to the German Government, which is situated in the northeast corner of the Electricity Building. The background of the space is occupied by a magnificent glass fronted show-case, which is divided into eleven compartments, containing specimens of some typical class of goods manufactured by the firm. The following are among the goods exhibited:

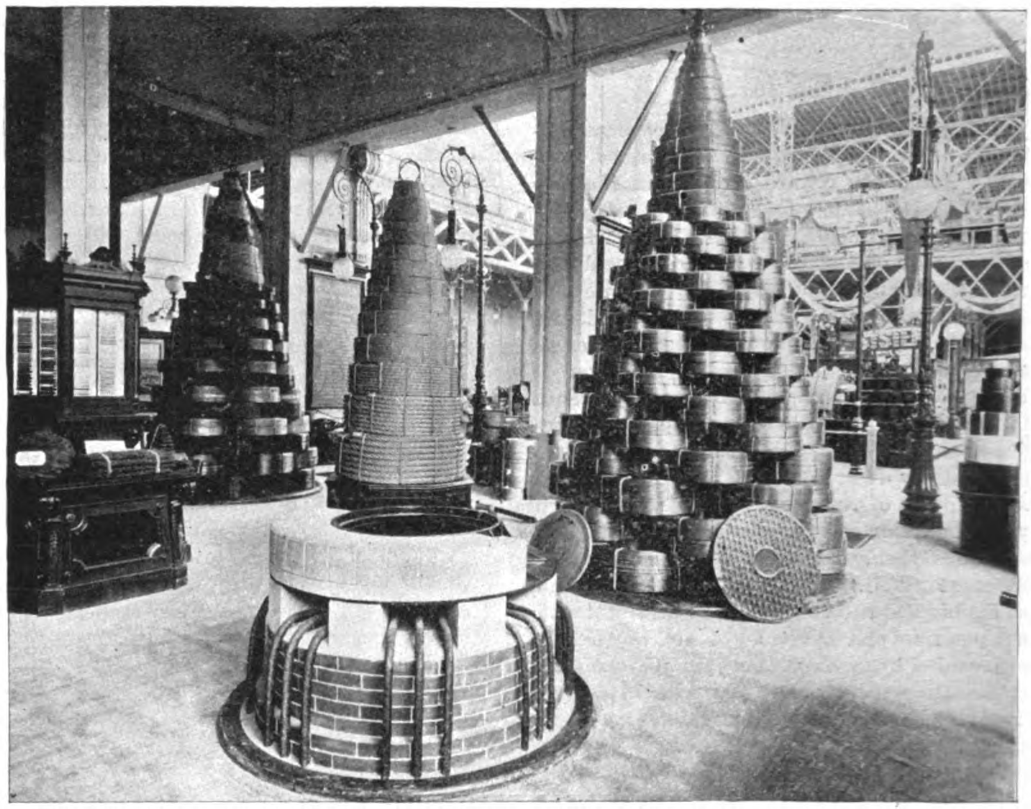
Telegraph cables covered or insulated with indiarubber, gutta percha, impregnated fibre and paper and air space, the latter of which is a valuable patent of Felton & Guilleaume. Torpedo cables are also exhibited in great variety, as are also telephone cables. Electric light cables in various insulations are represented by various specimens, among which are some very interesting cables made for transmitting high frequency alternating currents. Besides the specimens represented in the cases, different specimens of wire and cable have been arranged in the form of pyramids in the foreground, as illustrated in Fig. 1. Some idea of the magnitude of the exhibit may be found if it is borne in mind that the base of each pyramid is 25 feet in diameter and weighs over ten tons. The firm of Felton & Guilleaume are represented in the United States by J. H. Bunnell & Company of New York.

The details of the tests which are to be made on the electrical apparatus by the Committee on Awards was finally adopted last week. The tests are to be of three kinds, and are designated as tests A, B and C. They are as follows:

"A" tests: Not less than one or more than three complete tests are to be made with each apparatus to ascertain the economy in the use of steam and the relation of the indicated H. P. to the electrical output; one of such tests to be made with a load corresponding substantially with the maximum efficiency, one near the minimum allowable load, and one near the maximum allowable load.

"B" tests: Partial tests, supplementary to the above, without measuring the water evaporated, but varying the load by gradual increments through the practicable range to be made for comparing the indicated H. P. with the electrical output.

"C" tests: These tests are designed to aid in distributing the energy developed in the engine in excess of that shown by the output in watts, to include friction tests of engine and a determination of the resistance caused by exciting the field with the main circuit open; they include also tests of electrical resistance, heating of armature, field, etc.



Felton & Guilleaume's World's Fair Exhibit.

Arrangements have been made so that all apparatus to be tested shall be operated at least four hours with a load of not less than three-fifths of its full capacity before the committee take charge of it to test. The first complete or "A" test is then to be made, to be followed by the minimum "A" test, and that to be followed by the maximum "A" test. In case the committee find that they cannot complete a test at one time, the rule as to operating the dynamos for four hours before each test shall be followed the same as in the initial trial. The same preliminary is to be carried out in the tests designated B and C.

The following additional names have been added to the committee since the last report:

Ralph W. Pope, secretary of the American Institute of Electrical Engineers.

Dugald C. Jackson, Professor of Electrical Engineering, University of Wisconsin.

William Schraeder, Professor of Physics and Engineering, University of Missouri.

A. B. Ayres, Tulane University, Louisiana.

S. R. Tompkins, Professor of Electrical Engineering and Physics, Clemson College, South Carolina.

The question of signs seems to have taken possession of the exhibitors occupying the Electricity Building. Since the Westinghouse Company led off with the big Columbus sign on the south wall, the other companies have realized the value of advertising space, and have therefore applied their names and business to nearly every portion of unoccupied space around the building. The Fort Wayne Company have started the painters at work on the north wall of the Electricity *Building*, and it is expected that their name will be indelibly stamped upon the public mind, although the sign occupies a position at the opposite end of the building from their exhibit. The General Electric have also been infused with the sign idea. Last week two signs, 10 by 80 feet, bearing the company's name in large gilded letters were hung from the east and west balconies.

The Western Electric Company are continually adding novelties to their exhibit. The last is a horseshoe magnet, tightly secured to the floor, the pole pieces projecting upwards. An armature with a polished handle is laid across the top, and the public is invited to lift it as the current is turned on and off. Another exhibit that is attracting its share of attention in the company's display is a recently installed multiple drill press. This machine consists of twenty-four adjustable spindles so arranged that twenty-four different and distinct holes can be bored at one operation. The machine as exhibited is used in turning out souvenir blocks in which all of the different holes are drilled with the company's name on one side and "Drilled at One Operation" on the reverse, all of the work being done at the same instant.

On invitation of Helen Louise Johnson, editor of *Table Talk*, and by the courtesy of the Ansonia Electric Company, the Board of Lady Managers assembled in the north gallery of the Electricity Building last Wednesday, and listened to a very interesting lecture, with practical illustrations, on cooking by electricity. After the lecture a light lunch which was cooked by electricity was served.

A proposition is reported having in view the closing of the greater part of the Fair buildings in the evening. Director-General Davis has sent a communication to the Council of Administration recommending that hereafter all the Exposition buildings except the Electrical, Machinery and one other be closed every night. The Director-General's letter means that the Electricity Building shall be the only exhibit building fully open every night; that Machinery Hall shall be open only so far as relates to the operation of the machinery, and that the third building to which night visitors will be admitted shall be changed from night to night.

Electrophone Service.

The electrophone is practically the telephone modified in such a manner as to serve the purpose of transmitting sound from public buildings, such as concert halls, theatres, churches and lecture rooms, to certain centres for redistribution, thence to receiving points by conductors radiating from these centres or exchanges. The scheme was originally tested in London, but Paris was the first city to put it into practical use. It is now more than four years ago that the "Theatrephone"—to give it the French title—was started by a Parisian syndicate, formed for that purpose, and in that short period it has achieved a distinct success. At the present time the list of subscribers numbers over 1,500, with a rapid and continuous increase, and their installation is connected with all the principal theatres in the city. During the Electrical Exhibition at the Crystal Palace, the idea was given a trial which extended over five months, several of the London and one or two provincial theatres being included in the experiments. A charge of sixpence was made to the public, and during the period named 57,922 persons passed the turnstile of the hearing room, realizing a total receipt of £1,448. Still it was the marked success attained by the Parisian company as a permanent going concern that really suggested the formation of a syndicate for the purpose of establishing the system in London, though on a much more complete and comprehensive basis ; for, while the object of the French company seems, at any rate at present, limited to catering for the amusement of the public by supplying them with *petits morceaux* from their favorite theatres, the range of the English company is intended to be much greater. The initial part of their programme is, however, identical with that of the French company, viz., to enable the public, by payment of a small fee, to hear a portion of the entertainment proceeding at one or other of the London theatres, and this object is attained in the following manner. Specially constructed transmitters are placed on the stage of the theatre, just in front of the floats (or footlights), from whence the sound is conveyed over the wires of the National Telephone Company to the electrophone exchanges for redistribution to private subscribers, and a system of automatic boxes, which it is proposed to fit up in clubs, restaurants, railway stations, hotels, and similar places of public resort. The insertion of a coin in the box entitles one to a hearing of from five to ten minutes of the entertainment that may be on the circuit at the time. At the expiration of the fixed period automatic disconnection takes place. These boxes are controlled from the exchanges, and when an *entr'acte* occurs at one theatre they are all connected with another. The company, says *Industries and Iron*, has already arranged with the leading London theatres, and indeed connections are already completed with the following: Criterion, Gaiety, Comedy, Lyric, Prince of Wales', Shaftesbury, Trafalgar Square, Empire, Alhambra, Olympic, Grand and Royal Aquarium, and a room has been fitted up at the Earl's Court Exhibition where selections from the entertainments at the above houses can be heard during the evening. The result has been entirely satisfactory, music—either choral or solo, vocal or instrumental—or dialogue being transmitted with absolute clearness, a result which is attained by the use of a double metallic circuit, so that each listener hears on four wires.

The amusement portion of the scheme is not confined to London theatres, etc., only, for the provincial theatres will also be included. The latter, however, will not apply to the automatic boxes, but will only be available to private house subscribers to the National Telephone who, by making special arrangements with the Electrophone Company, can enjoy the music or dialogue of either London or provincial theatres in the privacy of their own residences.

In addition to places of amusement, it is anticipated that connections will be established at the Law Courts, and it is hoped that it may, later, be possible to obtain the same privileges in the House of Commons. Several members of Parliament are strongly in favor of the idea. Of course, this part of the scheme is, as yet, only a possibility, but it must be said that the electrophone people seem very hopeful that they will ultimately be able to announce it as an accomplished fact. One thing in their favor is that the transmitters are very small, and could be fitted so as to be invisible to any ordinary observer.

The whole of the rights for England of the French patents have been acquired by the Electrophone Company, but important modifications and improvements have been made in the system of working, while the automatic boxes are the work of an English inventor, and are held by the company under British patent. In addition to the work already designated the company contemplate attaching an intelligence bureau to their central exchange for the convenience of their customers, where commissions of any kind will be carried out for subscribers for a small fee. The bureau will be made as complete as possible in its operations, the idea being to provide means of saving time to clients. Thus there will be a shorthand writer and typewriter, who will be at the disposal of any registered subscriber who may wish to drop in and dictate letters, etc., while a registered subscriber wishing any small commission carried out, or any inquiries instituted, has only to telephone to the bureau to insure his desires being executed. The whole of the installation work of the company is carried out by the National Telephone Company, who have agreed not to carry any similar service from places of amusement or public resort for any person or persons other than the Electrophone Company for a certain period of years. In conclusion, it may be mentioned that the Electrophone Company are prepared to supply their system in connection with theatres and churches to the principal London hospitals free of any charge beyond that of actual cost of installation. This would be a source of pleasure and comfort to the thousands of sufferers who, during each year, are treated in these institutions.

The Hodgkins Fund Prizes.

In October, 1889, Thomas George Hodgkins, Esq., of Setauket, New York, made a donation to the Smithsonian Institution, the income from a part of which was to be devoted "to the increase and diffusion of more exact knowledge in regard to the nature and properties of atmospheric air in connection with the welfare of man."

With the intent of furthering the donor's wishes, the Smithsonian Institution now announces the following prizes to be awarded on or after July 1, 1894, should satisfactory papers be offered in competition :

1. A prize of $10,000 for a treatise embodying some new and important discovery in regard to the nature or properties of atmospheric air. These properties may be considered in their bearing upon any or all of the sciences—*e. g.*, not only in regard to meteorology, but in connection with hygiene, or with any department whatever of biological or physical knowledge.

2. A prize of $2,000 for the most satisfactory essay upon—

(*A*) The known properties of atmospheric air considered in their relationships to research in every department of natural science, and the importance of a study of the atmosphere considered in view of these relationships.

(*B*) The proper direction of future research in connection with the imperfections of our knowledge of atmospheric air, and of the connections of that knowledge with other sciences.

The essay, as a whole, should tend to indicate the path best calculated to lead to worthy results in connection with the future administration of the Hodgkins foundation.

3. A prize of $1,000 for the best popular treatise upon atmospheric air, its properties and relationships (including those to hygiene, physical and mental). This essay need not exceed 20,000 words in length; it should be written in simple language and be suitable for publication for popular instruction.

4. A medal will be established, under the name of the Hodgkins Medal of the Smithsonian Institution, which will be awarded annually or biennally for important contributions to our knowledge of the nature and properties of atmospheric air, or for practical applications of our existing knowledge of them to the welfare of mankind. This medal will be of gold, and will be accompanied by a duplicate impression in silver or bronze.

The treatise may be written in English, French, German or Italian, and should be sent to the Secretary of the Smithsonian Institution, Washington, before July 1, 1894, except those in competition for the first prize, the sending of which may be delayed until December 31, 1894.

If no disposition be made of the first prize at the time now announced, the Institution may continue it until a later day, should it be made evident that important investigations relative to its object are in progress, the results of which it is intended to offer in competition for the prize. The Smithsonian Institution reserves the right to limit or modify the conditions for this prize after December 1, 1894, should it be found necessary. Should any of the minor prizes not be awarded to papers sent in before July 1, 1894, the said prizes will be withdrawn from competition.

A Great Electric Scheme.

A party of Eastern capitalists, said to have some connection with the Santa Fe Railroad system, has been visiting the Grand Canyon of the Colorado River for the purpose of investigating the feasibility of laying an electric cable 500 miles in length along the river with which to drive small steamers up through the Black Canyon and other scenic points, where the cliffs, over a mile in height, overhang the stream. Power is to be generated by water-wheels driven by the current of the river itself, or wherever feasible the water will be diverted into canals cut in solid granite walls and dropped into the river again.

A copper wire cable will be suspended over the centre of the river, which is for the most part about 300 feet in width, and electric power will be conveyed to small steamers similar to the manner of running electric railways. The idea is that this will become the most popular route for tourist travel, in comparison to which the Yosemite will sink into insignificance. Another and main feature of the scheme is to convey surplus power down the river, where it will be used for pumping the water of the river to a height of from fifteen to twenty feet upon mesa lands for irrigation, converting an area larger than Massachusetts, now a desert, into a garden patch, where land is now valueless, and where fruits ripen in April, May and June, commanding the highest market prices.

It is announced that the New York, New Haven and Hartford Railroad Company has decided to follow the example of the Pennsylvania Railroad, and erect along its entire system a line of long distance telephones with which to transact its business between important points. It is figured that there will be big economies in substituting the telephone for the telegraph.

ELECTRICITY.

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R. H. WILLOUGHBY, - - ASSOCIATE EDITOR.

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INDEX TO VOL. IV.—The Index to Vol. IV of "Electricity" is now ready, and will be mailed to any address, upon request, from the main office, 6 Park Place, New York, or from our branch offices in Boston and Chicago.

The Storage Battery Situation.

The unfortunate litigation in which a large number of electrical patents have been involved has been the means of retarding the development of the art in many directions, and in no instance is this fact more apparent than in the case of storage batteries. A glance at the progress of this industry at home and abroad will amply attest this fact, and it is only necessary to examine the course pursued by the holders of the broadest patent in this country to explain the fact that in the manufacture and use of accumulators America is at least five years behind Europe.

It is perhaps not equally apparent why those having this business largely under their control have made no effort to keep abreast of the times by perfecting and introducing an article for which so great a demand exists, but it must be remembered that this company is controlled by the Trust, which evidently considers this branch as an interference with its other business, and only holds these patents as a means of obstructing any advances in this line.

It is well known that the company claiming to legally manufacture the only practical storage battery has never produced anything more substantial than a laboratory toy totally unfit for any kind of continuous or severe service, and has taken every advantage of the law to suppress competition. This of course is to be expected, as it is but natural for a company to make its patent claims as broad as possible; nor could any objection be urged against it except for the fact that, like the dog in the manger, it has refused to do anything itself and has prevented, as far as possible, anybody else from making any progress. The attitude assumed by this company is an acknowledged policy of obstruction which would place an efficient battery of this type for central station or railway work out of reach as long as this patent exists. The success which has met these efforts is unfortunately too complete, as there is probably not one concern in this country that can supply accumulators which can compare in quality or performance with any of those now in common use in many European stations.

In traction work the same lack of progress in this direction exists, and elsewhere will be found described this company's effort to bulldoze a competitor after its own apparatus had been rejected. As the opposition in this instance have a strong case, it is to be hoped that they will maintain their stand through the courts, and confine the obstructionists to the strict limit of their patents.

……o……

HOLDERS of General Electric shares had one consolation when they saw the price drop to 31¼. There was only $31.25 more to lose on every share they held—unless, as in Richmond Terminal, there was an assessment of $1.50 a share before they could get out clear.

More Lamp Factories Closed.

The advantages gained by the Trust in recent lamp litigation should not be underestimated. While they can not result in any material increase of earnings for the Trust itself within the next three months, they may easily pave the way for a further abuse of the privileges intended to be granted under the United States patent law.

The flat refusal of the New York Edison Company to sell lamps for use on an isolated plant in the Holland House, this city, noted in another column, is a fair example of what may be expected in the future. The equally flat refusal of the proprietors of this building to change their method of lighting, and their purchase of a supply of Westinghouse lamps, is proof of the fact that the purchasing public may be looked to to support independent manufacturers.

While we look for a complete victory for the outside interests at the final hearing in the Oconto case, which is soon to come up, and the early re-opening of the closed lamp factories, this is no time to idly await developments, or to go to sleep.

No opportunity should be lost for striking a blow at the Trust, and ELECTRICITY's only regret is that it is not able to print seven issues a week instead of one issue.

……o……

The Aid of Congress Must be Invoked.

By the time this issue of ELECTRICITY reaches our readers in the West, Congress will have convened in special session, and it should be invoked to lend its aid to secure justice to the entire public in the matter of the supply of electric lights—a public necessity—and to those who have invested their money in good faith in electrical manufactures.

The best interests of the art and of the trade demand that the Electric Trust should be compelled to abandon its illegitimate use of United States patents and to reorganize on an honorable and business-like basis.

If every man in the trade does his full duty in laying this matter before his Representative in Congress, a full and impartial investigation of the methods of the Electric Trust can not be avoided.

Such an investigation would result in the annihilation of the Electric Trust.

ELECTRICITY has on hand a number of copies of the blank forms of petition, printed two weeks ago, which we will be pleased to send free of charge to those who can use them.

The Trust scheme is not yet dead. It has, indeed, been crippled by the mismanagement of its own officials, and is temporarily weakened. But it is even now preparing to again raise its ugly head in defiance of the law, of decency, and of justice to invested capital.

Now is the time to strike—the time for every enemy of monopoly to do his duty.

……o……

THE Electric Trust having sold apparently all its treasury assets, the question arises, What will it sell the next time it needs money in its business? Will it sell its factory machines and office furniture?

The Truth is Coming Out. The developments in General Electric affairs last week were no surprise to those whose acquaintance with T-H. business methods extends back six or eight years.

They were not a surprise to the Wall Street speculators, who have a cruel habit of forming their own judgment of the affairs of a company, regardless of the high standing of the executive heads, and regardless of the number of official misstatements put forth.

If any one was surprised it was those stockholders who have paid no attention to the affairs of the company but have merely relied on the statements put forth by various members of the Board of Directors. And there is a mild suspicion abroad that some of these Directors, upon whose good names the company has lived for a year and a half, were also surprised. The comments of the *Tribune* are noteworthy as leading to this opinion.

It is the honest opinion of ELECTRICITY—and our opinion is reinforced by the judgment of the best-informed men in the business—that the company has from the start been paying money for dividends which never should have left the treasury, and that *a rigid adherence to the spirit of the law would have made the payment of any dividend whatever an impossibility.*

A synopsis of the various reports given out from time to time since the company was founded will appear in due season; if the same methods had been pursued by men of less standing in their respective communities, there would have been talk long before this of vigorous proceedings.

As the case stands to-day, the worst charges made by ELECTRICITY are thoroughly substantiated. Thousands of investors have lost their money in the largest electrical enterprise in America; they have lost it through the basest kind of misrepresentation, and the entire electrical business of the country will be the sufferer for a long time to come. Capital will not be easily found henceforward for any electrical enterprise whatever.

When we went to press last week we scarcely looked for the fulfilment of our prophecies to come so soon. But from the partial report which we have obtained of what took place at the Directors' meeting, referred to elsewhere, there is no reason to doubt that Drexel, Morgan & Company are in actual control of the company, and that a radical change in the management will not long be delayed. There is, further, no reason to doubt that the sub-companies in which the old T.-H. element were largely interested as individuals, have been worked to milk the parent company in a way that was scarcely looked for by the New York members of the Board of Directors. There will be a speedy end to this sort of thing.

The Boston clique, notwithstanding their brilliant record as financiers in New England, have proved themselves but children in Wall Street knowledge, and their usefulness as actual managers is at an end. There can be no doubt in the minds of any student of the situation that it required the strong arm of Mr. Pierpont Morgan himself to save the company from wreck.

Little by little the truth is coming out, and it will yet be plain to the bitterest enemies of ELECTRICITY that we have been too moderate in our criticisms.

That the General Electric Company has reached a turning point there is not a shadow of doubt. The success of the company will now depend on the thoroughness with which the T.-H. element are weeded out, and the liberality of the policy pursued towards their honest competitors in the field.

Until there is some assurance from headquarters that these suggestions will be acted on, there will be no diminution of the odium under which the company is now suffering, no softening of the feeling of bitter hatred which permeates the trade.

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What Does It Mean? In April last the General Electric Company published its first annual statement, making the flat assertion that the net profits for eight months had been upwards of $3,000,000, but withholding all information in regard to volume of business done and running expenses.

And the stock went down.

Some weeks ago there were many rumors afloat that the company was in serious need of funds, and that trouble was near at hand.

The stock went down.

These rumors were officially denied.

The stock still went down.

Then came the sale of New York and other local Edison illuminating companies' stock—a confession that the statements referred to had not been correct. At about this time the vice-president of the company was quoted in an interview as saying that the company "had been" in need of funds, but that the sale of these Edison illuminating companies' stocks would give them plenty of cash for a long time to come. Then the vice-president denied having made such an admission. Afterwards, we are told, he denied his denial.

The stock continued to go down.

Then came the official statement, which was not denied, that the proceeds of the sale of these gilt-edged treasury assets would pay all maturing obligations of the company then in sight.

And the stock again went down.

At this point the Wall Street bears asserted that these treasury assets had already been used as collateral for loans, and that the margin left to go into the Trust's treasury was not large; and ELECTRICITY asserted that when a man pawns his watch or his best suit of clothes he must be in need of funds.

And the stock went down.

Last week the Directors met "to consider new contracts," as it was announced.

And again the stock went down.

After the Directors' meeting it was officially announced that it had been decided to sell $4,000,000 of treasury assets, which would pay off all the floating debt, and that 70 per cent. of the $4,000,000 had already been pledged.

And the stock went down.

The next morning it was rumored that Drexel, Morgan & Company had secured a controlling interest in the company.

And the stock went up.

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The Art of Drawing Specifications. The manner in which the agents of the General Electric Company endeavored to make a sure thing of the contract for installing the proposed plant at the Joliet Penitentiary, as related last week, will surprise no one familiar with the methods of the Trust. The drawing of specifications is a fine art, and no one understands it better than the General Electric Company. It is gratifying to know that the plan has not worked smoothly at Joliet, and that before the plant is installed there will be a square deal.

That crookedness existed, and that crookedness was relied on to milk the State Treasury of $15,000 to $20,000 there can be little doubt.

To the Chicago *Tribune* is largely due the credit for frustrating the scheme before it was fully developed.

The manufacturer, whether of dynamos, engines or boilers, who becomes a party to any scheme whereby other manufacturers are practically barred from competition for a contract of this nature, publishes to the world the fact that he is afraid of competition, and the only inference is that he is *particeps criminis* in an intended robbery; either his apparatus is not up to the standard or he hopes to get more than the market price by a "divide" with the person authorized to make the purchase.

It looks at this distance as though both the latter were features in the Joliet affair.

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Arc Lamp Specifications. For years the agents of the Thomson-Houston Company, and lately of the General Electric Company, have given special attention to the drawing of specifications for plants upon which they were to bid and upon which they hoped to be the only *actual bidders.* They have never hesitated to adopt whatever means were necessary to bring the engineer around to their views, and in a great many cases they have been successful.

In the matter of arc lighting they have, on account of their ownership of certain patents on double carbon arc lamps, been industrious in their efforts to convince the public that the double-carbon lamp was the only practical all-night lamp, and they have been too successful in this regard. Whenever the opportunity presents itself, they get a clause worked in to the specifications that bids will not be accepted on single-carbon lamps.

This is a radical injustice, and it is time the public were made aware of the fact and of the reasons for the particular solicitude of the Trust lest single-carbon lamps be admitted to the competition.

The fact is that there has been material progress in the making of arc lamps in the past few years, and there are now single-carbon arc lamps on the market which are guaranteed by responsible manufacturers for all-night service, and in many places throughout the country they are in use and giving perfect satisfaction.

And moreover the single-carbon lamps have a decided advantage in the fact that they are simpler in construction, more easily attended to, and less liable to get out of order.

Purchasers of electrical apparatus, whether individuals or corporations, should see to it that the field is left open for free competition. In no other way can they be sure of getting good value for their money.

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We take pleasure in assuring the Electric Storage Battery Company of Philadelphia that Electricity is with them. We believe they have a good battery. And moreover, we wish to emphasize the fact that the Brush patent, which has been from the beginning in the hands of people who cannot make a good storage battery, has been used long enough as a club to knock in the head all progress in that branch of the art.

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While the New York *Sun* is recognized everywhere as the brainiest newspaper in America, there has always been a strange fatality attending its prophecies, showing that a man may be a good scribe and at the same time a poor prophet. This has been especially marked in matters of finance and politics. As an example, within forty-eight hours after the *Sun* proclaimed General Electric a good buy at 45 or thereabouts the stock dropped to 33.

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The Brooklyn City Railroad, which has had about 600 T.-H. car equipments in use for the past year, has used better judgment in placing its last order for 100 motors. Fifty of them will be of the Curtis Electric Company's make and fifty of the Westinghouse type.

A Remarkable Statement.

How the General Electric Company Tried to Silence Criticism.

(*From the Brooklyn Citizen.*)

"In the vicinity of eighty people who had ventured to criticise the conduct of the General Electric management were threatened with imprisonment. When the stock was selling out at 75 it was suggested in this column that but for the fact that criticism or adverse comment regarding the policy of the management or the condition of General Electric was almost an indictable offence a few plain remarks might be made."

The outrageous attempt to throttle Electricity made by the Trust is a matter of record. The failure of that attempt is also, we are proud to say, a matter of record.

The day that General Electric securities were listed on the New York Stock Exchange the affairs of that company became of public interest, and were legitimate subjects for newspaper comment.

The desperate effort made by the officials to keep the facts from the public has been one of the chief causes of the loss of confidence by its stockholders.

If the company's affairs had been in a healthy condition the publication of a full and clear statement would have been the natural course to pursue.

When all the vital facts were suppressed—the gross business done and running expenses—it was conclusive proof that they were not fit to publish.

The Trust may threaten eighty people with arrest every day in the year, but Electricity will, as heretofore, publish all the news and draw its own conclusions.

Legal Notes.

The Packard and Buckeye Lamp Factories Closed.

On Friday, July 28, Judge Ricks, of the United States Circuit Court for the Northern District of Ohio, on behalf of the Edison Electric Light Company et al., granted restraining orders against the New York and Ohio Company of Warren, Ohio, and the Buckeye Electric Company of Cleveland.

Judge Grosscup is Needed in New York.

On June 30, as announced in Electricity at the time, Judge Lacombe granted an order restraining the Holland House and others in this city from using Sawyer-Man lamps. Thirty days were granted to provide new lamps. The Holland House has a Westinghouse isolated plant. The proprietors applied to the Edison Company for lamps, but were met with a flat refusal unless they would also use the Edison current.

Finally, a supply of the Westinghouse stopper lamps having been purchased, the hotel was properly lighted without any infringement on the Edison patent.

Suit has been begun in the Circuit Court at Chicago by Campbell, Zell & Company of Baltimore, Md., against the Illinois Electrical Forging Company for $25,000. The action is brought to collect an account of $22.500 for boilers and machinery supplies furnished the defendant company and for damages and costs.

On Thursday last two suits were begun in the United States Circuit Court, New York, by the Edison Electric Illuminating Company, respectively against the Mount Morris Electric Light Company and the United Electric Light and Power Company, for injunctions restraining them from supplying current for incandescent lamps. These suits are the first suits brought on the patent in question against competing central station companies. The hearing will be held before Judge Lacombe on the 2d inst.

Commissioner Seymour of the Patent Office has rendered a decision in the disbarment proceedings of Church & Church against Foster & Freeman, attorneys for the Bell Telephone Company, and William E. Simonds, late Commissioner of Patents. Mr. Seymour finds that Foster & Freeman are not guilty of wrongdoing, as charged. As to ex-Commissioner Simonds, he finds that what he did was within his discretion as Commissioner, and that the taking of the copies of the Drawbaugh application, especially as he had the consent of Secretary Noble to do so, was not, under the rules of the office, a matter of which he could be cognizant. The complaint, therefore, against all of the parties was dismissed.

The Brush Electric Light and Power Company of Niagara Falls has made application to Justice Ward, of the Supreme Court, for an order of voluntary dissolution. The order is desired to enable them put affairs in shape to be sold to the Buffalo and Niagara Falls Electric Light and Power Company.

Death of John Stephenson.

John Stephenson, the pioneer of American street railway car builders, died on Monday, the 31st of July, at his home near New Rochelle, age eighty-four. He was born in County Armagh, Ireland, and came to this country with his parents in 1811.

Flight of Charles C. Lockstaedt.

Charles C. Lockstaedt, who put in a bid for lighting the World's Fair in the name of the South Side Machinery Company and afterwards turned the matter over to the Westinghouse Company, who secured the contract, has fled from Chicago, after having discounted notes for upwards of $50,000 to which he had forged the name of the Westinghouse Company.

General Electric.

Notes and Comments from Various Sources.

The collapse of the General Electric securities discloses a large floating debt on the heels of the declaration of a dividend at the rate of 8 per cent.—*New York Times.*

At a meeting of the Board of Directors of the General Electric Company it was decided to offer to the stockholders securities now in the treasury sufficient to pay the entire floating debt of about $4,000,000. Of the amount necessary to underwrite the above, seventy per cent. has already been subscribed. The dividend will be paid on Tuesday in cash. A circular will be issued early next week offering to the stockholders for every 100 shares of stock $1,500 par value of the securities in the treasury, which are to be sold at a price to net 80 per cent. of their par value.—*Statement of the Board of Directors.*

At the office of the General Electric Company to-day there was a positive refusal to add anything to the brief and indefinite statement made yesterday afternoon concerning the conclusions reached by the Board of Directors. It was requested that the "securities in the treasury" referred to in that statement as to be used for the payment of the entire floating debt of $4,000,000. be specified, but the request was denied.—*Evening Post.*

The inference from the statements made by officials of the General Electric Company for weeks and months was that this concern was placed in an impregnable position when $6,000,000 of the 5 per cent. debentures were floated some time since. The claim now that the insiders took the series at par and have also been heavy losers on the stock does not go far towards restoring confidence.—*World.*

The raid on General Electric was helped, undoubtedly, by liquidation in that stock on the part of tired holders, who are tired not only of the continued decline in the quotations, but also of the mystery that is observed concerning the operations of the company's business.—*Daily America.*

The statement that the company had something to sell looked as though they needed money and were willing to let go their household effects to obtain it. Another criticism was that it looked strange for a company in such a condition to declare with one breath that it needed money and with the next to assert that the dividend, due August 1, of 2 per cent. was waiting in cash to be paid.—*World.*

It would appear from these statements that the worst about General Electric is now known. This may be true as to its future but not as to its past. According to excellent information, the company has not derived the fullest benefits that it might from its dealings with subsidiary corporations.—*New York Sun.*

Within two months it was stated on high authority that the company had cash or quick assets much beyond its present obligations. It is hardly credible that a floating debt of $4,000,000 has been incurred in sixty days.—*Tribune.*

The untoward developments in the financial situation recently, rather than any sense of their duty to their security holders, have finally compelled an acknowledgment by the eminent capitalists referred to of the actual condition and necessities of the General Electric Company.—*Brooklyn Citizen.*

The official announcement that the General Electric Company had a floating debt of $4,000,000, and that it was forced to sell treasury assets in order to meet these obligations, was a most disagreeable surprise. It is only two months ago that an officer of the company stated that the sale of its Edison Electric Illuminating stock furnished money enough to meet all its obligations for some time, and it is within two weeks that the directors declared the usual quarterly dividend of 2 per cent. It is no wonder that the price of the stock fell abruptly.—*Tribune.*

Litigation Invited.

The Consolidated Electric Storage Company Must Prove Its Allegations.

The Electrical Storage Battery Company of Philadelphia, one of the few competitors of the Consolidated Company, has come into violent collision with the latter on the question of patent infringement and has taken steps to bring the question before the courts at once. The Metropolitan Railway Company of Washington recently adopted storage batteries on their road and have been trying a number of different makes of batteries, of which the "Chloride Accumulator" made by the Philadelphia Company proved one of the best.

The Consolidated Company, which under the Brush patents claims everything in this line except the plain Planté plates, notified Mr. Pearson, President of the Metropolitan Railway, in February and again in July, that they were about to proceed against the Philadelphia Company, and warned him against purchasing or using the chloride batteries. The following reply from Mr. Gibbs, of the Philadelphia Company, speaks for itself:

Electrical Storage Battery Company,
Drexel Building,
Philadelphia, Pa., July 27, 1893.

MR. WILLIAM BRACKEN, President Consolidated Electric Storage Co., New York, N. Y.

DEAR SIR: I am favored with copies of your letters of the 27th of February and 24th of July, 1893, to Mr. George W. Pearson, President of the Metropolitan Railway Company of Washington, D. C., wherein you state that the battery manufactured by the Electric Storage Battery Company of Philadelphia is a clear infringement of the Brush patents, and of which "there is no earthly doubt."

There may be no doubt in your mind. This is not surprising, as you seem to be completely ignorant of the state of the art as applied to the manufacture of storage batteries, but you will find the very greatest legal doubt when you come to take the advice of competent lawyers and experts who are familiar with the state of the art and do not rely upon your statements. No competent lawyer or expert can honestly advise you, with a full understanding of our battery and your Brush patents, as construed by the courts, that our battery infringes any claims of your Brush patent.

You show your ignorance of our battery when you say "They cast a lead frame or support around tablets of active material," for we do nothing of the kind. Our tablets are not of active material when the frame is cast around them, and that even you ought to know considering the experience you are supposed to have had with storage batteries. Our active material is formed out of the tablets by electrical disintegration after the tablets are cast and the frame cast around them. Again, the claims of your Brush patent, as construed by the courts, are not for "active material of absorptive substance," but for a "plate or suitable support primarily coated or combined with mechanically applied active material or material adapted to become active," as you no doubt know, and should have said had your desire been to truthfully advise Mr. Pearson instead of to deceive him to our injury.

By what authority do you say our battery infringes the claims of your Brush patent? Surely on the authority of no court, for, you well know that no court has declared our battery to be an infringement, and although we have been, to your knowledge, openly engaged in manufacturing our batteries for some years, you have not, down to this moment, proceeded against us, although threatening to do so for nearly eight months past. You apparently propose to dispose of our battery and business without even resorting to the courts wherein such questions are usually determined.

Undoubtedly this is the safest way for you, considering that our battery is totally unlike any battery yet held to be an infringement of your patents, and that it is a battery 100 per cent. better in every particular than any battery ever manufactured by you or under your patents. It certainly is a great burlesque on your intelligence or the intelligence of your engineers that we are able to manufacture a battery 100 per cent. better than any you ever produced if any features of your patents are employed by us.

Unlike you, we have sufficient confidence in our position to submit the question to the courts empowered to consider and determine such questions, and there we invite you to meet us at once, and unless you do so or discontinue your libelous statements against our battery, we will take such steps as we are advised are open to us to protect our interests.

We are advised by our counsel and experts that our battery does not infringe any of the claims of your patents, and having confidence in their opinion we propose to continue making and selling our battery, and shall protect and save harmless all users of them, not only as against any claim you may make, but against all claims from whatever source.

Now, being advised of our intentions we demand, in view of statements made in your letter to Mr. Pearson, and to other parties, that you proceed at once against us on a bill for infringement, accompanied with motion of injunction, so that the question of our infringement of your patents may be determined; and to that end we advise you, viz.:

We are a New Jersey corporation with a factory at Gloucester in that State where batteries are being manufactured daily, and we will at any time furnish you with one of our batteries, at the usual price, accompanying same with a sworn statement of precisely how they are made, with permission to use the same in any proceedings against us.

We have, to avoid delay, authorized our counsel, Mr. John R. Bennett, Potter Building, New York City, to accept service of papers in our name and to aid you in every way possible to reach the courts at the earliest possible moment, and you can arrange with him, either direct or through your counsel, for one of our batteries and a statement of its construction.

If you have confidence in your position you will, of course, accept our most reasonable proposition to proceed against us at once, and if you do not we hereby notify you that we shall proceed against you to protect our interests, holding you responsible for the damages resulting to our business by the making of statements and the sending out of such unfounded libelous letters as you have sent to Mr. Pearson.

Very truly yours,
W. W. GIBBS, President.

Mr. Gibbs's opinion as regards the non-infringement is supported by Dr. C. F. Chandler, who, in a report on the chloride accumulator, says:

"In conclusion I am therefore of the opinion that your battery does not either in itself, in the process by which it is manufactured, or in its use infringe the claims of the Brush patents.

"I am familiar with all the batteries that have been held to infringe the Brush patents, and in all of them the distinguishing features of the Brush invention as set forth in the above quoted passages of the opinion of the Court of Appeals were clearly present.

"No battery such as yours has been held to be an infringement of the Brush patent, and from my understanding of the opinion of the court of last resort, the Circuit Court of Appeals, such conclusion would be impossible."

The chloride accumulator plates are manufactured in the following manner: Chloride of lead and chloride of zinc mixed in the proper proportions are cast into rectangular tablets which may be then subjected to such treatment as will withdraw the chloride of zinc and at the same time decompose the chloride of lead and thus convert the tablets into plates suitable for use in storage batteries without any further mechanical treatment.

It is customary, however, to first incase the tablets in a frame of metal, which serves to hold them rigidly and protect them from injury in handling. This is accomplished by placing the tablets of chloride of lead and chloride of zinc in a suitable mould and pouring in a melted alloy of lead and antimony, which flows around the tablets, forming a frame in which they are firmly and permanently fixed.

The above constructed plates of chloride of lead and chloride of zinc are not capable of use in a storage battery. They are not capable of serving as oxygen plates as they will not absorb oxygen.

They are not capable of use as hydrogen plates, as not only would their immersion in the dilute sulphuric acid of a storage battery cell result in contaminating the fluid with chloride of zinc, which would be fatal to its proper action as a storage battery fluid, but the effect of hydrogen liberated would, if any action took place, be to form hydrochloric acid with the chlorine of the chloride of lead, which hydrochloric acid would further contaminate the fluid and make it inoperative as a storage battery fluid; moreover, these tablets are non-conductors of electricity.

It is evident, therefore, that the plate of tablets consisting of chloride of lead and chloride of zinc is worthless in its present condition as a storage battery plate, and cannot be used as such. Its chemical composition must first be radically changed in order to fit it for service in a storage battery either as an oxygen or as a hydrogen plate. This chemical change is brought about by means of a bath of chloride of zinc or some equivalent substance in which the plate of tablets is to be immersed in connection with a slab of metallic zinc. This arrangement is in fact a primary battery in which the zinc acts as the positive element while the tablets constitute the negative element.

The chemical action in this combination results in withdrawing the chloride of zinc from the tablets by simple solution in the bath, and the withdrawal of the chlorine of the chloride of lead from the tablets and the fixing it in combination with the zinc with the formation of chloride of zinc.

The chloride tablets in the plates are not in any sense active material, nor are they material capable of becoming active in a secondary battery fluid.

They only constitute material which may be subsequently rendered active by the electrical disintegration which is brought about when they are connected with the zinc plates in the bath of chloride of zinc. When the process of electrical disintegration is complete and we have washed all the chloride of zinc out of the plate, we have a mass of metallic lead which is suitable for immediate use in a storage battery without the tedious forming process of Planté, and without the application of any active material or material about to become active by the processes of Brush or Faure.

Cleveland Likes the Trolley.

The Cleveland City Railway Company has announced that it will abandon cable power on its Payne Avenue line, about three and one-fourth miles in length, and equip it with the trolley this fall. This company is a consolidation of the Cleveland Cable Railway Company and the Woodlawn Avenue and West Side Street Railroad Company. The latter road was equipped early in the spring with the trolley on all its lines but one, which still retains horses, and when the combination was effected it was predicted that the cable would be superceded by the trolley.

Cable traction has not been a signal success here and the trolley has. The cable road was built to float bonds on rather than to earn dividends on its stock, and it has been found that electric traction is cheaper here than cable and less likely to suffer complete paralysis from a broken cable.

It is believed that the Superior Street cable, which is the other branch of the road, will be replaced as soon as practicable by electricity. It is clear that the cable cannot compete with the trolley in Cleveland.

Among the wedding presents of the Duke of York and Princess May was an electric launch from the Royal London Yacht Club.

Boston Notes.

As the topic uppermost in men's minds in Boston the present week has been the General Electric Company's affairs, so it is entitled to first mention in these notes. There is no gainsaying the fact that everybody is becoming interested in the Trust, and as each succeeding day has dawned the interest has increased until just now, when it may be said that matters are at white heat. Slump, slump, slump has been the action of the stock, and these repeated tumbles, helped by the well founded statement that 2,000 employees have been laid off at Lynn, and the removal of the railway department to New York, have caused such universal consternation that everybody feels confident the end is near. When stocks begin to go off 8 and 9 points at a bound as General Electric has done to-day, no wonder men begin to exclaim, "Where are we at?" and "Listen, if you want to hear something drop."

That is a mighty powerful searchlight that has just been finished by the Schuyler Electric Company of Middletown, Conn., if we may believe the newspaper reports which state that, with lens and mirror five feet in diameter, the light shown by this monster will be equal to 375,000,000 candle power. We rather suspect the printer has wrongly added three ciphers, thus making millions when they should have stated 375,000 candle power. A light of the last named power is a good deal of a flame and indicates how useful electricity has become for lighting up the dark corners of the earth.

We have heard of two or three magnificent contracts for lighting plants ready for placing in New England as soon as the commercial and financial outlook improve. For no other reason are they withheld for the present, and this is an indication of the boom that may be expected as soon as the clouds lift, and that they will lift ere long is the sincere wish of everybody engaged in the electrical as in all other businesses.

Col. L. W. Burnham, the genial manager of he Electric Gas Lighting Company of this city, was to have left Boston for a two weeks' sojourn in Chicago in company with his daughter on Wednesday, but owing to a sudden attack of sickness he has been unable to start this week. Col. Burnham is so widely known and universally respected that his innumerable friends all over the country will receive this intelligence with regret.

A gigantic and handsome electric switchboard is in course of construction at the works of the W. S. Hill Electric Company, for the Boston Museum, the popular old family theatre, that is being renovated throughout and equipped with electric lights, fans and other devices.

The great gathering of cyclists and others at Waltham last Monday evening to see the races that were run under the brilliant rays of innumerable electric lights were more than pleased with the entire arrangements. Though several of the crack wheelmen did not materialize, the crowds thoroughly enjoyed themselves, the electric illuminations demonstrating the practicability of having out-door sports and pastimes arranged to take place after darkness has set in with as great assurance of their being successful as on the most brilliant day.

The frequent exceedingly hot days we have had of late have given quite a boom to the fan motor business, so that every local manufacturer of these useful devices has been about cleared out of his stock, hence the factories are kept pretty busy in that particular line. More than one Boston firm has already sold every fan motor equipment it can make up to the end of the season.

The large factory that is being erected in Milford, Mass., for the building and equipping of storage battery electric cars is being pushed by the company, which does not seem at all daunted by the defeat it has sustained recently in the State Legislature. So sanguine is the company that it is a matter of only a few months, or at most a year or two, when the public will insist on storage battery propulsion, that it is determined to be ready for that time, although even now it is doing quite a business in its own special line and has more to come.

General News.

What Is Going on in the Electrical World.

Denver, Col.—Moonlight excursions over the electric lines here are a popular fad this summer.

Gettysburg, Pa.—Notice to vacate the battlefield has been given to the electric railway company that was laying its tracks within the lines of the battle.

Aurora, Neb.—Bonds have been voted by this city to put in an electric light plant in connection with the waterworks. The city will own both the waterworks and the electric light plant.

Norwalk, Ohio.—Work on the Sandusky, Milan & Norwalk Electric road is at a standstill, and the men have been laid off on account of lack of funds caused by the present financial trouble.

Memphis, Tenn.—The great driving-wheel in the electric power house here exploded on Friday last, the flying pieces tearing up the building and instantly killing the engineer, Patrick McDermott.

Smyrna, Mich.—The Spencer Electric Light and Power Company, which recently filed articles at Belding, will put in two large dynamos at Symrna, utilizing the excellent water power at this place.

Flatbush, L. I., N. Y.—The Knickerbocker Electric Light and Power Company has been granted a franchise to "conduct and distribute electricity for lighting, for power or traction within the town of Flatbush."

Woodhaven, L. I.—The Jamaica town board, having rejected the bid of the Suburban Electric Lighting Company to furnish Woodhaven with arc lights at $80 per lamp, this village will remain in its present unlighted condition.

Washington, D. C—Negotiations have been concluded through which the Great Falls Electric Railroad has passed into the possession of a syndicate, the controlling interest being held by Stilson Hutchins and Jacob P. Clark.

St. Louis, Mo.—The East St. Louis Electric Street Railroad Company has increased its capital stock to $500,000 and issued bonds, the proceeds of the sale of which will be used to complete the double track extension to Fireworkstown.

Buenos Ayres, S. A.—Mayor Latrobe, of Baltimore, having heard that Buenos Ayres had an excellent system of electric lighting, wrote to the American consul for information about it, and the consul's reply was that Buenos Ayres is lighted by gas.

Leavenworth, Kan.—The city attorney has been instructed by the city council to institute proceedings in the District Court to compel the dummy line to forfeit its charter. This means that the company will either build an electric road or be deprived of all rights in the city.

Baltimore, Md.—The Southern Electric Company, of Baltimore, has made a voluntary assignment. Failure to collect overdue accounts made it impossible for the company to meet its obligations. The assets of the concern are estimated at $175,000; liabilities, $100,000.

San Francisco.—At the annual meeting of the stockholders of the California Electric Light Company the old board of directors were re-elected. The directors organized and elected the following-named officers: President, John R. Spring; vice-president, George H. Roe; secretary, J. R. Green; treasurer, the Nevada Bank.

Portsmouth, O.—Work on the Portsmouth electric railway was begun on the 20th inst. "amid music and oratory." Speeches were made by George Davis, president of the company; Sam Timmonds, its secretary; Jas. Whiteley, the contractor, and by leading citizens. After the speech-making the band played enlivening airs.

Elmira, N. Y.—At the conclusion of the Knights of Pythias parade here on Wednesday last, Manager Baldwin, of the Elmira and Horseheads Electric Railway, ran a solid train of sixteen cars to Eldridge Park, carrying nearly a thousand people. This is believed to be the greatest train ever run in this country by electric motors.

New York.—On Thursday night last the entire telephone plant at the Eighteenth street branch of the Metropolitan Telegraph and Telephone Company was destroyed by a fire which gutted the building. The plant was valued at $40,000.—The sheriff, on Friday last, sold out the effects of the Electrical Device Company, No. 42 Wall street.

Philadelphia. — President Widener, of the Metropolitan Traction Company, states that the business of the Catharine and Bainbridge streets road gives an example of the success of the trolley in Philadelphia. The thirteen cars on that line run by electricity are making five hundred and sixty miles per day, more mileage than was made by eighteen horse cars, and the receipts have averaged since the starting an increase of sixty per cent.

Boston.—The creditors of Jerome Redding & Company, electrical engineers and manufacturers of electrical goods, have decided to have the business continued by the assignee, the committee being continued to act in an advisory capacity in co-operation with him. The direct liabilities are about $6,500 and the indirect $500, while the assets nominally aggregate about $12,000. It is thought that the creditors will eventually get their pay in full.

Pittsburg, Pa.—The electric fountain to be donated to Schenley Park, this city, by the Fifth Avenue and Duquesne traction companies has been ordered, but it will not be completed for a month. It will probably be in operation by September 1. The plans are elaborate and the total cost will reach $20,000. The makers promise that it will be the finest of its kind in the world, surpassing even the remarkable fountain in Lincoln Park, Chicago, one of the wonders of that city.

Danville, Ky.—It is reported that a syndicate of wealthy Englishmen have purchased the Cumberland Falls, in Whitley County, and will erect there an immense electric plant, utilizing the falls as a motive power. From this plant they expect to furnish light and power to cities, corporations and individuals at a distance at a nominal cost. They also propose to build an electric passenger and freight railway from Jellico, via Williamsburg and the falls, to some point on the Cincinnati Southern Railway.

Noblesville, Ind.—The officers of the Chicago and Central Indiana Electric road a few days ago filed a petition with the board of commissioners of Marion County, at Indianapolis, asking for the privilege of running their tracks along the highways of said county to Broad Ripple, and thence to the corporate limits of Noblesville. The petition was withdrawn temporarily to arrange some details, and will be filed again. Three lines have been surveyed. It is said a novel storage battery by a local inventor will be tested by the company, and if approved will be used on the road.

Paterson, N. J.—The New Jersey Improvement Company, composed of New York, New Jersey and Philadelphia capitalists, is said to be preparing to build an electric railway between Paterson and New Brunswick, passing through or near Montclair, Orange, Plainfield, South Orange, Bloomfield and Metuchen and skirting the Orange Mountains for thirty miles. The officers of the company are: President and general manager, Jacob L. Stadelman, of Bath, Pa.; secretary, John N. Bethel, of Philadelphia; treasurer, Charles E. W. Smith, of Morristown; directors, Lewis C. Mans, Philadelphia; Roland F. Hill, New York; A. D. Thompson, Plainfield; and William N. Mills, Boston, Mass.

Lancaster, Pa.—The Pennsylvania Traction Company's board of directors have elected Hon. John J. Patterson president of the company. Work will be started immediately on the main line from Philadelphia to Harrisburg, but the first system that will be built will be what is to be called the Lancaster system. This is to consist of five different lines and they are all expected to be completed and equipped by Christmas. The speed of fifty or sixty miles an hour is expected to be attained on the main line, which is intended to compete with the Pennsylvania Railroad for passenger traffic.—A branch of the National Brotherhood of Electrical Workers was organized here recently; twenty-five names were enrolled.

The Law Battery.

Figure 1 represents the Law Battery complete.

Fig. 2 shows the carbon and zinc (negative and positive elements) connected to the cover. The negative element of Law Double Cylinder is a body of carbonized material moulded in the form of a cylinder within a cylinder, weighing 25 ounces, and being 6 inch. long x 3¼ inch. in diameter over all, thus giving an enormous surface for so small a body, there being 147 square inches of exposed carbon surface in this negative element. This is more than double the surface usually found in open circuit negative elements.

The Law Battery depends for its holding-up and recuperating power on this large exposure of the negative element, which takes care of the hydrogen gas created when the circuit is closed. There is nothing in this negative element to deteriorate, for as soon as the cell is thrown out of circuit, or is at rest, the gases dissipate and the element is restored to its normal condition. It is the practice in a great many elements to use a depolarizer, a chemical which undergoes a constant change from being called on during action of the battery to give off oxygen, and oftentimes when the cell is supposed to be at rest. It is this loss of chemical energy which deteriorates and renders useless the average negative element, and the peculiar construction and large exposed surface of the negative element of the Law cell render the use of chemicals unnecessary. The element does not deteriorate with use, and its service is most uniform and reliable. Its maintenance is without cost.

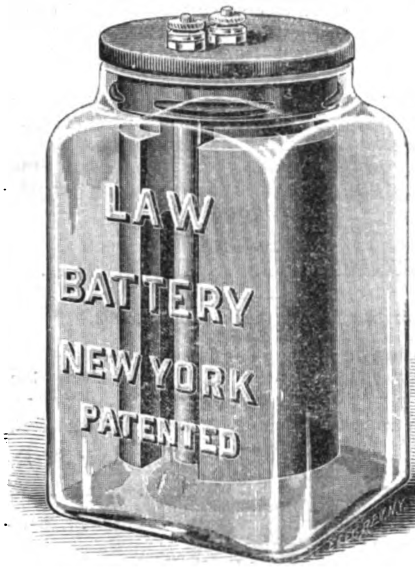


Fig. 1.

The positive element consists of a rod of alloyed zinc and mercury, 5⅛ inch. long x ⅜ inch. in diameter.

The jar is of flint glass, 4⅛ inch. diameter by 8 inch. high. The cover is of material closely resembling hard rubber in appearance. The flange of the cover carries three lugs adapted to engage with small lugs on the inside of the neck of the jar. A slight turn of the cover when in place locks and seals the jar so that the solution cannot evaporate or creep out. This evaporation and creeping is a detriment to the good working of a cell, as thereby the internal resistance is increased, and very frequently corrosion of the connections or wires occurs from this cause.

The zinc and carbon elements are bolted to the cover by means of a carbon-head-screw. Here again the Law cell is unique. Instead of connecting the metal post directly to the negative element a small carbon button is used into which the binding-post is firmly imbedded by a process used only by the Law Company. This button is made of very hard carbon of very heavy pressure, and after the binding-post is placed in position the carbon button is treated to a process which drives out all the air and moisture from the carbon button and renders it thoroughly impregnable to moisture. The button complete ud in half, showing dowel and metal, is illustrated in Fig. 3.

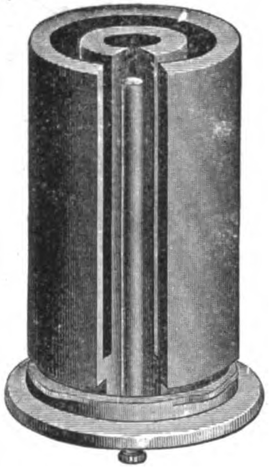


Fig. 2.

It will be observed that the negative element itself is not treated in any way with paraffin or other oils.

It is impossible to connect the metal binding-post to the carbon element direct and so treat the element as to prevent moisture and consequent corrosion at point of contact between metal and carbon, as this corrosion is an electrolytic action, and if enough paraffin was introduced into the element to prevent the absorption of moisture the element would be ruined as a negative element.

The excitant consists of five ounces of prime white granular sal ammoniac put up in a circular pasteboard box, illustrated by cut No. 4.

The complete cell is 8 inch. high over all x 4¼ inch. square, and weighs 4¾ lbs.

The metal binding-posts are tin plated, which prevents, to a great extent, the unsightly appearance caused by handling the binding-posts with wet hands.

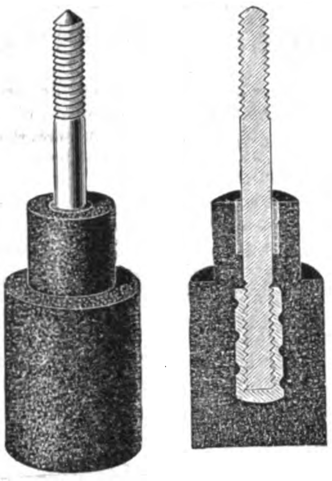


Fig. 3.

The cell is thoroughly adapted for telephone work and for electro-therapeutical work. The company guarantee against corrosion or renewal of any part of the cell excepting the zinc and sal ammoniac, which, of course, wear out with use.

Fig. 5 represents the Clay Porous Cup element made by the Law Battery Company, generally known as the "Leclanche Disque." This element differs from the usual manufactured article from the fact that the lead head has been done away with and a patented connection used instead, which renders corrosion at this point of the element impossible.

Fig. 4.

By referring to illustrations 6 and 7 the different parts of the connector can be understood. The washers next the screw are of pure block tin, having a centrally perforated hub projecting from one side. These hubs fit the hole in the carbon plate and project into the same from the opposite sides. The faces of the washers bear rigidly against the opposite faces of the carbon plate. The screw passes centrally through both of these hubs from one side of the element to the other. A small tinned washer is placed immediately under the head of the screw and bears against the large tinned washer. The thread end of the screw carries a nut which clamps the carbon plate and the washers securely together. Next to this nut on the screw is placed a tinned washer, then a binding nut and last a lock nut. Between the washer and the binding nut the conducting wire leading from the cell is to be clamped.

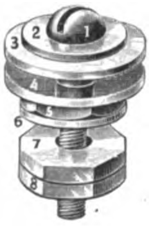


Fig. 6.

It will be observed that the hubs on the tinned washers effectually prevent contact between the carbon plate and the screw, the axis of this screw being held in a position concentric with the hub, and therefore the contact and connection is from the carbon plate direct to, and only to, the pure tinned washer, which covers a large surface each side of the plate.

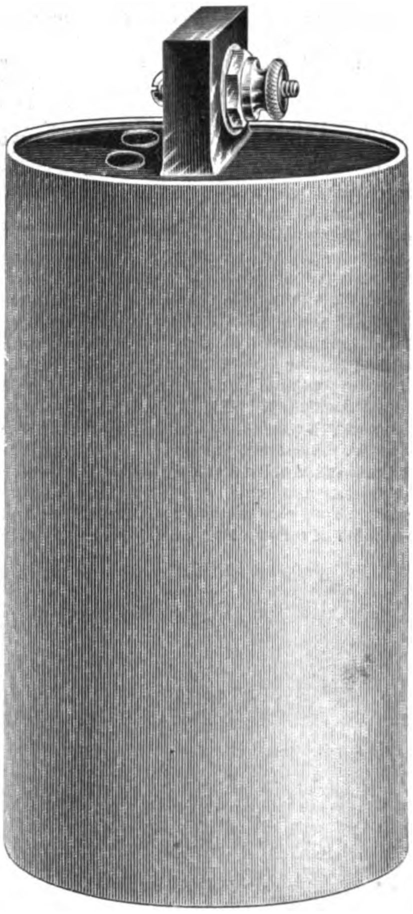


Fig. 5.

An attempt has been made to prevent corrosion by surrounding that portion of the screw standing in the carbon, and which was liable to come in contact with it, by using soft rubber washers or an insulating tape, but both these methods have been found to be ineffective, for after a short period of time the rubber loses its elasticity and becomes a seat for the moisture, or the tape becomes ineffective and draws and holds the moisture between the screw and the carbon, and the electrolytic action causes corrosion.

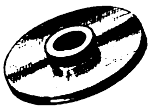


Fig. 7.

The electromotive force of this cell fitted with this element together with an alloyed zinc and good sal ammonia is 1.55 volts, and the amperage is in excess of that possible where a lead head is used, because of the extra resistance and the always present corrosion in the lead head. The crushed carbon and manganese used as a filler is selected with special reference to the work, and a third element is added in the filling which increases the E. M. F. to 1.55 volts.

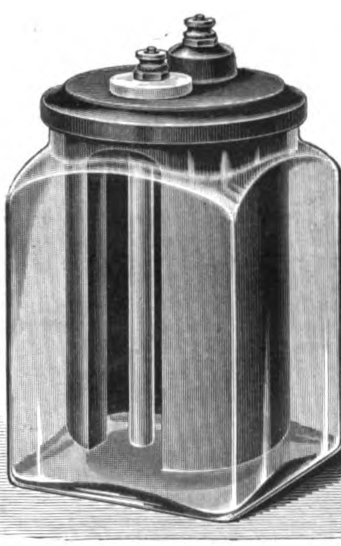


Fig. 8.

This connection has been fitted to all sizes of carbon plates and finds high commendation among the telephone companies, who use it in connection with a standard cell used for long distance work.

Fig. 8 shows a Single Cylinder Carbon Cell also manufactured by the Law Battery Company.

This consists of a cylinder made integral, with cover different from other cells of this class from the fact that the jar used is a round Leclanche jar with pour-out, and the porcelain bushing through which the zinc passes fits into this pour-out in the jar so as to prevent the carbon from turning. In other words, the cylinder is adapted to be used with a stock Leclanche disque jar. The zinc, however, is a special zinc and is an alloy, moulded with lugs at its top which hold it in place in the porcelain bushing and away from the bottom of the jar. This cell is specially intended for bell hangers and for that class of work where a reliable but cheap cell can be used.

Fig. 9 represents a Carbon Porous Vessel with a screw cover. Carbon porous cups as heretofore made for open circuit work have been filled with manganese and then permanently closed by filling or plugging with wax, which it did not pay to remove, so that when the element had lost its efficiency the depolarizing agent could not be renewed, but the complete element went to the ash barrel and a new one substituted. The illustration comprehends a carbon porous cup vessel in combination with a removable carbon cover. The cover being removable allows the renewal of the manganese or depolarizing agent whenever the same has become exhausted or deteriorated through work. This carbon porous cup and cover will do duty for an incalculable number of renewals of the depolarizing mixture.

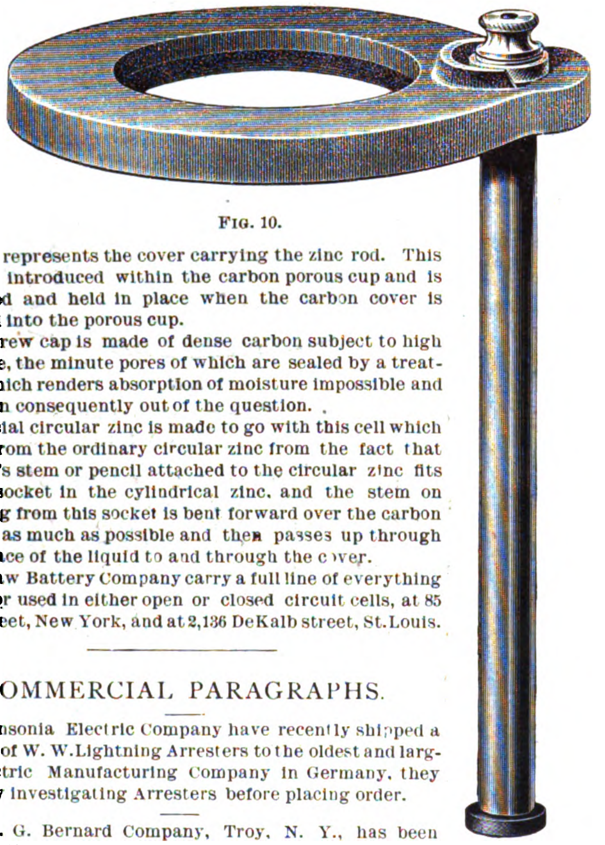


FIG. 10.

Fig. 10 represents the cover carrying the zinc rod. This cover is introduced within the carbon porous cup and is tightened and held in place when the carbon cover is screwed into the porous cup.

The screw cap is made of dense carbon subject to high pressure, the minute pores of which are sealed by a treatment which renders absorption of moisture impossible and corrosion consequently out of the question.

A special circular zinc is made to go with this cell which differs from the ordinary circular zinc from the fact that the zinc's stem or pencil attached to the circular zinc fits into a socket in the cylindrical zinc, and the stem on emerging from this socket is bent forward over the carbon element as much as possible and then passes up through the surface of the liquid to and through the cover.

The Law Battery Company carry a full line of everything needed or used in either open or closed circuit cells, at 85 John street, New York, and at 2,136 DeKalb street, St. Louis.

COMMERCIAL PARAGRAPHS.

The Ansonia Electric Company have recently shipped a number of W. W. Lightning Arresters to the oldest and largest Electric Manufacturing Company in Germany, they carefully investigating Arresters before placing order.

The E. G. Bernard Company, Troy, N. Y., has been awarded the contract for the electric lighting plant at the House of Refuge at Hudson, N. Y. The same firm is just completing the contract for lighting the Troy Orphan Asylum and also the putting in of 700 lights for the Shenandoah mills at Utica. The company reports business very good, despite the dull times.

The United Electric Improvement Company of Philadelphia is doing the electrical work for C. H. Crisman's plant at Branchville, N. J., which will be placed in operation early this month. Branchville will then have the honor of being the best lighted town in North Jersey.

The La Roche Electrical Company, of Sixth and Arch streets, Philadelphia, has purchased Schepper Bros.' six-story mill building, at American and Diamond streets, their business having grown so rapidly as to necessitate extended facilities. The building is 86 by 100 feet in dimensions and for many years was used by Schepper Bros. for the manufacture of worsted and woollen goods. During the past week a force of workmen has been employed putting the building in order for the firm's plant, which they intend to move from their present location. The interior of the western end of the building, fronting on Diamond street, is being remodelled for office purposes.

The Campbell & Zell Company of Baltimore, Md., have published a useful pictorial souvenir of the World's Columbian Exposition, for free circulation at the World's Fair in Chicago, and are distributing thousands of copies. It is formed of infolding leaves containing separate photographic views of the principal buildings, a birdseye view of the whole Fair, and an engraving representing the plant of 2,850 H. P. Zell Improved Water Tube Safety Boilers erected by the company in the main power house at Machinery Hall. (These boilers are equipped with patent petroleum burners for burning the crude product.) In addition to the illustrations in the book there is a valuable directory giving the location of railroad depots and routes, principal hotels, prominent buildings, theatres, museums, monuments, parks, etc., and much information for the visitor who wishes to improve all the opportunities offered by a visit to the Fair.

INCORPORATIONS.

The What Cheer Electric Light and Power Company, Des Moines, Iowa, has filed an amendment to its articles of incorporation limiting its capital stock to $14,000. Directors: J. B. Wilson, J. W. Emery, Henry Horn, W. C. Windell and W. C. Maltby.

The Electric Burglar-Alarm Company, Chicago, Ill.—to manufacture and sell burglar alarms and electrical goods. Capital stock, $250,000. Promoters: Jacob Lindheimer, Geo. D. Hoffman, Jacob Hoffman.

The Pennsylvania Traction Company, Lancaster, Pa.—to construct and operate motors and cables, or other machinery for supplying motive power to passenger railways, etc. Promoters: Robt. McMeen, S. M. Patterson, John D. Skiles, J. Hay Brown, John J. Patterson.

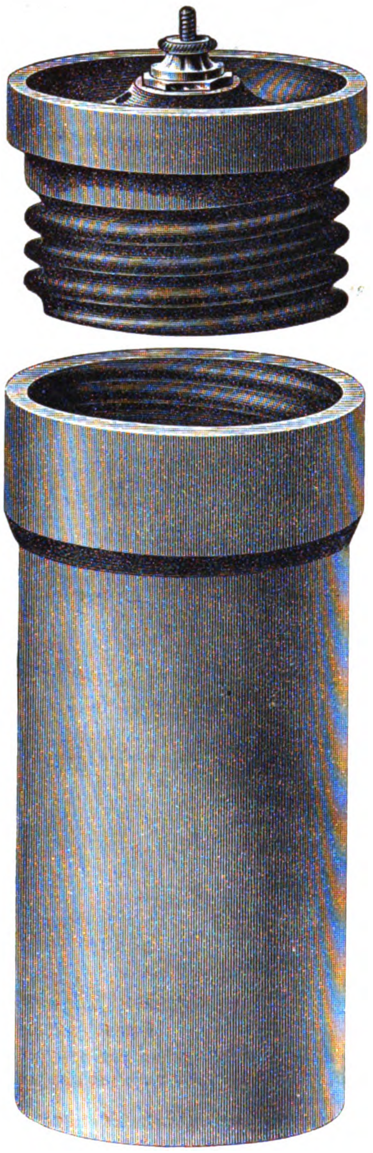


FIG. 9.

The Home Investment and Realty Company, Butte, Mont.—to construct railroads, do electric lighting, storage, etc. Capital stock, $200,000. Promoters: Jno. B. Read, Jas. H. Montieth, Frank S. Smith: Butte.

The Central Light and Power Company, Rochester, N. Y.—to manufacture and sell electricity for producing light, heat and power in Rochester. Capital stock, $25,000. Directors: J. Dewitt Butts, Frank W. Elwood, George Wilson, E. V. Stoddard, Joseph C. Tore, Hiram L. Parker, Isaac W. Butts and F. S. Macomber, of Rochester.

The Montclair Light, Heat and Power Company, Denver, Col.—to produce and sell electricity for light, heat and power, etc. Capital stock, $50,000. Promoters: Edw. W. Rollins, W. G. Fisher, G. A. Batchelder, Jno. H. Poole, Albert E. Grier, Denver.

The St. Vrain Water and Power Company, Ward, Col.—to acquire rights for mining, milling, electricity, power, etc., in Boulder County, Col. Capital stock, $100,000. Promoters: Robt. Haynes Kline, J. Quincy Hunsicker, Louis J. Beacon, Jos. K. Davidson Jr., of Philadelphia, Pa.; Jos. K. Davidson, Germantown, Pa.; John S. Reid, Ward, Col.

A charter has been granted at Harrisburg, Pa., to the West Side Electric Light Company of Luzerne Borough. Capital stock, $10,000.

The Goliad Water and Light Company, Goliad, Texas—to supply citizens of Goliad with water and electric light. Capital stock, $30,000. Promoters: J. H. Elwell, R. R. Stoul, W. B. Campbell, L. A. Mastze, Jno. W. Code, L. Seeligson, Jr., R. T. Davis, all of Goliad.

The South Peoria Street Railway Company, Peoria, Ill.—to construct and operate horse, dummy and electric railways or tramways in Peoria. Capital stock, $100,000. Promoters: Charles A. North, Isaac M. Horbacker, John W. Culbertson.

The General Machine and Electric Company (incorporated in West Virginia), New York City—to manufacture, sell and use electrical and other machinery, and mechanical devices, etc. Capital stock, $5,000,000. Promoters: Granville Woods, N. Y. City; Wm. S. Hanford and Oliver Duncan, Brooklyn.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JULY 4, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

500,827. Railway Signal System. G. L. Thomas, Brooklyn, N. Y., and E. C. Seward, Montclair, N. J. Filed March 6, 1893.
500,851. Electric Locomotive. L. W. Case, Highland Park, Conn. Filed May 9, 1891.
500,937. Conduit Railway Insulator. G. E. Noyes, Washington Grove, Md. Filed Aug. 8, 1892.
500,943. Electric Railway System. F. S. Perrin, Lynn, Mass. Filed April 2, 1892.
501,009. Overhead Electric Railway. J. C. Henry, Westfield, N. J. Filed Sept. 27, 1889.

ELECTRIC LIGHTS AND APPLIANCES.

500,657. Electric Arc Lamp: R. M. Hunter, Philadelphia, Pa. Filed April 3, 1893.
500,670. Incandescent Electric Lamp. W. E. Nickerson, Cambridge, and E. E. Cary, Boston, Mass. Filed April 1, 1893.
500,671. Incandescent Electric Lamp. W. E. Nickerson, Cambridge, Mass. Filed April 3, 1893.
500,829. Electric Arc Lamp. W. A. Turbayne, Detroit, Mich. Filed Nov. 5, 1892.
500,849. Electric Incandescent Lamp. H. D. Burnett, Lynn, Mass., and S. E. Doane, Swampscott, Mass. Filed Oct. 28, 1892.

DYNAMOS, MOTORS, ETC.

500,614. Brush Holders for Dynamo-Electric Machines. H. G. Reist, Lynn, Mass. Filed Jan. 28, 1893.
500,663. Electric Motor. J. MacHaffie, Schenectady, N. Y. Filed Oct. 8, 1891.
500,902. Ring Armature C. W. Jefferson, Schenectady, N. Y. Filed Feb. 13, 1893.

BATTERIES.

500,622. Secondary Battery. W. L. Silvey, Lima, O. Filed July 9, 1892.
500,978. Secondary Electric Battery. C. Theryc and A. Oblasser, Paris, France. Filed Dec. 2, 1892.

TELEPHONE AND TELEGRAPH APPARATUS.

500,545. Telephone System. G. L. Anders, London, England. Filed Dec. 1, 1892.
500,957. Ear Piece. R. Seiffert, Chicago, Ill. Filed Feb. 23, 1893.

MEASURING INSTRUMENTS.

500,868. Multiphase Meter. T. Duncan, Fort Wayne, Ind. Filed Sept. 3, 1892.
501,000. Meter for Alternating, Pulsating or Intermittent Electric Currents. T. Duncan, Fort Wayne, Ind. Filed Oct. 10, 1892.

SIGNALS AND SIGNALING APPARATUS.

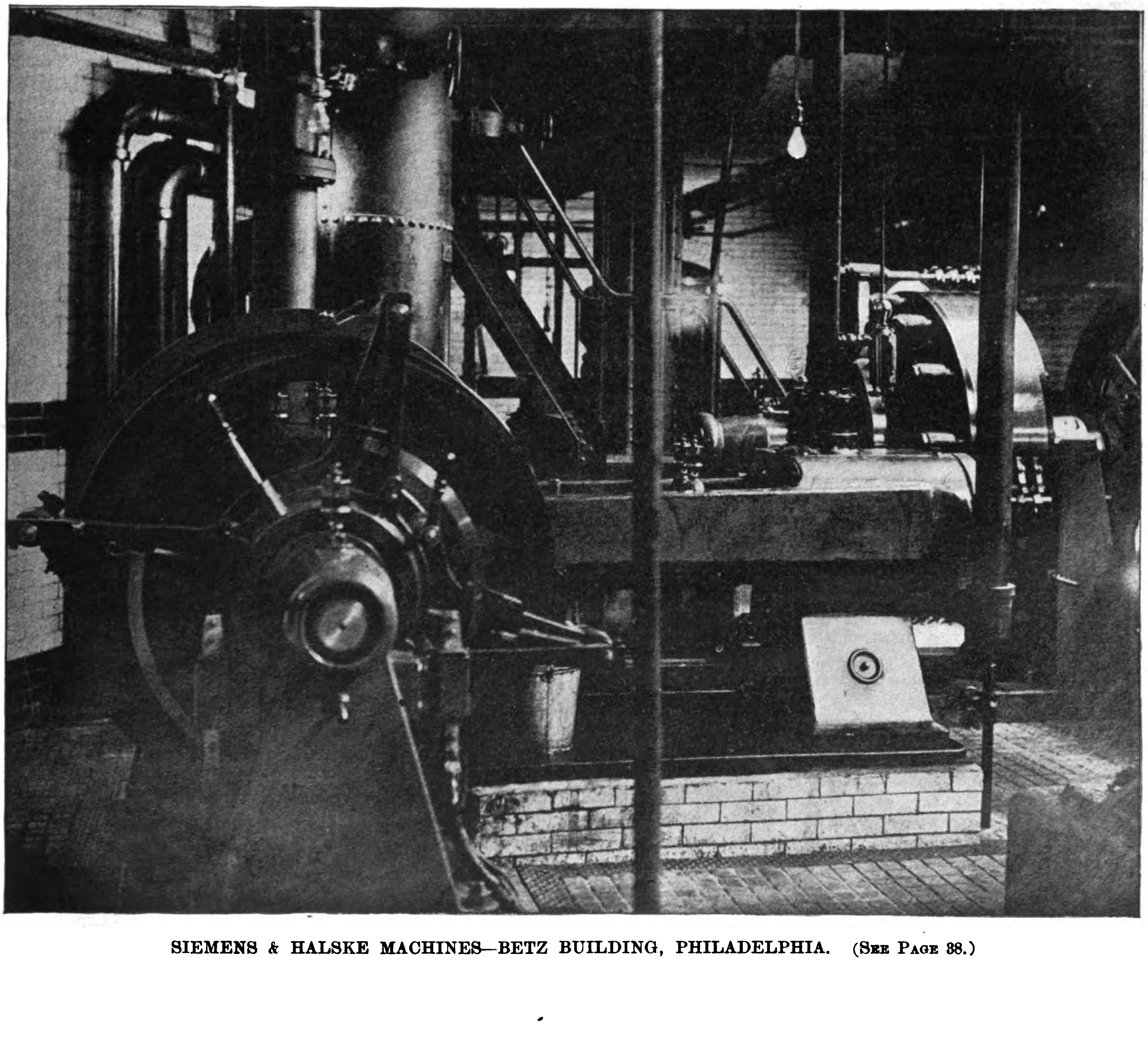
500,563. Signaling System. W. E. Decrow, Boston, Mass. Filed Dec. 31, 1892.

MISCELLANEOUS.

500,579. Power Transmission. A. L. Ide, Springfield, Ill. Filed July 12, 1892.
500,601. Safety Cut-Out. O. Offrell, Middletown, Conn. Filed Dec. 5, 1892.
500,604. Method of and Apparatus for Separating Ores., C. Q. Payne, Stamford, Conn. Filed April 19, 1892.
500,605. Magnetic Ore Separator. C. Q. Payne, Stamford, Conn. Filed May 22, 1892.
500,606. Device for and Method of Adjusting and Equalizing the Magnetic Density in the Pole Pieces of Magnetic Separators. C. Q. Payne, Stamford, Conn. Filed May 26, 1892.
500,629. Electric Switch. E. Thomson, Lynn, Mass. Filed April 20, 1890.
500,631. Rheostat. E. Thomson, Swampscott, Mass. Filed Aug. 25, 1892.
500,660. Method of and Means for Producing Alternating Currents. E. Thomson, Swampscott, Mass. Filed July 18, 1892.
500,681 Electric Soldering Iron and Heater. A. Tinnerholm, Schenectady, N. Y. Filed July 11, 1892.
500,726 Lightning Arrester. C. S. Van Nuis, New Brunswick, N. J. Filed Aug. 20, 1892.
500,767. Electro-Medical Appliance. S. Hetherington-Carruthers, Sydney, New South Wales. Filed Oct. 6, 1892.
500,775. Apparatus for Recording the Flexure of Bridges. E. Parenthou, Paris, France. Filed July 8, 1892.
500,776. Coin Operated Induction Coil. W. R. Pope, Baltimore, Md. Filed April 3, 1888.
500,822. Electric Hose Coupling. J. B. Strauss, Cincinnati, O. Filed Jan. 31, 1893.
500,828. Lightning Arrester. W. A. Turbayne, Detroit, Mich. Filed Nov. 6, 1892.
500,918. Electric Switch. G. E. Linton, Worcester, Mass. Filed April 11, 1893.
500,973. Electric Welding Machine. M. M. Suppes, Johnstown, Pa. Filed Sept. 10, 1892.
501,021. Insulating Coupling. L. McCarthy, Boston, Mass. Filed March 7, 1892.
501,038. Metal Working. J. H. Bassler, Myerstown, Pa. Filed Dec. 23, 1892.

ELECTRICITY.

Vol. V. New York. AUGUST 9, 1893. Chicago. No. 4



SIEMENS & HALSKE MACHINES—BETZ BUILDING, PHILADELPHIA. (See Page 38.)

A Compact Isolated Plant.

Siemens & Halske Dynamos Installed in Philadelphia.

It has long been a matter of regret to electrical engineers that in the designing of buildings in which isolated lighting plants are to be erected there is, as a rule, but scanty provision in the space set apart for this purpose, and for this reason the principal work in arranging such a plant is often to procure engines and dynamos of sufficiently compact construction to accommodate themselves to the available floor space. This has been an important factor in the movement towards direct connected engines and dynamos and the gradual disappearance of belting from plants of this kind.

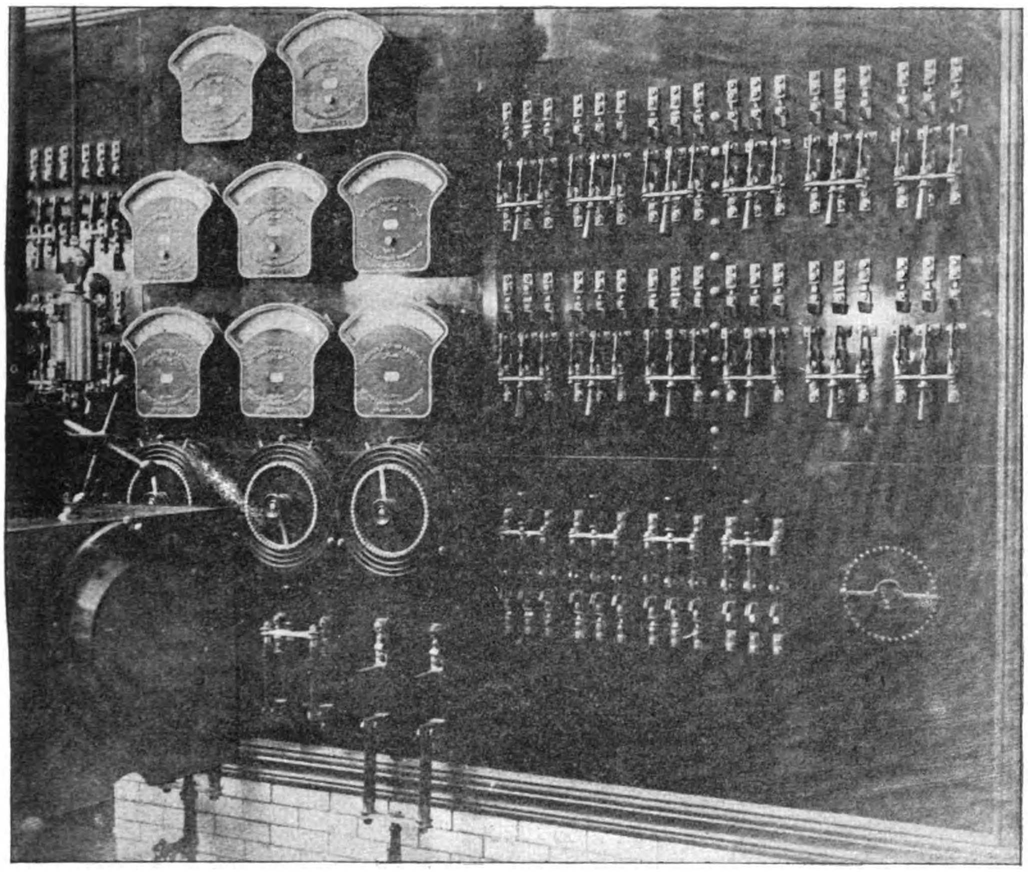


FIG. 1.

The isolated plant of the new Betz building in Philadelphia is probably one of the most compact plants to be found, and its electrical machinery, of the Siemens & Halske type, is the first in this country to be illustrated. The plant has a capacity of four thousand 16 C. P. incandescent lamps and consists of three direct connected Straight Line engines and multipolar dynamos, which with the switchboard occupy a space of but thirty by twenty-three feet, yet leaving sufficient passageway between the machines to give the attendants ready access to any part requiring attention.

Two of the dynamos have each a capacity of 1,600 lamps and the third of 800 lamps. These machines have six internal poles about which the armature revolves. The armature is wound with copper bars, the outside surface of which acts as the commutator, and the corresponding sections between the different poles are cross-connected so that only two sets of brushes are required.

The Frontispiece gives an idea of the way space has been economized in this plant, of which, owing to its location, only a portion can be photographed. The switchboard, shown in Fig. 1, is made of marbleized slate, and in addition to the Weston instruments and Carpenter rheostats contains only the switches for the feeders leading to auxiliary switchboards on each floor, and those connecting the house wiring to the street circuit in case of accident to the house plant.

The wiring is done on the three-wire system, and all the circuits are carried in interior conduit, but the three-wire system is only supplied in order to adapt the plant to the street circuit and is generally not in use. The middle wire of the system has a carrying capacity equal to both the outside wires, and the latter are used ordinarily as one wire and the middle one as the other of a two-wire system.

Fig. 3 shows one of the auxiliary switchboards with which each floor is supplied, containing the cut-outs and in some cases the switches which control the circuits on that floor. The illustration shown is on the thirteenth floor, which is largely utilized as a dining room and contains a number of electroliers and bracket lights that are controlled from the auxiliary board. On the other floors, where the office lights are more accessible, these switches are either dispensed with altogether or placed in convenient positions in the offices.

In addition to the use of separate conduits for each wire, weatherproof and fireproof wire is used, rendering any danger from short circuits almost impossible, and the substantial character of the equipment, which was installed by H. Ward Leonard & Company of New York, leaves hardly any chance of accident or trouble in the operation of the plant.

Personal.

Mr. James W. Godfrey, General Manager of the New York Insulated Wire Company, who has been in Chicago for a long time in charge of the company's large wiring contract at the Fair, has returned to New York.

Prof. James H. Mason, of the Mason Electrical Company, who has been doing the Fair, has returned to New York full of enthusiasm over the big show.

Mr. J. B. Olson has been appointed Manager of the Chicago office of the New York Insulated Wire Co.

Mr. John W. Howells has just returned from a business trip to the City of Mexico undertaken in the interest of the Edison Lamp Works.

World's Fair Notes.

The Department of Electricity has nearly completed arrangements to give a free course of practical lectures on electrical subjects by prominent electrical inventors and scientists. The lectures will be given on three days of the week, viz., Tuesdays, Thursdays and Saturdays, from 3 to 4 o'clock. The directors of the course have secured the use of the Western Electric Company's Scenic Theatre for the hours of the lectures Among the subjects to be handled are the following:

Testing Instruments.
Search Lights.
Electric Lighting by Arc Lights.
The Telautograph.
The Phonograph.
Electroplating.
Electric Railways.
Long Distance Transmission of Power.
High Tension and High Frequency of Alternating Currents.
Primary Batteries.
Electrical Patents.
Electricity in Mining.
Electric Welding.
Ocean Cables.
Underground Cables.
Alternating vs. Direct Currents.
Lightning Effects on Electrical Apparatus.

Each subject is to be treated by a man prominent in his line of work. Invitations have been issued to a number of the most prominent electricians to deliver additional lectures to the ones named above. If the course proves as interesting as it is expected to be, a larger room will be secured in which to deliver the lectures.

The following petition was circulated among the exhibitors in the Electricity Building last week. It was handed to Professor Barrett, Chief of the Electrical Department, for such action as he saw fit to take:

PROF. J. P. BARRETT,
Chief Department of Electricity.

DEAR SIR: There having been more or less said against the electric belts exhibited in this building, and referring to them as fakes, we the undersigned respectfully request that said belts be submitted to the jury for them to test same for voltage, amperage and internal resistance.

We ask this to sustain you in your action in giving them a space, and also in justice to themselves as exhibitors. There are many electrical appliances and belts that are fakes, from which no current can be obtained, and those that do not have merit should be known, especially the exhibitors that you have admitted in this Electrical Building in the World's Fair.

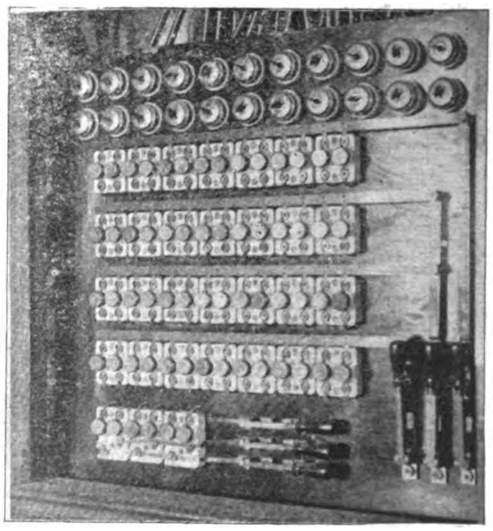


FIG. 2.

A large number of the exhibitors in the Electricity Building have, in conjunction with exhibitors in the other buildings, formed an association, to be known as the Associated American Exhibitors of the World's Columbian Exposition. The object and purpose of the society, as stated in the first announcement, is to observe American week after a manner which will be in direct interest of every American exhibitor in the Exposition.

The name of Dr. Louis Duncan was added to the list of judges of electrical apparatus last week.

The Duration of the Discharges of Induction Coils.[*]

BY H. LOUIS JONES, M.D.

In the course of an investigation into some of the properties of medical induction coils I had occasion to set up an apparatus for counting the rate of vibration of their contact breakers, and so obtained the accompanying tracings, which may be of interest to your readers, because they seem to show that the secondary discharges of induction coils are not so brief as is generally supposed. For particular coil Blaserna worked out the times of 0.000485 second and 0.000275 second as the duration of the make (inverse) and break (direct) discharges, and these figures are usually taken as showing that the discharges are of extremely short duration. The coil used is 7 in. long and 2⅜ in. in diameter. Core small, ¾ in. in diameter; primary turns 100, secondary 8,000 approximately; resistance of secondary 2,750 ohms, wound in two sections, paraffin insulated; weight of hammer, 300 grains; spring of stiff brass, 1½ in. long, ½ in. broad. Contact breaker screw close up to head of hammer, which, therefore, rebounds at once after contact, 52-55 times per second. With 4 volts and 2 amperes, gives 1 in. sparks. Condenser the usual size as fitted.

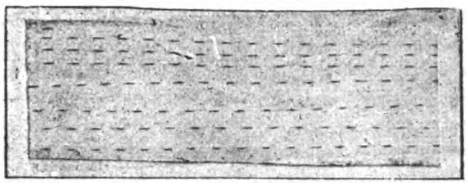


Fig. 1.—Electric Light ~ 100. Length of diagram = one-seventh Second.

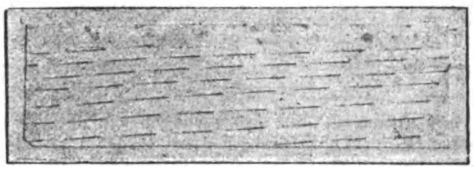


Fig. 2.—"Break" Discharges of Coil. Length of diagram = one-seventh Second.

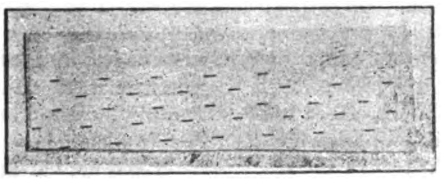


Fig. 3.—" Make " of Coil. Length of diagram = one-seventh Second.

The tracings (Fig. 1, 2, and 3) were taken upon a small revolving drum of metal covered with a strip of blotting paper wetted with starch paste containing iodide of potassium; the liberation of iodine at the positive pole strikes a dark blue color with the starch. This reaction is much more sensitive than that of the ferrocyanide of potassium papers used in Bain's chemical printing telegraph. The drum was fixed upon the axle of a small electromotor, which was joined to a Young's speed indicator (Fig. 4). One terminal of the secondary coil was connected to the rotating drum, and the other to a fine platinum needle which was held against the paper by the hand and was moved from end to end of the revolving drum. The needle was bent near the end into an acute angle or elbow; this was the part used to make contact with the drum, as the point was found to scratch the soft paper. The marks made by the bent elbow of the needle were not at all elongated until the recording surface was made to move, so the shape of the markings is not due to the shape of the surface of the needle. In this way a succession of streaks and intervals was drawn in a spiral upon the cylinder. The paper was taken off the drum and the tracings were photographed at once, as the marks are very fugitive. The figures represent the stripes of paper used, photographed to half-scale.[†]

For purposes of comparison a trace was taken from the alternating electric lighting current. This is shown in Fig. 1. Fig. 2 shows the "break" discharges (positive pole) of the secondary of an induction coil capable of giving 1 in. sparks. Fig. 3 shows the "make" discharges (positive pole) of the same coil, the direction of current in the primary having been reversed. The strips are to be read from right to left, beginning at the right hand top corner.

The speed of rotation recorded was seven revolutions per second, the circumference of the drum 4½ in., the velocity of the surface 31½ in. per second.

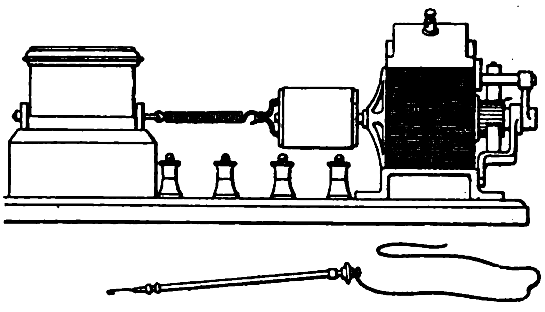


Fig. 4.—Motor, Revolving Drum, and Counter.

The rate of vibration of the contact-breaker works out at 52 to 55 a second; and the rate of alternation of the electric lighting current at 112, the nominal rate of the latter being 100, I believe. The difference between these two figures is probably due to error in the indications of the speed indicator, which is a little difficult to read exactly, but it may show that the alternator at the central station was running a trifle faster than usual on the morning when the trace was taken. On another trial the rate came out at 105. Several tracings were taken on each occasion, and on each of those occasions the several traces agreed among themselves.

Measurement of the photographed tracings gives the mean duration of the discharges as follows:

Break..................0.0134 second.
Make...................0.0046 "

The dotted marks at the top of Fig. 2 were caused by sparks passing through the air to the paper. It is interesting to note that they are not elongated or drawn out. The other marks are very long, and also taper off in a significant way; but no sign of this tapering appearance can be seen in Fig. 3.

The intervals in Fig. 1 (dynamo current) are longer than the marks; and from this we may reasonably infer that the method of recording does not exaggerate the length of the discharge, but rather tends to reduce its apparent duration. The resistance of the damp paper varies a good deal, but its average is rather more than 1,000 ohms.

When the make-and-break tracings are combined, and this can be done very simply by superposing their photographic negatives, it is clear that the intervals which correspond to the periods of no current in the secondary coil are very short indeed—at a rough estimate about 0.001 second, or even less in a total period of 0.019 second. At first I assumed that the short marks must be "break" discharges, and the long ones "make" discharges, but further experiments showed that this was not the case.

By substituting a mercury break for the vibrating spring contact-breaker it is possible to get single discharges, the primary circuit being made and broken by hand. When these single discharges are recorded upon the moving surface it is found that the "make" tracing does not exhibit the abrupt short character shown in Fig. 3, but is longer and tapers away like the "break" discharges of Fig. 2. This led me to suppose that the "make" discharge was cut short by the next succeeding "break" discharge, and in order to settle this point a tracing was taken with two needles at once, one for each pole; it was then clear that the break discharge followed closely upon the make discharge without any perceptible interval at all. The character of the tracing given by both poles writing side by side (Fig. 5.) is interesting. It was drawn by hand on a slip of paper, and gives a good general idea of the relations in time of the make and break discharges. It also explained why the "make" discharges had a shorter duration than the break. No doubt the character of the tracings depends a good deal upon the contact-breaker used. Some of these make a large excursion and leave the primary circuit open for a comparatively long time while with others the primary is kept closed for a comparatively long time before it is broken again. The contact-breaker of the coil used in these experiments has a short and stiff spring and makes very brief contacts.

The tracings of Fig. 2 show that the current at break of an induction coil discharging through a resistance of about 1,000 ohms may last as long as one-eightieth of a second. The shorter duration of the make discharge in the coil used is due to the fact that it is cut short by the establishment of a "break" current in the opposite direction.

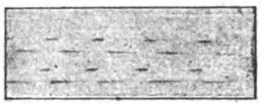


Fig. 5.—"Make" and "Break" (Positive) Discharges. To be read from left to right.

No sign of oscillation, or more correctly, no sign of alternation, can be seen in these tracings. In *The Electrician* (London) for December 25, 1891, is an abstract of a Paper on the Induction Coil, by M. Colley, with figures of vacuum tube discharges as seen in a rapidly revolving mirror, and with curves to represent the oscillations of the discharge; though showing large oscillations, the curves do not show alternations or changes of sign. If such had been present in my experiments the tracings should have shown them as gaps in the length of each small mark.

I should have been glad to supplement this communication with some notes on the effect on the tracings of putting a vacuum tube in the circuit; but I have not yet been able to get any satisfactory results, for the vacuum tube diminishes the current so greatly that the tracings become very faint, and the iodide of potassium paper sometimes behaves capriciously; however, a vacuum tube does seem to shorten the duration of the discharge considerably.

Tracings of smaller medical coils are essentially the same as those of the one used, the main difference is that the make marks are longer, if the contact-breaker is less rigid and more springy.

Austrian Delegates to the Electrical Congress.

The Electrotechnischer Verein of Vienna has appointed the following of its members delegates to represent it at the World's Electrical Congress which convenes in Chicago August 21: Nikola Tesla, A. Prosch, Inspector of the Austrian State Railways; Ernest Egger, Dr. Johann Sahulka, Constructor at the Imperial High School, Vienna; Fred. W. Tischendörfer, and Joseph Wetzler.

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[*] Towards the expenses of this research a grant was made by the British Medical Association, on the recommendation of the Scientific Grants Committee of the Association.—" Electrician," London.

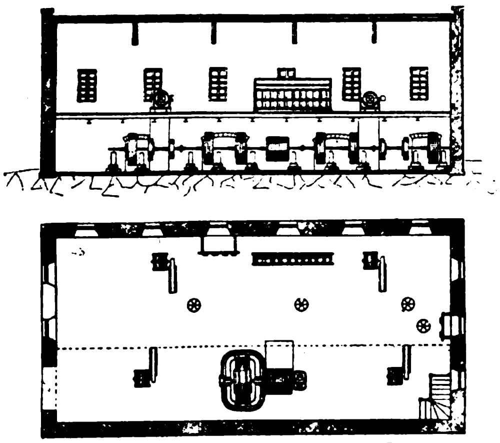
[†] No. 3 was reduced a little too much in the camera.

The Guadalajara Electric-Light Installation.*

BY RAFAEL M. DE AROZARENA.

Among the industrial enterprises taken up in Mexico by local capital, the plant for the supply of the electric light and power in the City of Guadalajara, Jalisco, is one of the most notable, not merely because of its magnitude with respect to the investment required, but also because the project necessitated the use of novel and special machinery, the source of supply being located 17 miles from the base of demand.

The problem was to install at the falls of Juanacatlán (the Niagara of Mexico) a hydraulic and electric plant which should be capable of supplying in the city of Guadalajara—distance 17 miles—sufficient electric energy to operate some 950 H. P. in the form of light, divided up as follows: seven thousand five hundred incandescent lights of 16 candle-power each and 200 arc lights of 2,000 candle-power each.



LONGITUDINAL AND HORIZONTAL SECTIONS.

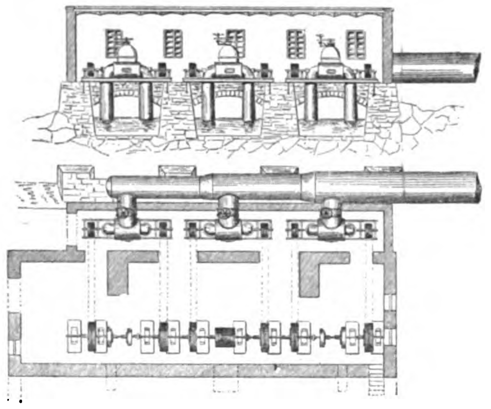
After careful consideration and study, the plans were projected and machinery ordered from the following well-known houses: the electric machinery and material from the Thomson-Houston International Electric Company, of Boston, Mass.; the turbines and piping from James Leffel & Company, of Springfield, O.; the valves from the Ludlow Valve Manufacturing Company; the countershaft, clutches, pulleys and bearings from the Hill Clutch Company, of Cleveland, O.; and the iron poles for carrying the wire on the main line from the falls to the city—a distance of 16 miles—as well as for the wires in the city, from the Reading Iron Company, of Reading, Pa.

The falls of Juanacatlán are on the Grande River, and situated some 17 miles (28 km.) southeast from the city of Guadalajara. The whole volume of the river falls at this point some 58 ft. in a perpendicular line, with the shores above the falls sloping gently to the stream. Below the falls the shores on both sides slope almost at an angle of 45°, leaving but little room at the bottom upon which a building could be erected, for which reason the building was projected of three stories, as shown by the section of Drawing No. 1.

The work above the falls was simple and of easy execution, for, the river being very wide at this point, its depth is small, and a masonry wall some 3 ft. high was built, running across the river for two-thirds of its width and at an angle of 45° to the line of the falls, the object of which was to carry the greater part of the water in the river to a given point on its left bank directly at the falls; then a raceway was formed 14 ft. high by 14 ft. wide, from which the 7-ft. diameter conduit pipe carried the water down to the turbines. This conduit pipe is made of wrought-iron sheets ¼ in. diameter, riveted together, no flanges being used. At the head of the pipe is located a vent pipe, to protect the pipe from collapsing when the wooden gate which is located at its entrance is closed. The pipe, to conform to the nature of the fall at this point, has two elbows of 90° and one of 45°, from which on a horizontal line it connects the three turbines together, reducing its diameter from 7 to 6 ft. between the first and second turbine, and from 6 to 5 ft. between the second and third turbine. Directly in line with the piping are located the three horizontal double Leffel turbines, and between the turbines and the conduit pipe in the connecting pipes, which are 4 ft. 6 in. diameter each, are located Ludlow straightway gate valves, which are opened and shut by geared hand wheels, thereby permitting the water to be closed off from each or any of the turbines without having to stop the others.

The turbines located on the first floor of the building are horizontal double wheels, placed in one case; both wheels are connected directly on to the same shaft, which extends out from the case on both sides, and has at each end a sheave pulley for transmitting the power. Each turbine is 20 ins. diameter, and has its independent draft tube; and as the river is known to rise in the rainy season from 1 to 2 m., the turbines were placed 16 ft. above the bed of the river, with draft tubes, all 10 ft. long, discharging into a well 4 ins. deep (which is the average depth of the river in the dry season), making the distance from the center of the turbines to the surface of constant water in the tailrace exactly 12 ins. This mode of setting turbines with draft tubes has given the writer excellent results here in Mexico.

The power of each set of turbines is 550 H. P., making a total of 1,650 H. P. The power is transmitted from the turbines to a countershaft placed in the second floor of the building. A rope driver is used, of endless manilla, plumbago, tallow-laid rope, 1 in. diameter, using an idler pulley on a stress car, with weight. Each pulley has 15 groves to receive the 15 strands of rope.



SECTION AND PLAN OF TURBINES AND COUNTERSHAFT.

The 42-in. diameter pulleys on the turbines connect with clutch pulleys on the countershaft of 84 ins. diameter, giving a speed of 6,594 ft. per minute to the rope. This driver, when the speed does not exceed 7,500 ft. per minute, by using sheaves at least 40 times the diameter of the rope, the writer has found to be very satisfactory, and on account of its duration much cheaper than belt drivers, especially for damp places.

In Orizaba, over two years ago, the writer used this driver for transmitting 188 H. P., for electric-light work; the rope, which to-day shows no signs of wear, is the same one which has been used from the start, and the plant has run on an average 11 hours every night, without any interruption. Great care must be taken, however, not to put too much weight on the stress car which carries the idler pulley.

Arc-Lighting Dynamos.—For furnishing current to operate the arc lights, the familiar Thomson-Houston "M. D." dynamos were employed. They have capacity each for 50 arc lights of 2,000 candle-power, or, in other words, a rated output of 25 kilowatts. The current strength is 10 amperes and consequently the maximum voltage 2,500.

The dynamos weigh 3 tons each, require floor space of about 15 sq. ft., a belt speed of 3,868 ft. per minute, with a consumption of nearly 50 H. P. under full load. Four such dynamos are in use, operated two in "series" to avoid multiplicity of wire. Thus, for a total capacity of 200 lights, only two circuits leave the generating station. Each dynamo is supplied with the usual ingenious and efficient "automatic regulator and controller," without which it would be well-nigh impossible to fulfil the condition. With such, however, lamps may be lighted or extinguished without the necessity of paying attention to the dynamo.

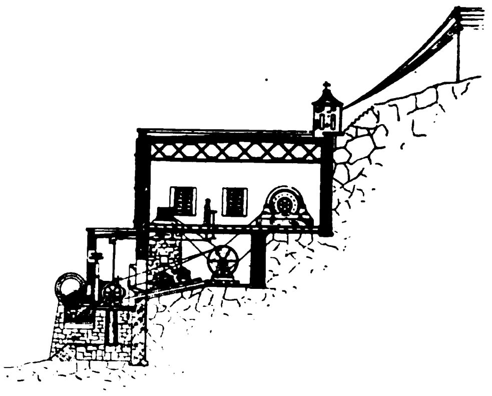
Arc Circuits.—The current is conveyed from the dynamos by means of highly insulated copper wires to a slate switchboard arranged for any desired combination of machines; from here through current indicators to the lightning arresters, from which the wires are led to the pole line. The pressure utilized being rather above the safe limit, the insulation of the circuit is augmented by fastening the wires upon oil insulators, mounted upon wooden cross-arms. The construction of these insulators is such that leakage is practically prevented, as, in order to escape by leakage, it would be necessary for the electricity not only to overcome the wire insulation, but also to pass through two strata of oil, the insulating qualities of which are well known.

In the city of Guadalajara these circuits are led to a central distributing station, in which is placed a duplicate plant of lightning arresters, switchboards and testing instruments. It is from this station that the lights are directly controlled.

Arc Lamps. — Standard double carbon arc lamps are used throughout the city. They are suspended from steel cables stretched from corner to corner, supported by house structures arranged with pulleys and cables so that the renewal of carbons may be readily attended to.

Incandescent Dynamos.—As but one dynamo was desired for this installation, one of special construction was supplied. It is of the alternating current type, has 40 pole pieces, and yields approximately 350 amperes at 1,000 volts, or, say, 350 kilowatts.

The dynamo weighs between 30 and 40 tons, requires a floor space of 216 sq. ft. and a belt speed of 6,024 ft. per minute, consuming, under full load, some 750 H. P. The armature is run at the low speed of but 300 revolutions per minute, and the shaft, which is 9 ins. in diameter, is furnished with a 60-in. diameter pulley, having 28 grooves for 1¼-in. rope, as this dynamo is driven from the countershaft with a rope driver the same as between the turbines and the countershaft. The 40 pole pieces forming the field magnets are excited by means of a separate exciter known as "D-5," and having an output of 5 kilowatts at 125 volts.



CROSS-SECTION OF STATION.

Various indicating instruments are installed, enabling the operator to tell at a glance what load is upon either machine and at what pressure the dynamos are operating. To convey with moderate loss so great a current as 350 amperes over a distance of 17 miles would require a copper wire having a sectional area of about 4 sq. ins. Such a conductor could not be used, for practical reasons, to say nothing of the expense, which would be itself prohibitive. As the proper section of copper wires varies directly with the current it is necessary to carry, it is obvious that, in order to transmit such power over a wire of moderate size, the quantity of current must be reduced. Without changing the quantity of wire this may be done by increasing the voltage, which, accordingly, was raised to a maximum of 5,000, thus reducing the current to about 70 amperes, and the size of the wire to one having a sectional area of .1662 in.

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* Read before the International Engineering Congress of the Columbian Exposition, 1893.

Step-Up Transformers.—To so increase the voltage from 1,000 to 5,000, a bank of 10 step-up transformers was installed. These are built upon the lines of the type "F" oil transformer manufactured by the General Electric Company. They transform the energy of the dynamo at an efficiency of about 98 per cent., delivering to the line, therefore, 98 per cent. of the energy supplied them and at five times the pressure. The transformers are so designed as to be filled with oil, the insulating qualities of which are very high, thereby increasing the insulation resistance of the transformer, rendering it less subject to damage from lightning discharges, and, indeed, restoring the insulation, should it be destroyed by means of a stroke of lightning. The transformers are banked or operated in multiple. They have a capacity of 30 kilowatts each, weigh approximately 1,300 lbs., each requiring 12 cu. ft. of space. They are protected by a simple but effective system of circuit breakers and fuse connections, and the current passing from them is carried through a special lightning arrester designed to protect circuits of extraordinary high potential.

Main Circuit.—The cross-arms, pins and insulators used in connection with the alternating circuit are precisely the same as those described under the heading "Arc Circuits."

Step-Down Transformers.—The high potential incandescent line carried to the central station in the city of Guadalajara is passed through lightning arresters and safety devices, as described above, to the bank of step down transformers, which reduces the pressure to 1,000 volts, at which potential it is carried through the streets of Guadalajara as in ordinary installations. In the Guadalajara Central Station switchboards are installed, enabling any combination of lights and circuits to be made, without attention to the dynamos at the point of generation. The number of lights in operation, the physical conditions of the circuits, and indeed the conditions of the dynamos at the generating station, can all be determined in Guadalajara. Telephonic communication is established between the two stations, enabling those in charge to give their directions promptly.

As a further protection against lightning, which in the State of Jalisco is very severe, iron poles have been used, each surmounted by a pointed lightning arrester rising some 3 ft. above the top of the pole, or, say, 5 ft. from the highest current conveying wire. These arresters are, of course, mechanically connected to the iron poles, besides which they are joined to each other by means of an iron wire. This is considered the most effective protection possible, as it produces an artificial earth above the wires conveying the electrical current.

The plant of the National Electric Manufacturing Company of Eau Claire, Wis., under an order of court is to be sold by the receiver, Mr. Ralph E. Rust, on September 4.

The Inventor of Gutta-Percha-Covered Wire.

Mrs. E. H. Danchell, in a recent letter to the *Engineer* on this subject, gives the following facts: "On March 19, 1845, Mr. F. Wishaw, the secretary of the Society of Arts, England, read a paper upon gutta-percha before that society, and exhibited specimens of that material in the raw state, and moulded into various shapes by himself. This, then, was probably the occasion at which both Mr. William Siemens and Mr. Danchell obtained samples, and the former sent it to his brother, Mr. E. W. Siemens, at Berlin, while my husband at once conceived the idea of applying it as an insulating material for telegraph wires, and succeeded in doing this, and then started for Berlin. My husband thus spent money, time and brains, and solved the problem, while no statement is forthcoming of Mr. E. W. Siemens having done so till 1847. It appears that gutta-percha already then, that is in 1845, through a Dr. Montgomerie, of Singapore, had become known to a few in London, for there are the following British patents at this time, viz.: Brooman, dated March 11th, 1845, No. 10,550, for preparing gutta-percha by purifying, masticating, and mixing it with sulphur, rubber, French chalk, etc. Brooman, dated March 27, 1845, No. 10,582, for making it into thread. Nickels, May 20, 1845, No. 10,673, for applying it to book covers, writing cases, etc. Bewley, dated September 4, 1845, No. 10,825, for molding and pressing it into various shapes, also for lapping it in strips round a core, the edges being joined by heat or solution. His patent specification shows a cylinder with piston and steam-heated die box; the gutta-percha being pressed through it and around a core bar, or wire, thus coating the wire. He also describes another apparatus for doing the same thing, viz., by means of grooved rolls and a core. His final specification was filed on February 22, 1846. Between March 11, 1845, the date of Brooman's above-named patent No. 10,550, and April 23, 1850, the date when Mr. E. W. Siemens applied for his patent for an improved machine for covering telegraph wires—forming, in fact, an improvement upon Bewley's patent No. 10,825, of September 4, 1845—there are over fifty British patents for treating and applying gutta-percha to a great many purposes, and amongst them is one by Ricardo, No. 12,262, of 1848, for covering telegraph wires with gutta-percha, and one by Barlow and Forster, No. 12,136, of 1848, for the same purpose."

The "Earth" Question.

The Report of the Committee.

A few weeks ago we published an account, sent by our London correspondent, of the evidence elicited during the sitting of the Joint Committee of Lords and Commons, which committee, it will be remembered, was appointed solely for the purpose of studying the important question that had arisen between the Telephone Company and the Electric Tramway and Railway Company regarding the "earth."

The report of the committee, which sat for eight days, has now been made public. The main tenor of it is that in the present state of electrical science it is not desirable to insist upon electrical tramways using an insulated return conductor, and that to impose such a condition would interfere with the development of electric traction. The committee, however, recommend that the Board of Trade shall have power to make regulations to secure the best system of working electric tramways and railways, regard being had to the cost of carrying out such regulations and their effect upon the commercial prospects of the undertaking. The committee state that they regard with apprehension a large extension of the system of overhead wires in crowded centres, and recommend that statutory powers be granted to enable telephone companies to lay their wires underground.

The Light of the Electric Arc.

At a meeting of the International Society of Electricians, on the 7th ult., M. Violle described the experiments which he had been making on the electric arc. This experimenter has found that the light intensity of the positive carbon remains sensibly constant when the power supplied is varied in the proportion of 1 to 60. He has employed two methods of measurement, that of the spectrophotometer, the accuracy of which is really much greater than is usually stated to be the case, and a second method due to Arago employing interference fringes. M. Violle exhibited a number of photographs of arcs of different candle power, in order to show the constancy of the intensity of the positive carbon. By measuring the opacity of the negative plates, these photographs could be used as a gauge of the intensity. M. Violle recalled that this phenomenon had already been investigated by Rosetti, as well as by Capt. Abney and Silvanus Thompson; and everyone had attributed it to vaporization of the carbon. This opinion was perfectly justified, for the deposit on the negative carbon has the appearance of having been condensed from vapor, and M. Violle has actually been able to produce crystals on this part. A photograph of an arc produced between carbons of purified retort carbon was shown, and it exhibited a very curious appearance. Despretz had also observed that the phenomenon was due to volatilization, but that there was fusion or more or less softening of the carbon; he had also attributed the deposit of carbon, which is formed in the arc, to the condensation of vapor of carbon, but he was unable to elucidate the question because he used impure carbons. M. Blondel has recently recognized that impurities in the carbon have not, in practice, any sensible effect on the intensity, which remains constant with carbons of very different quality. The intensity of the arc, he thought, was therefore a constant, and it might be utilized as such. M. Violle stated, in conclusion, that the temperature of 3,500° C., which is given for the arc, ought to be considered as a provisional value, although the true temperature is probably but little different from this figure.

The St. Louis Consolidation.

As predicted exclusively in Electricity some weeks ago, the consolidation of the Missouri Electric Lighting and Power Company and the Municipal Electric Lighting and Power Company at St. Louis is now announced. The incandescent service will be from the plant of the former company, and the arc service from the latter. An effort will be made to secure a more favorable contract with the city, the present one having proved unprofitable; at the present rate, it is said, there would be a further loss of over $100,000 in the contract.

The Edison Illuminating Company of St. Louis, a paper company, organized by local capitalists, and whose capital stock has been increased within a year from $5,000 to $4,000,000, is understood to have arranged the deal, and eventually the consolidated companies will be united under the name of the Edison Company.

Judge Harlan has signed an order authorizing Morrill N. Packard, trustee for the Southern Electric Company, to carry out all the contracts already made. The order was signed on a petition presented by the trustee and the creditors.

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English Patent Law. In view of the expiration of the Edison lamp patent in England in November next, the English manufacturers are beginning to interest themselves in this subject, which heretofore has been totally ignored owing to the law which prevails in that country forbidding even experimental work on patented articles. As a result of this the makers of incandescent lamps will enter into this branch of business entirely devoid of any practical experience, and it will probably require a long period of experimental work to put them in a position to compete with the present makers.

The law prohibiting experimental work appears to us to be a most effective barrier to research and progress in invention and one that reacts as unfavorably upon inventors generally as upon the public; and where, as in the lamp business, the details of the process of manufacture can be kept more or less secret, the monopoly which a patent secures to an inventor may be extended much beyond the limit of its legal existence. In this case the public will start in with the same knowledge that the present company started with at the time the patent was granted, and gain the necessary experience during a time when the business is open to all. This time must be more or less wasted in arranging and perfecting details which on this side of the water are well known, and which inure to the public benefit immediately on the expiration of a patent.

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Electric Traction Regulations. The English Parliamentary Committee which has lately been considering the question of earth returns for electric railways in relation to telegraphic and telephonic disturbances, has made a report which, on the whole, is decidedly favorable to the railway interests, and has framed a clause to be inserted in all franchises providing for the use of heavy currents except those for electric lighting.

From the summary of this report, printed elsewhere, it will be seen that it is in the nature of a victory for the traction interests, and it is generally commended by the technical press, which predicts an era of electric railway progress as a consequence of the removal of the restrictive measures which have so far checked any material advance in this direction in England.

The report takes the same view that the courts in this country have generally held in regard to telephone disturbances, and declares that in the light of present experience it is inadvisable to insist on insulated returns for railway circuits, and that there is moreover sufficient reason for recommending double telephone circuits, as the evidence submitted showed that this plan not only improved the service but in many cases was already being adopted.

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ELECTRICAL men throughout the country, and especially readers of ELECTRICITY, will no doubt be interested in knowing more about the Hon. H. S. Pingree, Mayor of Detroit. They will find a full page sketch of this pugnacious and level-headed gentleman, with portrait, in the New York *Tribune* of Sunday, August 6.

The Smaller Stockholders Frozen Out. On Friday, July 28, the opinion was general in Wall Street that the Electric Trust would be in serious difficulty within twenty-four hours. The directors were in session nearly all day, and after the close of business on the Exchange gave out the notice which was printed in our last issue, that a syndicate had agreed to take treasury securities to an amount to net the company $4,500,000, which would pay off the floating debt. It was also announced that the stockholders would have the preference in the offer of these securities.

The statement was brief, and almost unintelligible, but it answered the purpose in that it showed that a receivership had been averted. The stock went up a little, and the newspaper critics suspended judgment.

Further details of the scheme are now at hand, which are almost worthy of the fertile brain of Henry S. Ives or of Jay Gould in the early seventies. When these latter gentlemen, however, carried out schemes like this, they were publicly branded as "gutting the treasury"; in the case of General Electric and its ancient and honorable Board of Directors it is called "providing for the floating debt," which means, we suppose, merchandise bills, running expenses and money borrowed to pay dividends.

It is asserted by the insiders that these treasury securities are a bargain at the price, and that the Tramway and Illuminating Company will make a good thing.

Hence we suspect that it is again intended to humbug the public, and "let them in" on the good thing.

From all the knowledge we have of these securities they seem to be the tail-ends of cats and dogs—stocks and bonds which could not be worked into T.-H. trusts, United Securities Company's bonds nor Electrical Corporation's bonds—securities which no bank would take as collateral even before the stringency. We suppose, for instance, that the remainder of the Syracuse bonds are included, and the bonds of the Pueblo company—the company which the General Electric Company had to buy outright to protect its $175,000 of second mortgage bonds, and which is losing at the rate of $20,000 a year.

Such we believe to be the quality of the "bargains" which have been taken over by the new financing company. However, until the attempt is made to sell Tramway and Illuminating Company's stock to the *public*, it may truly be claimed that it is none of the public's business what the stocks and bonds consist of.

But whatever their value, the method of disposal of these securities is unfair to those of the stockholders in General Electric who have not ready money to invest in anything just now.

Early in the year 1892 the stock and bonds of the General Electric Company were listed on the New York Stock Exchange. The company filed a sworn statement of assets in which were included a large part of these treasury securities just sold.

The stock was industriously boomed by subsidized brokers and by the Press Agent. It was represented that the company was earning 17 per cent. on its capital, and all the way from 150 to 200 was talked of as the price which the shares would reach in 1893. The public bought largely, at from 100 to 119.

After eight months of business, during which quarterly dividends of 2 per cent. had been paid, the company put forth its first regular statement, showing as treasury assets stocks and bonds of local companies (not manufacturing companies) valued at about $10,500,000. The dividend was still maintained, and stock was still bought by the public.

It is fair to assume that these purchasers supposed they were buying stock in a company honestly earning an 8 per cent. dividend and a small surplus besides, as shown by the statement, and *that each share of stock bought carried with it pro rata ownership in the assets of the company, including these treasury securities.*

Now they are politely informed that the exigencies of the situation demand the sale of these treasury securities, and that a new company, composed chiefly of the wealthiest members of the directory, has agreed to buy the most of them.

The stockholders of moderate means will, of course, be unable at this time to avail themselves of the offer of the Board, and it is only the insiders who can embrace the opportunity.

The money realized goes into the treasury, true enough, but not to extend the business ; simply to pay a floating debt, which, if the statements made at the time the public bought stock had been true, would not have existed at all.

The company has been saved from wreck, and we are ready to believe that the scheme, under the circumstances, was best for all concerned.

But the fact remains, and cannot be buried under a volume of argument or official statements, that if the public had had before them from June 1, 1892, to January 1, 1893, a complete and honest statement of the condition of the General Electric Company, they would not have been in it at all, and would not have lost their money.

The Boston *Herald* is correct in its assertion that "It is to be regretted that the General Electric Company was ever organized." It is regretted by every man in the electrical trade, by the public who bought stock, and without doubt by all the leading organizers of the company, even Mr. Coffin himself.

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The query why more central stations do not pay has been often raised. There are several reasons, the chief of which is suggested by the tabulated statement printed elsewhere, showing how the Thomson-Houston Company was able to utilize the securities of various local companies, taken usually as a bonus after receiving ample cash for its apparatus at a reasonable valuation. Central station companies that went into business by paying cash for their apparatus and bonding themselves for two or three times their value, giving 30 or 40 per cent. of the bonds for an alleged "patent license" which has proved a delusion and a fraud, are not likely to pay in this generation. By reading between the lines of the table referred to some central station men can see why their stations do not pay.

Judge Lacombe's Interpretation of the Law. A curious misstatement of fact has gone forth in a press dispatch from New York in regard to the remarks made by Judge Lacombe when the case of the Edison Electric Light Company vs. the Mount Morris and United Electric Light and Power Companies came up before him last week. The dispatch was headed "A Setback for the Edison Company," etc., and was wholly incorrect. Mr. Elihu Root, leading counsel for one of the defendant companies, had gone out of town for the summer, and at the urgent request of Mr. Clarke and Mr. Cravath, counsel respectively for the two defendant companies, Judge Lacombe, under protest, granted an adjournment till after August 15, allowing the Mount Morris Company time to engage new counsel in place of Mr. Root, if necessary. A reference to Judge Lacombe's remarks, printed elsewhere, shows that there has been no change since last December in his opinion of the rights of the owners of the Edison patent. They can sell lamps to whom they choose, or they can refuse to sell or to manufacture any lamps at all if they see fit, under the law as interpreted by Judge Lacombe.

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The Bears are not Omnipotent. The Wall Street "bears" have come in for a great deal of newspaper comment of late, some of it of a rather uncomplimentary character. They are accused by some silly writers of being wholly responsible for the present demoralized condition of the market for all securities.

These writers appear to lose sight of the fact that no broker can persist for a great while in selling stock which he cannot deliver. In other words, no bear raid can be successful unless the actual holders sell the stock. General Electric has not been forced down by the bears; it went lower and lower because there were more people who wanted to sell it than there were who wanted to buy at any price. It is worthy of note that these bears some time ago decided not to speculate in New York Edison Illuminating. One or two raids were attempted, but the actual stock was not forthcoming, and they lost money on their ventures.

It looks to an outsider as if the power of the bears was greatly over-estimated. They backed their judgment that General Electric would go below 50, but if the holders of the stock had refused to sell, the bears would have been bitten, and the price would not have been lowered.

A couple of weeks ago President Sturgis read the bears a lecture on the floor of the Exchange. In so far as his remarks were directed towards the disgraceful methods of such firms as A. J. Weil & Company, whose board member has since been suspended for a year, they were well merited. But the betting of speculators ought not to have a very powerful influence in upsetting actual values, or in causing bona fide owners to sell their stock at a loss. The majority betting on a horse creates the favorite, but the favorite comes in a tail-ender as often as he does a winner; and election bets, in whatever volume, change few votes. Why should simple betting at the Stock Exchange convince the public that their securities are worth less than they cost ?

Electricity maintains that the chief cause of the wasteful shrinkage in values of sound stocks, which we are at present witnessing, is found, not in bear raids, but goes back for about a year, when the most unscrupulous operators in the Street, who had been properly subsidized by Trust officials, were booming Trust stocks by all the arts known to Wall Street to a price two to five times above their actual value, thus enabling the insiders to unload at the expense of the ignorant public.

The fall in Trust stocks cannot be considered a shrinkage in values, because the values never existed upon which to base the inflated quotations.

It will be remembered that the two operators most conspicuous in booming General Electric were Messrs. J. R. Keene and S. V. White. The former was quoted as follows in Electricity for September 14, 1892 :

> "The General Electric is earning 17 per cent. per annum on its stock. This is exclusive of stocks received by it from corporations organized at various points to do business in special lines, such as electric lighting, etc., which get the authority to use the patents owned by the General Electric Company. Its business is continually expanding and it is only a question of time when the present rate of dividend, 2 per cent. quarterly, will be increased. Any person who can buy the stock, and will hold it firmly until next year, will get a large advance, not only in the price of the stock, but in the dividend.
>
> "If there are any stocks which should claim attention at the present time they are to be found in the industrial group."

Even at this late day, we insist that Mr. Keene should be summoned before the Board of Governors, and severely reprimanded for his lying statements.

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If Mr. Edward H. Johnson should prove to be the Coming Man, the General Electric interests would have the best wishes of the trade at large, and bitter hatred would give way to huzzahs from all directions.

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World's Fair Photographs. Our childish contemporaries the *Electrical World* and the *Western Electrician* are wasting space in a controversy over certain photographs of the Edison tower of light which might better be devoted to other uses. The tower of light is a marvel of beauty to those who can see it lighted up, but no photograph of it could reproduce its splendors, and the photograph in question was not worth stealing, or quarreling about after it was stolen. The editors of our esteemed contemporaries might better go out behind the Electricity Building and play marbles.

But as for the conduct of the official photographer in this, as in other matters, that is another story. He is an abomination and a disgrace, whose constant abuse of his privileges, coupled with evident inability to secure decent photographs, is an outrage, not alone upon the exhibitors and the newspapers, but upon the entire public, who have a right to demand that the photographs of all the beauties of the great show should be up to the highest standard of the art, and as plentiful as possible. If the country were flooded with first-class photographs of the various features of the show, infinite pleasure and instruction would be carried to many thousands who cannot visit Chicago.

We do not know who this photographer is or what his antecedents, but from his work we judge that he is a graduate from the whitewash brigade who were employed on the grounds before the Fair opened.

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THE infamous action of the authorities in admitting the electro-medical fakes to the Electricity Building at the Fair is attracting attention abroad. The London *Electrical Review* devotes some space to these fakes in its July 28 issue. ELECTRICITY has endeavored to make it plain to foreign visitors, and to the foreign press, that these fakes have no standing among reputable electrical people on this side, and that their admission to the building is generally recognized as an injustice to the legitimate exhibitors, and a double injustice to the manufacturers of *bona fide* electrical apparatus which is sold to reputable physicians.

……

THE editor of the financial column in the *Electrical World* is getting into the bad habit of stealing all his news from ELECTRICITY, which, of course, renders our esteemed contemporary just one week behindhand in these matters. This course is wholly unnecessary. If the young man will call at this office regularly on Monday afternoons at 6 o'clock, we will give him a fair summary of the news which we have gathered for the week. We make this offer, not for the sake of the *Electrical World* itself, but for the sake of its readers, who deserve better treatment.

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THE United States Consul at Bangkok, in reporting the establishment of a street railroad three miles long in that city, equipped with Short apparatus, expresses the opinion that if the American electrical companies were to send competent representatives to the large cities of Asia they could secure a number of contracts similar to the one that has been so satisfactorily executed by the Cleveland firm.

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To THE victors belong the spoils! And now is the time for independent manufacturers to hustle for contracts. Begin to hustle in the proper manner, by sending an advertising order to ELECTRICITY.

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ELECTRICITY has been a forceful factor in the electrical business world for the past year. Send in your advertisement.

……

IT WAS a very suggestive pointer on the situation, that when the General Electric Company seemed likely to be put into the hands of a receiver within twenty-four hours, as it did a couple of weeks ago, no one in the trade had either sympathy or sorrow to express. Some fears were entertained for the immediate results to the trade at large, but it was and is the universal opinion that business will never be in a healthy or satisfactory condition till the Trust is out of the way.

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MR. HENRY VILLARD is probably the only one of the leading spirits in the organization of the General Electric Company who is unmoved by passing events. He sold out above par.

THE Association of Edison Illuminating Companies meets in Chicago this week. There has in the past been ample reason for the existence of this association, and it has been of untold value to its members. But it seems to us that the time will soon come when the association will deem it good judgment to go over in a body to membership in the National Electric Light Association, where they would be welcome, and where their field of usefulness may be still further extended.

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WITH three financing companies at its service to raise the sinews of war, the Electric Trust ought to be able to carry out at least one more campaign.

A Trustful Soul.

The following questions and answers have appeared in the financial columns of the Boston *Advertiser*:

Investment Editor: Do you think anything serious is the matter with General Electric Company except the panic? I think you said once that they were likely to continue their present rate of dividend. I know that nearly all stocks have suffered, but General Electric especially. Don't you think the stock will improve when the panic passes away?

INVESTOR.

Atlantic City, N. J., July 24.

The managers of General Electric tell me they will maintain their present dividends, and they include the heaviest moneyed men in the country. Why they do not buy in the stock at present prices, all that is offered, I do not know. General Electric preferred must be an excellent purchase at these prices. Nothing can affect its dividends.

ABOVE PAR.

State Street. July 25.

Edison Gets the Credit for the Niagara Scheme.

(*Omaha Bee.*)

"Edison hopes some day to make Niagara furnish enough electric power to run every railroad train and light every town in the State of New York."

The Best Read Paper.

The largest trade paper advertiser in the United States recently concluded a personal letter to one of our constituents as follows:

"ELECTRICITY looks well and is doing yeoman's service on behalf of the manufacturer and tradesman as against combinations and trusts. It is the best read Electrical paper in the country to-day."

General Electric.

What is Said of It Nowadays.

General Electric opened at 48½ and sold at 52, but reacted to 46¾. The committee that is investigating the company's affairs will, it is said, report that the assets in the treasury are sufficient to protect the stock to the extent of at least sixty cents on the dollar; that is to say, this protection would be offered if the company was to wind up—which it has no intention of doing.—*N. Y. Mercury.*

It is to be regretted that the General Electric Company was ever organized. The separate concerns had a fine business, all they could attend to probably, and the prices of competition would likely have proved less difficult to meet than the perils of combination. It is a gigantic task at times to finance a monopoly and always difficult to manage it.—*Boston Herald.*

A recent issue of the *Electrical Engineer* of New York contains a paper and a short note on "Calculating Armatures." The title puzzled us at first, as our thoughts were carried to phenomenal "calculating boys"; but we find that this is not an announcement of a new prodigy, but merely a new method for getting out armature quantities. The method "is based on the analogy between the torque at the periphery of the armature and the pressure on the piston of a steam engine." If occult analogies can ever evolve good armature proportions, this one may do as well as another. In a similar manner we might design a flap-valve from its analogy with a five-barred gate, or an arc lamp from its analogy with the rush-light.—*Electrician*, London.

Trusts and U. S. Patents.

Keep Your Eye on This Lawsuit.

P. H. Williams, of Holland, Mich., manufacturer of spring tooth harrows, has filed suit in the United States Court at Grand Rapids against D. C. and H. C. Reed et al., of Kalamazoo, to recover $50,000 damages for interference with the business of plaintiff.

The defendants are members of the National Harrow Company and as such brought action against Williams for infringement of patent.

The suit is one in a series of like suits brought against anti-trust harrow manufacturers in all parts of the country.

The anti-trust men claim that a conspiracy has been organized, in violation of the Sherman Law of July, 1890, to ruin their business, and have appealed to the provisions of that law for protection.

Judge Lacombe's View of the Law.

[Report of Edison Illuminating Company vs. Mt. Morris Electric Light Company.]

Mr. Clarke (of defendants' counsel)—"The defendants' plant was installed prior to the decisions. The plaintiff here has gone on since that time furnishing that lamp to use in connection with that plant, but now they refuse arbitrarily——."

The Court—"He has a right to under the patent—that is what the monopoly given to him under the patent is for. A man may sell his lamps, or stop selling them, just as he pleases."

Was it the Forerunner of the Telautograph?[*]

"Copying Electric Telegraph."

[From the Civil Engineer and Architects' Journal, London England, May, 1848.]

An electric telegraph which will produce at a distant town fac-simile copies of writing applied to the instrument in London has just been invented by Mr. F. C. Bakewell. We have seen a specimen of the telegraphic writing copied from the original by a separate instrument, only connected with the other by wires in the ordinary manner. We understand that arrangements are being made to give the invention a trial at a long distance, for the purpose of adopting this mode of telegraphic communication generally if it be found as applicable between distant towns as it is at short intervals. The rapidity with which copies may be made with this instrument will far exceed the manual dexterity of the quickest writer; for the inventor expects to be able to transmit 500 words per minute. Where shorthand is employed, of course, the rapidity of transmission would be much greater; and plans and engravings may be copied by the same instrument.

[From the same journal, issued July, 1848.]

We mentioned in a former number that an electric telegraph had been invented by means of which a written communication could be copied at a distant town, so as to enable correspondents to recognize the handwriting of each other. This telegraph has during the past month had several trials between London and Slough. The results of these trials have proved that the power transmitted along the wires is quite sufficient for long distances and the copying process. Specimens of the writings copied from 400 miles of wire are exact fac-similes. Great confidence will be given to this method of communication by which messages are received in the well known handwriting of familiar correspondents. By the common method in general use there is no proof that the information received is authentic.

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[*] Contributed by Mr. G. Wilfred Pearce, of New Brunswick, N. J.

Legal Notes.

In the suits brought against the City Electric Street Railway Company of Little Rock, Ark., by certain banks for notes given by the railway company and discounted by the plaintiffs, Judge Lea has rendered a decision in favor of the plaintiffs. The answer of the defendant alleges that the officers had not been authorized to give the notes. The plaintiffs demurred to this, stating that the books of the defendant showed that this authority had been given. The Judge sustained the demurrer, and rendered judgment accordingly, holding the plaintiffs to be innocent purchasers. An appeal to the Supreme Court was granted, and the cases will go there for final settlement.

Solicitors for the General Electric Company have filed in Salem the answers to the bill in equity filed against the General Electric Company, the Thomson-Houston Electric Company, and E. Wilbur Rice, Jr., and Walter H. Knight, in the Supreme Judicial Court, at Salem, May 6, in which the plaintiff charges the defendants with bribery and instigation of theft in securing plans and blue prints from the Westinghouse Company. The answers are three in number—one for each defendant—and deny all charges, although admitting that in the possession of the company there may have been various prints of apparatus manufactured by the plaintiff, but secured in the ordinary course of business, without wrongful action on the part of the defendants.

Judge Green, of the United States Circuit Court, dismissed the suit of the Accumulator Company of Newark, N. J., against the Consolidated Electric Storage Company of Camden, for want of jurisdiction, the Faure patent having expired.

The Ansonia Electric Company of Ansonia, Conn., and Chicago, Ill., has begun suit against Hugh McMillan in the Wayne Circuit Court, Detroit, Mich., for $10,000 damages.

The Ansonia Company has also brought suit against the Detroit Electrical Works to recover on some notes given before Mr. McMillan's mortgage was foreclosed.

The cases of the Edison Electric Light Company vs. the Mt. Morris and United States Companies, which came up before Judge Lacombe on August 2, was adjourned peremptorily to be called again about September 1.

A decree has been indorsed by Judge Hunt at Cincinnati in the case of Tozier vs. the Novelty Electric Supply Manufacturing Company. The report of the receiver is confirmed, compensation fixed, and the payment of a dividend of 12½ per cent. is authorized to general creditors.

The Edison Electric Light Company has filed with the county clerk at Albany a notice of appeal from the judgment of the General Term in the matter of the taxes enforced by the State in 1889 and 1890 as the result of a suit brought by Hon. Edward Wemple, then Comptroller of the State.

The suit which the New York and New Jersey Telephone Company brought against the Metropolitan Telephone and Telegraph Company to recover $500,000 damages for breach of contract, decided some time ago by Judge O'Brien in favor of the plaintiff, has been sent to a referee who is to determine the amount of damages.

To satisfy a judgment of $600, Deputy Sheriff Louis Walters, of Queens County, has levied on the Norton Electric Light Company plant at Fresh Pond, which supplies with light the picnic parks near Ridgewood, L. I.

A bond in the sum of $200,000 has been given to the Sheriff of San Francisco for the delivery of the dynamos, motors, cars and other properties of the San Francisco and San Mateo Railway Company, seized at the instance of the Thomson-Houston Electric Company. The sureties are: Behrend Joost, $125,000; James A. Wymire, $50,000; Fabian Joost, $25,000.

More Details.

The Latest Plans to Raise Funds for the Trust.

The Illegal Abuse of U. S. Patents Will Now Proceed.

The following additional information has been gathered in regard to the sale of treasury securities announced ten days ago by the General Electric Company.

The new company to be organized on the treasury assets is to be styled the Tramway and Illuminating Trust, and capitalized for $4,500,000 ten-year debenture sixes and as much stock. The bonds may be redeemed at a premium. The trust will last ten years, or longer, at its own option.

The securities are to be selected by a committee from mortgage bonds, secured short time obligations and miscellaneous railway and illuminating securities, of the aggregate value of about $10,500,000.

It is said that on Friday, the 28th July last, the General Electric Company had $1,400,000 cash, and owed $5,000,000, including the $600,000 since paid in dividends. It had other receivables on the same date. It will receive $4,050,000 from the sale of its $10,500,000 treasury securities. This, added to $1,400,000, makes $5,450,000, set against the dividend and debt of $5,000,000. Allowing for contingencies even, this seems to provide for the floating debt and the current dividend. Future dividends are a future problem.

It is said that the Tramway and Illuminating Company receives two notes for $450,000 each, drawn by the General Electric Company, one of which is for value received, the other being a kind of bonus or reward of merit.

The Boston *Herald* presents the following interesting summary. We trust that it is free from typographical errors, and that the publisher of ELECTRICITY will not be indicted for copying it:

The proposed organization of the Tramway & Illuminating Trust renders interesting a resumé of the previous Thomson-Houston trusts or series, which have been organized upon treasury securities as a basis. Such resumé has been compiled as below:

SERIES A.

Established December, 1885.

Number of shares	5,000
Cost to shareholders per share	$80.00
Original amount in trust	451,251.40
Divided in cash	340,000.00
Divided per share in cash	68.00

This series was finally closed by last payment and distribution of proceeds from sale of securities October, 1889.

SERIES B.

Established August, 1886.

Number of shares		5,000
Cost to shareholders per share		$40.00
Original amount in trust		495,167.03
Divided in cash		265,000.00
Divided per share in cash		53.00
Remaining in hands of trustees:		
Bonds, face value	$103,000.00	
Stock, face value	1,000.00	
Cash	340.90	
Face value of securities now on hand	$104,340.90	
Per share		$20 87

SERIES C.

Established January, 1889.

Number of shares		40,000
Cost to shareholders per share		$10.00
Original amount in trust		1,263,940.22
Divided in cash		600,000.00
Divided per share in cash		15.00
Remaining in hands of trustees:		
Bonds, face value	$343,500.00	
Stocks, face value	469,400.00	
Accounts receivable and notes receivable	7,973.86	
Cash	21,350.74	
Face value of securities, etc., now on hand	$842,224.60	
Per share		$21.05

SERIES D.

Established October, 1889.

Number of shares		120,000
Cost to shareholders per share		Given as dividend
Original amount in trust		$2,416,468.27
Divided in cash		570,000 00
Divided per share in cash		4.75
Remaining in hands of trustees:		
Bonds, face value	$718,100.00	
Stock, face value	1,077,300.00	
Accounts receivable and notes receivable	83,272.02	
Cash	106,306.63	
Face value of securities, etc., now on hand	$1,984,978.65	
Per share		$16.54

It will be observed with reference to series "C" and "D" that while $600,000 in cash has been distributed among the shareholders of the former the par value of the securities originally placed in trust has only been reduced by $421,000, and that while $570,000 cash has been distributed among the shareholders of the latter the par value of the securities originally placed in the hands of the trustees has been reduced by only $432,000. The opportunities for profitable reorganizations and consolidations have operated to bring about these results.

The exceedingly profitable character of these series gives birth to a query whether the company has not sold its block of treasury securities pretty low at $4,050,000 net. Also, the query whether all shareholders should not be allowed to join the subscription upon the same terms. It is presumable that shareholders who subscribe outside the syndicate at a higher than the syndicate price will be very few, while shareholders who would join in the subscription upon the same terms as the syndicate might be considerable. Ought there to be any discrimination in favor of one set of shareholders as against another set? Ought a few wealthy shareholders to be permitted to select from the treasury assets at less than 50 cents on the dollar and organize a new concern to work off such assets for the benefit of the shareholders of that concern?

Trusts and Personal Liberty.

Combinations Must not Trample Upon the Liberty of the Individual.

(From a recent Address by David J. Brewer, Associate Justice of the United States Supreme Court.)

The proposition that the many may rule the one is carried into the daily life of the nation in a practical way to the extent that the individual is swallowed up in the mass, and the personal independence of every citizen, in all matters of contract and labor and life, is in danger of being destroyed.

The most noticeable social fact of to-day is that of the combination of capital and the organization of labor. Whatever may be the causes, and whatever may be the results, good or bad, the fact is beyond dispute that the trend of the two great industrial forces of capital and labor is along the line of consolidation and cooperation. I am not here to decry this tendency. I realize full well that only through this movement are the great material achievements of the day possible; but one thing is clear, and that is that the penalty which the nation pays for all its benefits is the growing disposition to sacrifice the individual to the mass, to make the liberty of the one something which may be ruthlessly trampled into the dust because of some supposed benefit to the many.

A capital combine may, as is claimed, produce better, cheaper and more satisfactory results in manufacture, transportation and general business; but too often the combine is not content with the voluntary co-operation of such as choose to join. It grasps at monopoly, and seeks to crush out all competition. If any individual prefers his independent business, however small, and refuses to join the combine, it proceeds to assail that business. With its accumulation of wealth, it can afford for awhile to so largely undersell as to speedily destroy it. It thus crushes or swallows the individual, and he is assaulted as though he were an outlaw. . . .

The business men are becoming the slaves of the combine, the laborers, of the trades union and organization. As against this servitude and sacrifice of individual liberty, I wish to enter my earnest protest. In every century humanity has looked forward through tears to a better day to come, and has asserted as the ideal yet to be attained the liberty of the individual. *Is it not bartering away the experiences of the past, are we not selling our birthright for a mess of pottage, when we encourage or even tolerate the domination of the combine*, when we look in silence upon the growing servitude of the individual to the organization ?

Current Items.

The British Government is anxious to give the people greater telephonic advantages than they now have of telegraphic facilities, which latter are exceptionally good. Among other projects of the British Post Office officials is one to establish at Leeds, in the very centre of England, a telephone exchange with which every large town in the United Kingdom will be connected, so that it will be possible for any town to speak with any other. It is intended that the work in the towns themselves shall be done principally by the telephone companies, but the Post Office itself will open exchanges where there are no companies.

At several places in Milwaukee, the Wisconsin Telephone Company has put in nickel-in-the-slot machines, by means of which telephones for public use can be provided without keeping an attendant in charge of them. There are slots for nickels, quarters, half dollars and dollars, so that the apparatus can be used for toll connections. Each coin when it is dropped into the machine causes a bell to ring and the sound of this bell is telephoned to the central office, where the operator is able to tell by the tone what amount has been paid, because there is a bell of different pitch for each of the slots. The machines that have been put in work very well and the operators rarely fail to distinguish by the sound of the bell how much money the man at the other end of the line has placed in the slot.

The car which is doing the welding on the street railway in Boston looks like a large freight car. It is equipped with motors to move it from place to place, and besides has a generator of 125 horse power on it which furnishes the power for the heat used in welding the rails. In doing work so quickly as it is done by this process there is a rough place left at the joint. This is smoothed away as though it were solder by an arc welder consisting of a large carbon about the size of one's arm, mounted on an immense glass handle. The rough steel places fall before it as lead, and the joint is made perfectly smooth. The old idea of allowing a space at the joints of the rails for the expansion and contraction of the steel has been done away with, for it has been found by experiment that the steel does not expand or contract much more than the ground itself.

In a recent electric road constructed in England a radical departure from American methods has been made. A trolley wire is suspended from arms projecting from steel columns; no guy wires are employed, as the steel wires are especially designed to withstand severe strains. At the corners the trolley wires, instead of following a curve of the same radius of the track, as in the American systems, is turned on an angle, the whole system depending on the flexibility of the trolley arm, or side collector, as it is called, which automatically engages the trolley wire in any position from two to twelve feet from the side of the car.

The Minneapolis *Tribune* states that a graduate of the University there, named C. W. Carter, has invented a car brake, to be controlled by electricity, which is regarded as the best device yet invented for the purpose. "The mechanism," says the paper quoted, "is extremely simple and safe, and it entirely does away with the old-time levers, being controlled on the concentric principle acting on the forward and rear wheels of the truck. Arrangements have been made for a test to be given within a few days on the electric cars of this city."

A diminutive electric fan in the office of the Department of Public Works at Pittsburg was located on a window sill, where its noise disturbed the clerks, and they placed it on a metal heater. A reporter says that the instant the current was turned on the electricity performed a clog dance, and waltzed the fan all over the heater, and at a speed that would make a Homewood flyer stand aghast. All the time the blue fluid flashed out in two-foot lengths, and the burring and whirring of the swift-revolving wheel nearly caused a stampede in the office. But relief came at last, when the machine with a mighty effort, as if to get away from the heater, danced off the side of it, and fell with a bump to the floor, bringing the circus to a close.

Dr. Bottomley before the Glasgow Phil. Society showed some photographs of bullets in motion, referred to in a paragraph in the Digest, April 15. Photographs were shown of a bullet in carbonic acid gas to show the slower speed of the air waves; others of a discharge of shot, and a bullet passing through a plate of glass, showing how the splinters are first splashed back when the bullet enters the glass, and after it has passed through it sucks them through the hole, carrying them with it and gradually depositing them. He mentions that Professor Boys has shown that the duration of a spark from a Leyden jar under certain conditions was about one-twentieth of a millionth of a second.

The French language, it appears, is better adapted to the purpose of the telephone than the English. It is stated that the large number of sibilant or hiss syllables in English renders it a less easy and accurate means of communication. Some English words are especially difficult of transmission by telephone. The word "soldier" is cited as one of these. Proper names frequently occur in the midst of an otherwise perfectly audible and intelligent conversation which the ear cannot possibly catch. These must be spelled out, involving delay.

A despatch to the N. Y. *Herald* from San Jose, Guatemala, states that direct communication over the Central and South American Telegraph Company's wires, via Galveston, was opened on the 24th July between Guatemala and the United States. The official opening took place on July 19, with great ceremony, the day being the anniversary of the opening of the railway between San Jose and Guatemala City, which occurred in 1884, and also the anniversary of the birth of the late President Rufino Barrios. The Government paid the cable company $150,000 in American gold on the day the lines were officially opened.

A profitable field is opened for men of artistic judgment and cultivated taste in the arrangement of electric lights in ball rooms, reception rooms and other apartments where decoretive effects are of value. The mobile electric glow-lamp affords advantages in illumination that were totally unattainable from stationary gas fixtures, and a talent for locating electric lamps in positions best adapted to the prevalent hues of the furniture and draperies of an apartment and to its form and dimensions so as to produce the desired effects of color and perspective, will be duly appreciated and fitly rewarded.

The Boston *Courier* suggests that since the speed of ocean steamers of the present models and method of propulsion has practically reached its limit, a new means of ocean travel might be found in submarine vessels of proper form, propelled by the trolley, with power supplied from cables laid as at present. The writer would have the vessels suspended at a depth below the reach of the waves, and thus swiftly glide along undisturbed by the storms that furrow the surface and make unaccustomed voyagers yearn for the the land. He does not submit any ideas as to ventilation, etc., convinced, perhaps, that by the time his system comes into vogue mankind will have ceased to breathe.

A Hartford (Conn.) paper, in recording the fact that the searchlights with which the Schuyler Electric Light Company are experimenting in Middletown are seen in New Britain, states that an aged couple who strongly believe in Lieut. Totten's prophetic vagaries were seen standing in their door-yard watching the lights with awe-stricken interest, taking them for indications of the beginning of the fulfilment of the Tottenistic prophecies. From their remarks, overheard by a gentleman passing, their faith in the divine origin of the flitting beams seemed complete, and when told that the lights were simply a demonstration of the power of electricity, although their awe was allayed, they were evidently not pleased to have their cherished beliefs rudely shaken by the cold facts.

It is not often that the engineering world is called upon to witness the completion of a work nearly 2,500 years after it was first projected; but such is the case with the canal through the Isthmus of Corinth. Projected 600 years before Christ, agitated again 300 years later, actually begun by the Emperor Nero, it is completed in 1893.—*American Engineer and Railroad Journal.*

Boston Notes.

There are two or more new style arc lamps about ready for being put on the market by Boston inventors and manufacturers, for which extraordinary claims are made. Should these claims be realized, it certainly seems as if we might look for a fairly complete revolution in the arc light department of electrical science.

The factories of the General Electric Company at Lynn are running only five days a week for the present, consequent upon the general business depression that prevails everywhere. This arrangement meets with the approval of the employees in general, as during the fine weather it enables them to enjoy two whole rest days a week. During July the company is reported to have booked over $1,000,000 worth of cash orders.

One of the most attractive resorts about this city is the Marine Park, City Point and Castle Island, where is situated Fort Independence, just off the point. The pier at City Point is brilliantly lighted by innumerable electric lights, while Castle Island is connected to the main land by a handsome pier, along the entire length of which are arc lights a short distance apart. The island forms one branch of the park system of Boston, and in an evening thousands of foot passengers throng these piers. They form the most striking features in Boston's beautiful harbor.

The present financial stress and consequent scarcity of work and money is seriously affecting the various seaside resorts in this neighborhood, but is in some respects telling in favor of the West End R. R. Co. In view of being unable to take their annual vacation by the sea, thousands of persons remain at home in the city and treat themselves most evenings to a long and pleasant electric car ride into the suburbs. One of the favorite rides is by way of Beacon street to Chestnut Hill Reservoir, over four miles out, through the beautiful town of Brookline. The scenery around Chestnut Hill is very fine, and the cars are taxed to the utmost to carry all the passengers. Many ride out to Newton, another beautiful city. Some of the five-cent trips thus being taken extend from nine to eleven miles, which people of moderate means don't fail to avail themselves of.

The International Trust Co., which is one of the leading banking firms in Boston, moved into its handsome new nine story building, corner of Milk and Devonshire streets, and began business there last Monday morning. The isolated electric lighting plant and the beautiful fixtures are among the most complete and artistic in New England, some very unique features having been introduced in the system of illumination.

His many friends will hear with regret of the serious illness of Col. L. W. Burnham, General Manager of the Electric Gas Lighting

Co., this city. Col. Burnham was making ready to start on a two weeks' trip to the World's Fair with his daughter when he was suddenly seized by an attack that quite prostrated him, and he is still confined to his bed. As is well known, he has worked like a Trojan for years, building up one of the most prosperous electrical firms in the country, with the result that his health has been impaired. Of late, however, he has been a good deal of his former self again, and was really feeling, as he imagined, first-class when his present sickness overtook him. He has the best wishes of all his friends for a complete and speedy recovery.

An interesting instance of the "freshness" which characterizes many of the young salesmen employed by the General Electric Company occurred a few days ago when one of these "fresh" young men walked into the office of the purchasing agent of one of the largest electric lighting companies in New England. This young man's employers, the Trust, had heard that said agent was purchasing supplies from outside firms and not from the General Electric Company; so they deputed the fresh young man to wait on this gentleman and respectfully inform him that it was his duty to purchase all his supplies from the Trust. The agent, singular to say, declined to see that his duty lay in that direction at all, and intimated to the fresh young man that his duty prompted him to do as he liked in the matter having in view his employers' best interest. Then the fresh young man desired to know where the agent was purchasing a certain line of supplies, which impertinent query roused the agent's color somewhat, and he brusquely answered the fresh young man that it was none of his d——d business to know, but so long as he could buy supplies of nearly any kind for 25 per cent. less than the General Electric Company's rates, he should continue to buy them where he chose, and the Trust and its goods and prices were at liberty to go to blazes—the quicker the better. This is a true story.

The beautiful marine resort, quaint old Marblehead, is to secure a new lease of existence by being connected with Salem, Lynn and Boston by electric railway. It is expected that cars will be running by Monday. When this system is complete the many lovely places on the north shore of Massachusetts Bay will be within easy reach of thousands of pleasure seekers.

General News.

What is Going on in the Electrical World.

Norfolk, Va.—Construction work has begun on the electric railway which is to take the place of the horse car lines.

Providence, R. I.—The new electric road through East Providence to Riverside and Crescent Park has been opened to public travel.

Hillsboro, Ill.—The city council has awarded the contract for lighting the city to the Electric Light Company. The electric light plant is nearly finished.

Watertown, Mass.—Many of the business firms in Watertown are considering the introduction of electric motors as a means of furnishing power for their business.

Binghamton, N. Y.—The bid of the General Electric Company for lighting the city for three years at 30 cents a light per night has been accepted by the common council.

Windsor, Conn.—The Eddy Electric Manufacturing Company, which recently went on to a time basis of five days per week, has made another reduction to eight hours per day.

Philadelphia.—Geo. W. Pierce, manufacturer of electrical supplies at 510 Arch street, has disappeared, leaving a number of debts unsettled. His factory will be sold by the sheriff.

Cincinnati.—The franchise for the proposed electric railway to Oakley has been awarded to the Cincinnati, Oakley & Madison Electric Railway Company for a term of twenty-five years.

Gardner, Mass.—The selectmen have granted a franchise to the Gardner Electric Street Railway Company to run a line between the several contiguous villages. The authorized capital is $75,000.

Jamestown, N. Y.—N. W. Gokey & Son have purchased a majority stock of the Jamestown Electric Light and Power Company, and will combine that plant with the plant which they have had in operation in their factory.

Bridgeport, Conn.—The Bryant Electric Company is now working on half time. The company has large orders, but on account of the dullness of the season the fulfilment of them has been postponed.

Mt. Pleasant, Pa.—The Citizens' Electric Street Railway Company, recently organized to build a line, has abandoned the enterprise because of the refusal of the borough authorities to give to the corporation the right to lay tracks in the town.

Lynn., Mass—The extension of the Wakefield & Stoneham Electric Street Railway line from Wakefield to Lynn is to be begun soon. The company has voted to increase its capital stock from $50,000 to $150,000 for the purpose of road construction.

Oneonta, N. Y.—The Oneonta Electric Light and Power Company, which not long ago had several judgments against it, has, according to a circular issued by the company, paid all these outstanding claims in full and has floated the whole of its new series of bonds.

Pottstown, Pa.—A Philadelphia syndicate has authorized the purchase of the seventy-acre farm on which are located the famous Ringing Rocks and adjoining property, with a view of building an electric railroad from Pottstown to that place and erecting there a large mountain hotel.

New Haven, Conn.—Improvements on the State street and Whitney avenue railroads are being pushed forward rapidly, and it may soon be expected to see the roads electrically equipped. The new power house will be 250x80 feet. The contract for the dynamos, etc., has been awarded.

Tiffin, Ohio.—Work on the Tiffin & Fostoria Electric Railway is progressing, and it is hoped by the president, R. W. Brown, to have the road completed next October. The road will be nearly fourteen miles long and will ultimately become a part of the proposed line from Findlay to Put-in Bay.

Albany, N. Y.—A method for lighting railroad passenger cars by electricity has been tested for some time on a New York Central car with good results, and it is thought that in a short time all the cars for the Central turned out at the West Albany shops will be equipped with the new lighting apparatus.

Carrolltown, Pa.—An electric light company has been organized at Carrolltown with a capital stock of $20,000. A number of Altoona business men are connected with the new corporation, which will furnish electric light for Carrolltown and also for the thriving towns near by—Hastings, Spangler and Bainsboro.

Mount Vernon, N. Y.—The Union Electric Railway Company, having applied to the authorities for a year's extension of time in which to complete their road in Mt. Vernon, and the common council having refused to grant the request, the road withdrew its bond for $25,000 and has retired from the field for the present.

San Francisco.—Severe tests have been made lately of the Hatch storage battery on an experimental car of the San Francisco Electrical Storage Company which are said to have convinced several electrical experts of its practical efficiency.—Despite the troubles of the San Francisco and San Mateo electric road with the Thomson-Houston Electrical Company, work on the extension to Baden is being pushed.

Brooklyn, N. Y.—The Union Elevated Railroad Company have been considering the substitution of electricity for steam as a motive power on their road.—Mayor Boody has signed the resolution passed by the board of aldermen granting franchises to the Broadway Railroad Company for over twenty miles of streets, and also approved the application of the same company to change its motive power to electricity.

Easton, Pa.—The contract for the building of the Pen Argyl, Bangor & Water Gap Electric Road has been awarded to Davis & Ludwig, of New York City. Work is to be commenced at East Bangor and pushed westward to Wind Gap, the contract calling for the completion of the line as far as Pen Argyl by Oct. 1, and that part of the line will then be put in operation. The company has decided to locate its power plant, etc., in Bangor.

Baltimore, Md.—It is understood that work will soon begin on the power-house to be built on O'Donnell's wharf by the City and Suburban Railway Company. The plant will have a capacity of 5,000 horse power and will be so arranged as to increase the horse power in the future i necessary. In a few weeks, it is said, the entire City and Suburban system will be operated with electric cars.—The three electric locomotives to haul trains through the new Baltimore and Ohio Railroad tunnel under the city of Baltimore are completed and will soon be tested.

Newark, N. J.—The Newark Passenger Railroad Company has agreed to lease its lines to the New Jersey Traction Company. The latter company is building a second road from Jersey City to Newark along the old Newark turnpike.—The transfer of the franchises of the Newark Passenger Company to the syndicate known as the New Jersey Traction Company is one of the largest transactions in traction interests ever known. The lease is to run for 999 years, and under its terms the New Jersey Traction Company will enjoy a practical monopoly of the street car traffic in Hudson, Essex and Union counties of New Jersey, and will be in such affiliation with other companies in Mercer and other of the more populous counties as to enable them to control practically the entire traction interests of New Jersey.

U. S. Government Contract

For the Wilmot & Hobbs Manufacturing Company.

The Wilmot & Hobbs Manufacturing Company, of Bridgeport, Conn., have secured recently another large contract from the U. S. Government for their cold rolled "Swedoh" steel, which is being used for some very severe stamped and drawn work that the Government have been making for some time. This steel is something quite new for such work and after being submitted to some very severe competitive tests it has been demonstrated that it is far superior to anything heretofore used for this work. We understand this company is making quite a specialty of it.

Abreast of the Times.

The General Incandescent Arc Light Company, with keen appreciation of the growing demand for efficient arc lamps for use on alternating current systems, has brought out a new line of alternate current lamps which will be supplied in various styles.

Hercules Switches at the Fair.

Office of
D. H. Burnham, Director of Works,
World's Columbian Exposition,
Jackson Park,
Chicago, Ill., March 11, 1893.

Mr. F. H. Angell, Gen'l Agt. Utica Elec. Mfg and Supply
Co., 10 Cornelia St., Utica, N. Y.

Dear Sir: We are in receipt of sample Hercules No. 1 Arc Light Cut-Out and beg to inform you that we have given the same a thorough test, which has proved very satisfactory. This switch was tested by first cutting in 40 lamps, then 50, and finally cutting in 70 lights. The switch operated very satisfactorily up to 50 lights, without any trouble whatever. Up to 70 lights, however, we found it necessary to throw the handle over as rapidly as possible. With this little extra exertion, the switch operated very successfully, and I can congratulate you upon its operation. We yesterday sent you a telegram as follows: "Sample satisfactory; ship Hercules Cut-Outs ordered, with glass covers, immediately."

Yours, very tuly,
S. G. Neiler,
Assistant Electrical Engineer.

Cutter's Economic Door Switch.

The number of incandescent lamps in any place depend not so much on the cost of the current as on the devices for readily turning the lights off and on so as to keep the consumption at a minimum. And even where the switches are conveniently located it requires some attention to turn them, and if this is left to the hired help the chances are that the lamps may be left burning continuously. This is practically the case with closets, store-rooms and such places where the light is needed but rarely. Such parts of the house have generally been left without any convenient means of lighting, merely for the lack of a simple device for controlling the current.

This want is now met by the "Economic Door Switch" devised by George Cutter, of Chicago, which can be set flush in the rabbitt of the door jamb so that the door itself presses against the projecting button. On opening the door the light is turned on and burns until the door is closed when the switch shuts off the current. The action is automatic so there is no possibility of wasting any current when the door is closed, and no hunting for the switch in the dark. The added convenience is worth considerable, while the saving in current and in the life of the lamps will soon pay for the switch itself. Such a device will make the lighting of odd rooms and corners inexpensive, and thus give electricity its well deserved place throughou the house.

The switch as such is well built and has the conducting parts insulated from the casing by hard rubber bushings. The casing is cylindrical, so that it will slip right into a hole drilled in the woodwork, making the fittings a very simple matter. It is being put on the market by George Cutter and will no doubt meet quite a demand.

The C. & H. Double Pole Switch.

In addition to the line of switches recently illustrated in these columns, the firm of Cutler & Hammer, of Chicago, have just placed on the market the new double pole snap knife switch herewith illustrated. The blades and all other parts are made of sheet or rolled copper highly polished and are mounted on slate blocks. The claim made for the switch is that although it is a double break snap switch it costs no more than the ordinary knife switch.

In addition to the above line of specialties the firm have added a very simple and effective automatic motor starter with a magnetic release. In placing the device upon the market the firm believes that it is only necessary to present its merits of safety in connection with motors to the owners of motors and central station men to make them realize that they cannot do without them. A large number of the starters have already been placed in Chicago, due largely to the fact that the underwriters have not only realized the safety the device affords but have insisted that all motors must be provided with an automatic release switch or starter.

Economic Door Switch. *A New Lamp Device.*

A New Lamp Device.

A new device for holding incandescent lamps in any position has recently been placed on the market by Bruce & Nutting, of Chicago. The apparatus is constructed so that a lamp held on the end of the rod can be adjusted to any position either sidewise or up and down within a radius of eight to ten feet. The lamp holder is especially useful in factories, stores shops and draughting rooms or wherever it is desirable to change the position of the light from one place to another and bring it close to the work.

COMMERCIAL PARAGRAPHS.

Mr. A. L. Bogart sends out a circular to the trade, announcing material reductions in prices of his many electric gas lighting specialties.

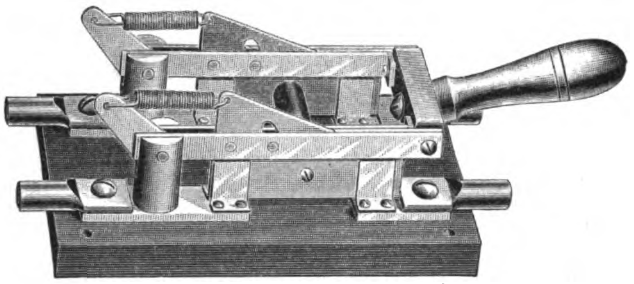
Queen & Company, Incorporated, Philadelphia, are congratulating themselves upon the large number of "Magnetic Vane" Ammeters and Voltmeters which they have sold up to date this year.

An increase of two hundred per cent. over the first seven months of 1892 is not a bad record, especially in the face of recent and present financial disturbances.

The unique porcelain device we illustrated in our columns a few weeks ago, which has been put on the market by the Hammond Cleat Company of Boston, has proved to be a "ten strike." Orders are being received from all parts of the country, and it is being proved that the more they are used the better they are liked.

The new 60 arc light dynamo equipped with the Elkins Automatic Regulator and built by the Consolidated Electric Manufacturing Company of Boston, which has been installed in the electric light station, Old Orchard, Me., is giving perfect satisfaction. It is being run at its full capacity and regulates to the greatest degree of nicety. Changes made from full load to zero do not cause the slightest sparking. It is a remarkably efficient machine and works most economically. The lamps, which were also made by the same company, are very constant and make a perfect arc.

Mr. J. Bradford Sargent, General Eastern Agent for the Sterling Water Tube Boiler, is feeling more than pleased with the extraordinarily fine record recently made after many trying tests of the merits of this now well known type of boilers on the San Francisco and San Mateo Railway. The evaporation of 12.16 pounds of water to one pound of coal is such a result as any firm of boiler makers may well feel proud of, and it is not to be wondered at that so many of these boilers are already in use and others being installed right along. Mr. Sargent has just closed a contract for a 250 H. P. boiler for the Portland (Me.) Street Railway Company.



THE C. & H. DOUBLE POLE SWITCH.

INCORPORATIONS.

Powell Oil Mill Company, Bastrop, Tex.—to manufacture cotton seed oil, gin cotton and supply electric light to the public. Capital stock, $50,000. Promoters: W. C. Powell, P. O. Elzner, J. L. Wilbarger, all of Bastrop.

The Miller Electric Company, 13 Astor Place, New York City—to manufacture and sell electrical appliances. Capital stock, $5,000. Promoters: Sylvanus E. Miller, Brooklyn, N. Y.; Samuel Shethar, New Castle, N.Y.; Edward A. Nichols, New York City.

Santa Cruz Electric Navigation Company, Santa Cruz, Cal.—to construct, own, operate boats, vessels, to be propelled by electricity, sails, steam or otherwise. Capital stock. $10,000. Promoters: F. W. Swanton, Jas. McNeil, Jno. Sullivan, F. W. Ely, Santa Cruz, Cal.

Duplex Trolley Company, New York City—to acquire patent rights for appliances for the transmission of electricity. Capital stock, $10,000. Promoters: C. E. Chinnock, 157 Sixth ave., Jos. Bruns, 346 First st., both of Brooklyn, N. Y.; D. E. Rose, 286 Elizabeth st., New York City.

Atchison Railway and Electric Light Company, Atchison, Kan.—to build, construct and operate street railways in Atchison by electricity or other motive power, manufacture gas and electric light, construct and maintain union stock yards. Capital stock, $250,000. Promoters: Edward Morton, New York City; A. J. Harwi, J. C. Fox, B. P. Waggener, David Kelso, W. P. Waggener, A. W. Simpson, all of Atchison, Kan.

Tucson Water, Electric Light and Power Company, Tucson, Arizona, and Atchison, Kan.—to supply water, electric light and power. Capital stock, $50,000. Promoters: Sylvester Watts, St. Louis, Mo.; Henry A. Lawton, Terry Parker, Stanton Park, James W. Parker, all of Atchison.

The Southern California Development Company, Redlands, Cal.—to deal in, improve and cultivate lands, build and operate water works, machinery, electric plants, etc. Capital stock, $15,000,000. Promoters: A. P. Willoughby, New York City; B. O. Johnson, R. E. Archer, C. E. Fish, Redlands; B. W. Brown, Moreno, Cal.

The Holt Electric Indicator Company, New London, Conn.—to manufacture indicators, ships' logs, electrical apparatus and instruments of precision. Capital stock, $15,000. Incorporators: Geo. B. Prest, Chas. T. Holt, Wm. S. Starr, of New London, and others.

The Pacific Underground Electric Railway Company, San Francisco, Cal.—to deal in patents for underground conduits for electric railways, and manufacture and sell such devices. Capital stock, $100,000. Promoters: J. J. Scrivener, F. S. Chadbourne, Jno. F. Burgin, A. Craig, D. B. Richards, San Francisco.

The Osterholm Electric Belt and Appliance Company, New Haven, Conn.—to manufacture and sell electric belts and appliances and to buy and sell other electrical appliances on commission and otherwise. Capital stock, $1,000. Promoters: John Kallgren, T. O. Osterholm, John Anderson, G. W. Erickson, New Haven.

The Western Printing Telegraph Company, Chicago—to manufacture instruments and appliances and construct telegraph and telephone lines. Capital stock, $1,000,000. Incorporators: Frank R. Walton, James W. Chisholm and Cleaveland F. Dundersdale.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JULY 11, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

501,183. Electric Signaling Circuit. W. Daves, Jersey City, N. J. Filed May 2, 1892.
501,195. Electric Locomotive. Elmer A. Sperry, Chicago, Ill. Filed April 29, 1892.
501,246. Electric Locomotive. Wm. E. C. Eustis, Milton, Mass. Filed Nov. 5, 1891.
501,258. Electric Circuit Closing Device. Wm. Seals, Boston, Mass. Filed April 10, 1893.
501,307. Railway Signal. James Wayland, Newark, N. J. Filed Jan. 21, 1892.
501,438. Railroad Crossing Alarm or Signal. Elwood C. Potter, Vineland, N J. Filed April 6, 1891.
501,481. Trolley Wire Hanger. Alexander W. Meston, St. Louis, Mo. Filed Oct. 31, 1892.

ELECTRIC LIGHTS AND APPLIANCES.

501,074. Electric Arc Lamp. J. Jergle, Austria-Hungary. Filed Nov. 25, 1891.
501,080. Electric Arc Lamp. G. Kirkegaard, Brooklyn, N.Y. Filed Nov. 12, 1892.
501,081. Electric Arc Lamp. G. Kirkegaard, Brooklyn, N.Y. Filed Feb. 20, 1893.
501,095. Electric Lighting System. P. Nordmann, Berlin, Germany. Filed Nov. 18, 1892.
501,170. Duplex Electric Arc Lamp. Chas. E. Scribner, Chicago, Ill. Filed Oct. 27, 1890.
501,183. Electric Signaling Circuit. Wm. Daves, Jersey City, N. J. Filed May 2, 1892.
501,205. Socket for Incandescent Lamps. Ekel Ekstrom, Lynn, Mass. Filed June 27, 1892.
501,206. Electric Current Apparatus. Jonathan P. B. Fiske, Lynn, Mass. Filed Aug. 12, 1891.

DYNAMOS, MOTORS, ETC.

501,049. Commutator Connection. Norman C. Bassett, Lynn, Mass. Filed Feb. 9, 1893.
501,059. Regulator for Dynamo-Electric Machines. William H. Elkins, Cambridge, Mass. Filed June 23, 1892.
501,060. Brush for Dynamo-Electric Machines and Motors. Jonathan P. B. Fiske, Lynn, Mass. Filed Jan. 31, 1893.
501,117. Dynamo-Electric Machine. Harry L. Tyler, Corning, N. Y. Filed Oct. 17, 1892.
501,193. Commutator Brush Holder. Alton J. Shaw, Muskegon Mich Filed Feb. 17, 1893.
501,194. Revolving Armature for Electric Machine. Elmer A. Sperry, Chicago, Ill. Filed Jan. 8, 1892.
501,309. Method of Regulating Dynamo Electric Machines. Merle J. Wightman and Hermann Lemp, Hartford, Conn. Filed Feb. 13, 1886.
501,376. Armature. Joseph J. Smith and Geo. W. Findlater, Jamaica, N. Y. Filed May 26, 1892.
501,482. Revolving Motor. Herbert L. Parker and Alexander W. Meston, St. Louis, Mo. Filed Oct. 22, 1892.

TELEPHONE AND TELEGRAPH APPARATUS.

501,085. Telephone Circuit and Apparatus. S. J. Larned, Evanston, Ill., and F. A. Pickernell, Newark, N. J. Filed March 20, 1893.
501,086. Station Apparatus for Telephone Circuits. S. J. Larned, Evanston, Ill., and F. A. Pickernell, Newark, N. J. Filed March 20, 1893.
501,087. Electric Signaling. T. D. Lockward, Melrose, Mass., and Sherwood J. Larned, Evanston, Ill. Filed March 27, 1893
501,102. Telephone Signaling Apparatus and Circuit. F. A. Pickernell, Newark, N. J. Filed March 20, 1893.
501,168. Telephone Switch. Chas. E. Scribner, Chicago, Ill. Filed Dec. 27, 1886.
501,169. Telephone Exchange Apparatus. Chas. E. Scribner, Chicago, Ill. Filed June 6, 1888.
501,185. Visible Signal. Francis W. Dunbar, N. Y. Filed May 4, 1893.
501,405. Support for Telephonic Receivers. Norval L. Burchell and Burnet L. Nevius, Jr., Washington, D. C. Filed Nov. 3, 1892.
501,472. Station Apparatus for Telephonic and Telegraphic Circuit. Theodore Spencer, Cambridge, Mass. Filed Feb. 20, 1893.

BATTERIES.

501,151. Electric Battery. James H. Mason, Brooklyn, N. Y. Filed Nov. 14, 1892.

MEASURING INSTRUMENTS.

501,104. Ammeter. Wm. Hockhausen, Brooklyn, N. Y. Filed Feb. 28, 1891.

MISCELLANEOUS.

501,068. Electric Snap Switch. Caryl D. Haskins, Lynn, Mass. Filed Jan. 24, 1893.
501,071. Electric Switch. Carl Friedrich Wilhelm Hofer, Berlin, Germany. Filed March 25, 1893.
501,094. Equalizer for Rotary Current System. P. Nordmann, Berlin, Germany. Filed Feb. 23, 1893.
501,114. Lightning Arrester. E. Thomson, Lynn, Mass. Filed June 20, 1890.
501,178. Electric Switch. Frederick A. Thum, Newark, N. J. Filed March 14, 1893.
501,191. Switch for Electric Conductors. Olaf Offrell, Middletown, Conn. Filed Aug. 12, 1892.
501,201. Automatic Circuit Interrupter. Alexander Wurts, Pittsburg, Pa. Filed Oct. 5, 1892.
501,241. Lightning Arrester. James E. Browne, Elizabeth, N. J. Filed Sept. 12, 1892.
501,270, Letter Box. Peter J. Fitzgerald, Hyde Park, Mass. Filed Oct. 13, 1890.
501 291. Electric Time Switch. James F. McLaughlin, Philadelphia, Pa. Filed Sept. 29, 1892.
501,292. Electric Bell. Wilson J. Newman, Brooklyn, N.Y. Filed Oct. 28, 1892.
501,306. Electric Alarm Money Drawer. William J. Walker and Alexander L. Bedford, St. Louis, Mo. Filed April 12, 1893.
501,445. Junction Box. William Brooks Sayers, Glasgow, Scotland. Filed June 16, 1892.
501,450. Electric Switch. Lucius T. Stanley, Brooklyn, N. Y. Filed March 27, 1893.

ELECTRICITY.

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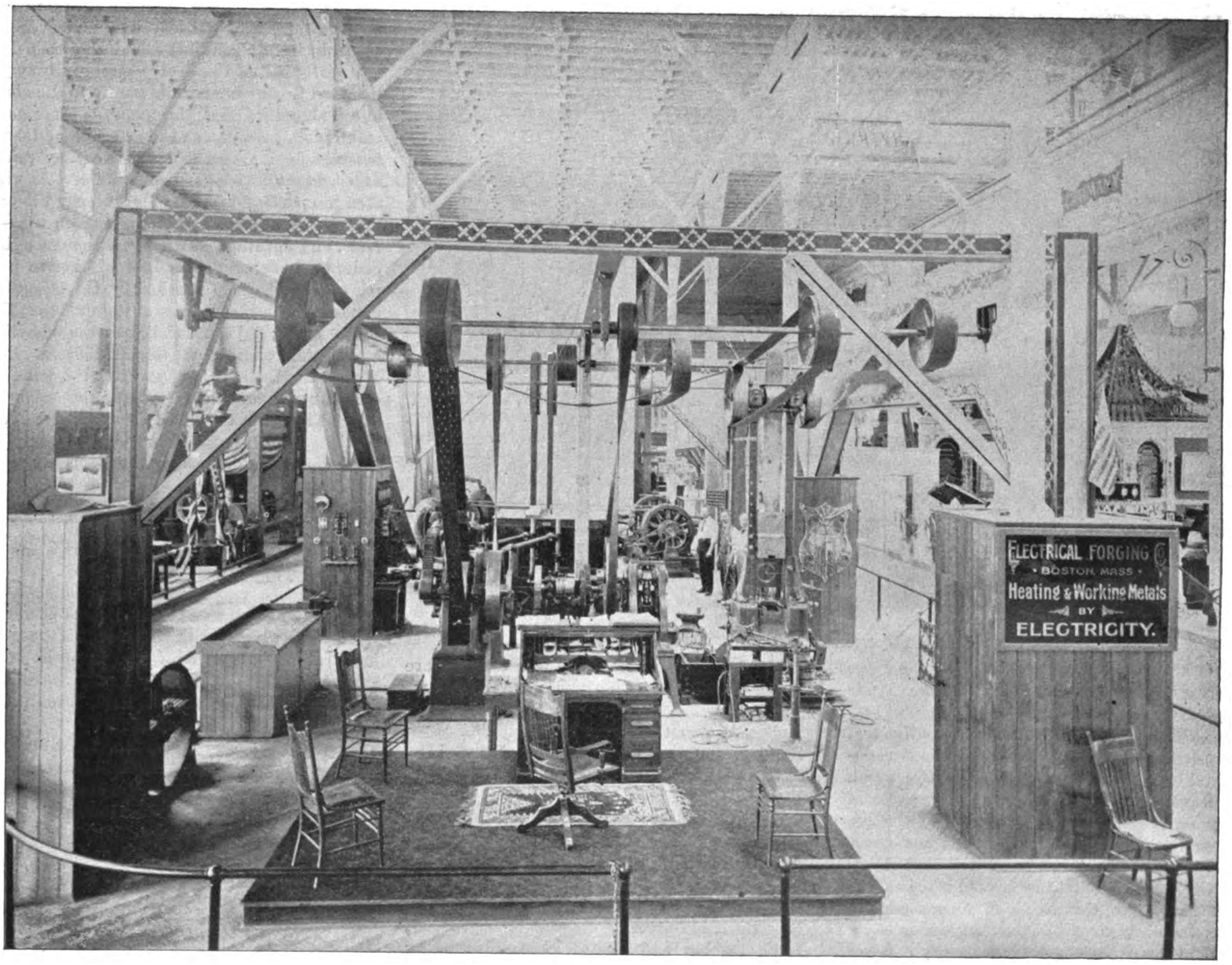


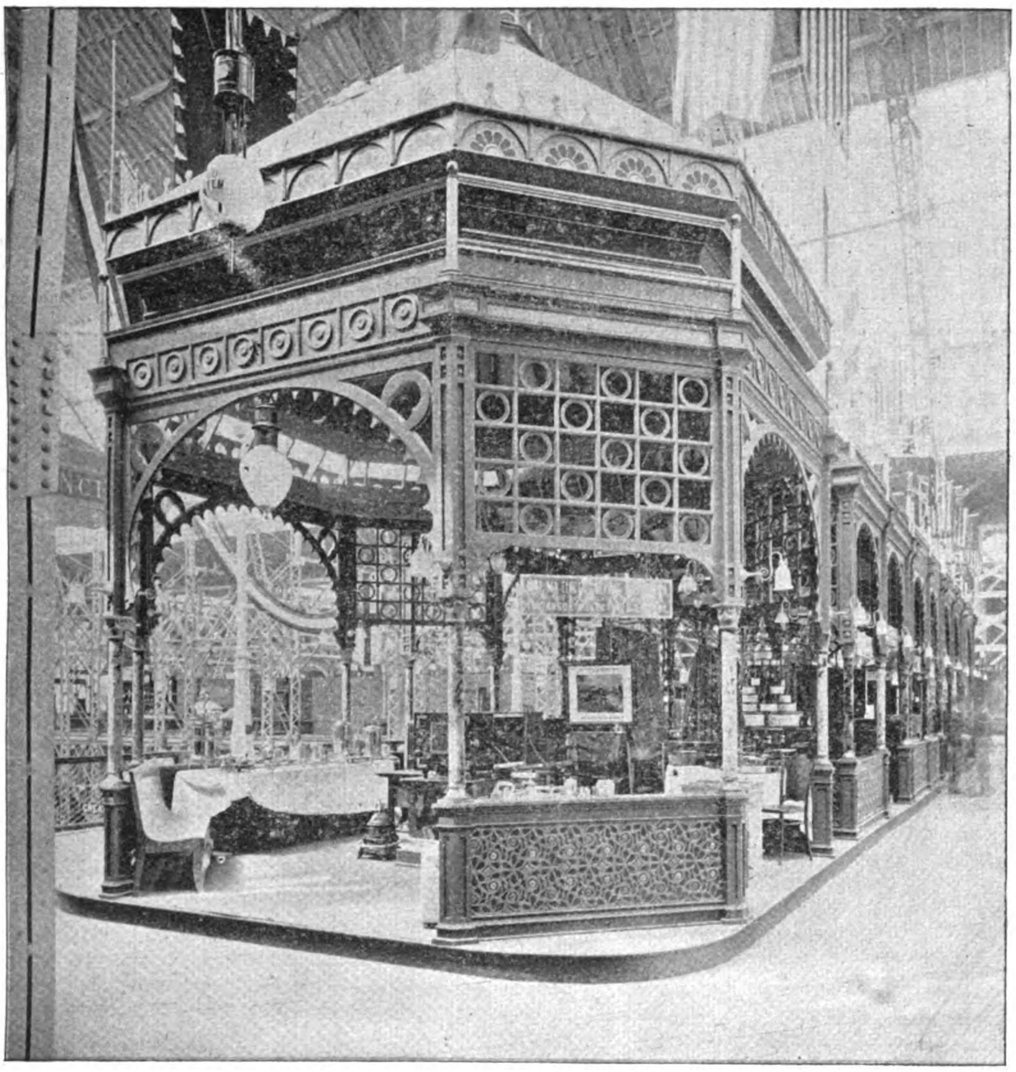
ELECTRICAL FORGING COMPANY'S WORLD'S FAIR EXHIBIT. (SEE PAGE 50)

World's Fair Notes.

Electrical Forging Company's Exhibit.

The exhibit of the Electrical Forging Company of Boston, which is located on the east side of the main floor of the Electricity Building, is one of the most novel and at the same time interesting displays that can be found among the many machines in the building. Except for this exhibit it might well be said that the northeast corner of the Electricity Building would have little attraction for the ordinary World's Fair visitor.

Most of the patrons of the Exposition want to see a machine "where the wheels go round." The Electrical Forging Company seem to have appreciated this fact and have arranged to have their machines in continuous operation during the greater part of the day and evening. That the work is appreciated is proved by the large crowds always to be seen around the space occupied by the company.



Ansonia Electric Company's World's Fair Exhibit.

The exhibit, which is shown in our Frontispiece, consists of nearly all the different machines manufactured by the company. The generator which supplies the current for the heater is capable of delivering 35 amperes at a pressure of 2,400 volts. The current is delivered to a 5-foot transformer the core of which contains over 800 pounds of soft iron wire. The metal to be heated is placed between the jaws or clamps which form a portion of the secondary circuit of the transformer.

Arrangements are made so that eight pieces of work can be heated in as many different clamps at one time. The gentlemen in charge illustrate the operation of the machine by actually heating rods of various metals of from one-eighth to three inches in diameter. They also show the method of welding iron, steel and brass bars.

One of the most interesting and puzzling parts of the exhibit, both to the layman and the electrician, is the raising of the temperature of a bar of iron to a welding heat by placing it in a pail of water. The many amusing questions asked of the attendants in regard to this feat would stock a specialty actor for a year to come should he jot them down. The exhibit is in charge of Mr. George H. Burton, the inventor, assisted by Mr. Williams.

Ansonia Electric Company's Exhibit.

The exhibit of the Ansonia Electric Company, as illustrated in this issue, consists of a combined display of electrical supplies manufactured by the numerous companies of which the Ansonia Company are the Western representatives. The pavilion, which occupies the centre of the north gallery, is arranged so that each of the manufacturing concerns has a separate section for its goods. Among the companies whose names are hanging over the many entrances are the following:

Helios Electric Company, Philadelphia.
Stanley Manufacturing Company, Pittsfield.
J. Lang & Company, Chicago.
Richard Pfund, New York.
Cutter Electrical Manufacturing Company, Philadelphia.
American Electrical Heating Corporation.
Star Electric Company, Chicago.
Wm. Burnley, North East, Pa.
Electric Manufacturing Company, Dayton, O.
India Rubber and Gutta Percha Insulating Company, N. Y.
Otto Rauda, New York.
National Electric Manufacturing Company, Milford, Conn.

Besides the above, a large number of other companies have representation in the shape of small exhibits. Nowhere can a person gain a better idea of the extensive line of supplies carried by the Ansonia Company than by a visit to their exhibit. In their pavilion the company claim to not only show some of the latest electrical appliances of the day but also some of the earliest. Included among the latter are some of the machines used by Moses G. Farmer and William Wallace in their early experiments in electricity. The photograph illustrating the pavilion is taken from the end occupied by the American Electric Heating Company, and it may be said that it forms a very interesting part of the exhibit. Lectures in cooking by electricity are given three times a week, and practical demonstrations are made on numerous electrical utensils. The Ansonia Company have installed an electrically operated elevator near their booth, and are carrying free all visitors who wish to go to the gallery floor.

Performance of Street Railway Power Plants.

BY WM. A. PIKE AND T. W. HUGO.*

No mechanic art has become so interwoven with our everyday existence as that of electric engineering. No branch of industry has grown, in so short a period of time, to the proportions now assumed by the practical applications of the developments of the science of electricity, and as a consequence the application has been in advance of the definite knowledge of the results of such application; in other words, the application has led the pace, and that being a fast one the engineer is now almost breathless, endeavoring to catch up and find out just what he has been doing. Especially is this the fact in street railway practice, and it is to contribute a mite to the general knowledge box that this paper is presented, as embracing, possibly, as wide a scope and as extensive a field, under ordinary everyday practice as has heretofore been made public. As will be seen, no particular piece of machinery was under criticism, no person's creation was on trial—the facts, and nothing but the facts, being sought, in order (1) to ascertain the cost of motive power per car mile [*a*] as furnished by the tri-cylinder condensing Corliss engines at Power House No. 1, Minneapolis; [*b*] as furnished by the tri-cylinder condensing engines at the Hill Street Power House, St. Paul; [*c*] as furnished by the two-cylinder non-condensing Westinghouse engines at the Thirty-first Street Power House, Minneapolis.

(2) To obtain data as to the economy of the boilers used.

(3) To obtain data as to the relative value of crude petroleum and coal as fuel.

(4) To compare the cost of furnishing power by large tri-cylinder condensing engines and small Westinghouse two-cylinder non-condensing engines, or concentrated vs. subdivided power.

The tests which are the basis of this paper were made at the instance of Mr. Thomas Lowry, President of the Twin City Rapid Transit Company, Minneapolis and St. Paul, Minn., on the various plants of the company.

The tests at Power House No. 1, Minneapolis, and the principal tests at the Hill Street Station, St. Paul, were made under the joint supervision of Messrs. Wm. A. Pike, of Minneapolis; T. W. Hugo, of Duluth, members of the American Society of Mechanical Engineers, and Mr. Aid Collins, agent of the Hartford Boiler Insurance Company, of Minneapolis, the test using screenings for fuel at St. Paul; and the tests at the Thirty-first Street Power House, Minneapolis, were under the direction of Mr. Pike alone. It is perhaps proper to state that the first proposition for these tests was made to the Hartford Boiler Insurance Company, but as this company did not care to undertake the work it was arranged for as stated above. Acknowledgment is hereby made of the courtesy of Mr. Thomas Lowry in allowing the publication of these results and of the very efficient services of a large number of engineering students from the University of Minnesota, who constituted the greater part of the corps of observers.

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* Abstract of paper read at the Chicago Meeting of the American Society of Mechanical Engineers.

It might be interesting to describe many of the details, such as the commissary department, necessary to provide for supplying the needs of the thirty persons engaged in this particular work. None of the regular employees took any part in anything connected with the extra work of the tests; they merely kept the plant in its usual working conditions. Many features required considerable thought which in tests on a small scale demand very little consideration, but it is believed that the technical features alone will comprise a bulky paper, and some of the incidents may form the subject matter for future papers. Although much care and attention were given to every detail, yet the pump which causes trouble when most urgently needed, the joint and the valve which leak on such occasions but at no other time, the indicator spring which breaks, the cord which stretches, the fellow who lets the indicator cards fall into the oil tank, and the kodak fiend were all on duty, and the usual makeshifts and improvisations were called into service, and the genius of the operators taxed to keep things moving, and it is believed that the results obtained are correct and worthy of study.

TEST NO. 1, MINNEAPOLIS, MARCH 5, 1893.

Power House No. 1 contains the plant from which was obtained the power used during the first series of tests, two tri-cylinder condensing engines of the design of the E. P. Allis Company, of Milwaukee, Wis., together with a single cylinder engine of the same make, five Babcock & Wilcox and two Stirling water tube boilers, sixteen Edison railway generators of 175 kilowatts capacity, and two of 89 kilowatts, constitute the motive machinery. Each of the two tri-cylinder engines was belted to a line shaft through which the power was transmitted to the generators, and also to a 100-light Excelsior, new style, arc dynamo, furnishing lights as needed.

The system of transmission is the single trolley overhead system, operating eighteen car lines with a total of about eighty miles of track, including that portion of the inter-urban line connecting Minneapolis and St. Paul from Minneapolis to Midway, a distance of about four miles. Motors ranging from 15 to 30 H. P. of the Sprague and the Thomson-Houston types are used on the cars.

PRECAUTIONS TO INSURE ACCURACY.

(1) Previous to the tests all steam gauges used were tested by comparison with a mercury column, and then either corrected, or a table of errors made from which true pressures were obtained.

(2) All indicator springs were tested under steam pressures by comparison with a correct gauge, and either found correct or their numbers changed to correspond with true pressures.

(3) All thermometers were tested by comparison with boiling and freezing points, and by comparison with a standard thermometer.

(4) All scales used were adjusted and certified to by Fairbanks, Morse & Company.

(5) The pyrometers were compared with a correct thermometer in a smoke flue, and a table of corrections made.

(6) The water meter used for measuring the injection water was calibrated by weighing the water actually discharged and comparing it with its readings.

METHODS ADOPTED IN CONDUCTING THE TESTS.

During the whole time occupied in the tests all observations necessary to obtain the desired data were taken every stated ten minutes, an electric gong operated by the timekeeper giving the signal to all, except in the case of the ammeter readings, which were taken every fifteen seconds; the current was all passed through two ammeters so regulated that an equal amount of current went through each. The voltage was practically constant, and was also noted.

All water and fuel oil were weighed accurately before passing to the boilers. Two large wooden tanks were elevated on scales placed on platforms. The supply for those tanks was provided with a branch pipe and stop-valve for each tank, and by a stop-valve and pipe from the bottom, each discharged into the iron receiving tank.

The feed water was pumped to the weighing tanks by a 7 x 10 x 10 inch duplex steam-pump, and taken from the iron receiving tank by a second steam-pump of the same size and sent to the boilers.

The fuel oil was pumped by a 4½ x 2¾ x 4 inch duplex pump into two iron tanks placed on scales elevated on a platform from which, by discharge pipes at the bottom and stop-valves, the oil was drawn off into another iron tank, also elevated on a platform, from whence by gravity it was conducted to the atomizers that supplied the furnaces.

During ordinary running but one of each of the above-mentioned pumps is used, the other being held in reserve.

During the first test the Babcock & Wilcox boilers, Nos. 1, 2, 3, 4, 5, supplied steam for the two tri-cylinder engines exclusively, except that used for atomizing the fuel oil fed to the furnaces of those boilers, for which, however, a proper deduction is made.

To supply the steam for the condenser engines, feed and oil pumps, and for the heating system of the building the Stirling boiler No. 2 was used, and a separate pump, 4½ x 2¾ x 4 inches, supplied it with feed water.

All possible outlets for either steam or water, except those necessary for furnishing steam to the engines and water to the boilers, were blanked off or known to be tight, except in one case hereafter noted.

Steam-engine indicators were attached to each end of each cylinder, the motion being received through a swinging pendulum, the cords being guided by a properly constructed arc fastened to this pendulum; and as in these tests twelve indicators were in some cases employed, and as it was considered advisable to have the diagrams taken simultaneously, an electric attachment was devised, by means of which the pencils of all the instruments were moved up to their respective drums at the same instant.

In addition, an indicator was attached to each of the condenser engines and diagrams taken at the usual stated periods, at the sound of the signal gong.

The water collected from steam-jackets and separators was weighed separately, as is more fully described hereafter.

The revolutions of the engine were obtained from continuously recording revolution counters, and, in connection with boiler and receiver pressures, and vacuum gauge and barometric readings were noted at each stated period of ten minutes.

At the stated periods the height of water and oil in the feeding tanks, and the height of water in the boilers, as shown by the glass water-gauge, was noted, so that if, by any accident, it became necessary to stop the test before the expiration of the expected time the data of the entire test would not be lost, and by going back to the last stated period a general summing up could be made covering the actual time of the test; also, these figures for each stated period are valuable as checks on final results.

Calorimeters of the barrel, separator, and throttling type for determining the percentage of moisture in the steam were attached to the main steam-pipe in the boiler room to feed the pipe of each engine just above the throttle valve.

The pyrometers and draught gauge were inserted in the main flue, and a record kept, as well as of the steam-pressures and feed-water temperatures at the boiler.

Samples of the fuel oil used were taken for chemical analysis at suitable intervals.

On blanks furnished each street-car conductor was noted every stated ten minutes:

(1) Whether moving or stopped.

(2) Number of passengers.

(3) Location of car.

(4) Whether car is lighted or not.

A record was kept of the number of lamps burning, and the length of time in use at the different stations and other places, from which the power used for this purpose was calculated.

Kind	Babcock & Wilcox
No. of head drums	2
Diam. of head drums	36 inches
Length of head drums	17 feet 8 inches
Diam. of water tubes	4 inches
No. of tubes { 144 main tubes	17 feet 9⅛ inches
16 tubes between headers and drum	7 feet 4 inches
16 headers	5 feet high x 6 inches wide
Mud drum	9 feet long, 18 inches diam.
Area of grate	71 square feet
Heating surface (figures from makers)	3,128 square feet
Ratio of grate to heating surface	1:44
Distance from grate to tubes	3 feet 8 inches at front, 2 feet 4 inches at bridge

Each Babcock & Wilcox boiler has two steam-pipes, stated to be 5⅝ inches in diameter, and is 2 feet 4 inches long, connecting with an 8-inch pipe having two L's and one , which connects with a 12-inch header. This header, after leaving boiler No. 5, connects with a 15⅝-inch main, running to separator No. 1. This main is 175 feet 2½ inches long, and after making five turns connects with the separator at a point 2 feet 6 inches from the bottom, and one 10-inch branch is taken from the top of the separator and runs to engine No. 1, and from the opposite side of the separator, and 15 inches above the inlet, a 15⅝-inch pipe runs to separator No. 2, 45 feet 9 inches distant.

The water collected in the separators and jackets is usually drawn therefrom by ordinary steam-traps and discharged into a tank from whence it is pumped to a receiver in the boiler room, where, after being mixed with sufficient overflow water from the condensers, it is used for feed water.

The pipe supplying jackets is 1¼ inches in diameter and is connected to a T in the branch steam-pipe 4 feet above the separator of the main steam-pipe.

The steam-pipe from each separator to the engine is about 10 feet long and 10 inches diameter, with one turn, to a valve, then with four turns to the engine it is 8 inches diameter and 56½ feet long.

The Stirling boilers have each one 8-inch steam-pipe 27 feet long, with two turns and an angle valve, connecting to a header 8 inches diameter from the Stirling boiler No. 1 to No. 2, and 12 feet long, connected by an 8 x 12 x 8 inch T to a 12-inch header, 28 feet long, having two turns, to the main steam-pipe before spoken of in connection with the Babcock & Wilcox boilers.

During the main test the Stirling boiler No. 2 was piped directly to condenser engines, to feed water and fuel-oil pumps, and to heating system for building, as follows: A 3-inch pipe, 96 feet long, with five turns to the feed pumps, pipe bare; a 3½-inch pipe, 208 feet long, with five turns, runs to the condenser engines—108 feet of this pipe in the basement was covered; a 3-inch steam-pipe to the heating system of the building.

All other steam-pipes are protected by, first, a dead air-space of ⅝ inch, made by a sheet-iron cylinder with collars turned in at the ends, and then covered with asbestos cement ⅞ inch thick.

The tri-cylinder engines are of the cross compound type with the high pressure, and intermediate cylinders arranged tandem on one side, and the low pressure by itself on the opposite side, with its crank 90 degs. from the other, and reheater receivers between the cylinders.

The exhaust from the H. P. cylinder is carried to No. 1 receiver, which is 27½ inches diameter and 15 feet 6 inches long, and from which the supply to the intermediate cylinder is taken.

The exhaust from the intermediate cylinder is carried to No. 2 receiver, which is 28½ inches in diameter and 21 feet 6 inches long.

These receivers are surrounded by a jacket space of 1⅝ inches, the whole protected by a covering of asbestos, except the ends, which are uncovered.

The cylinders of both engines have a steam-jacket space of about 1½ inches, and are then covered with a layer of asbestos cement 2½ inches thick, covered over all with sheet-steel. The heads are jacketed, but not covered with asbestos. All ends except the crank-ends of the intermediate and low-pressure cylinders have false covers.

The steam for these jackets is taken from the main steam-pipe after leaving the separator No. 1; on the one side it passes around the H. P. cylinder, then around the intermediate cylinder, then around receiver No. 1. On the other side it passes first around the low-pressure cylinder, and then around the receiver No. 2, between the intermediate and low-pressure cylinders.

(To be continued.)

Alternate Current Motors for Railway Traction.

The Pittsburg *Despatch* has the following:

"Mr. Westinghouse has recently secured patents for a system of operating cars by means of currents in bars conveyed underground in proper conduits. Instead of using the continuous current for the supply of electricity, the alternating current will be used, so that no current will have to be returned through the rails and water pipes. A pair of high tension lines will be laid along the line, and the current will be reduced to a safe working pressure by converters and fed into short sections of the railway conduit, so that, in the first place, there will be no traveling of the current over long distances, and, secondly, the current being of the alternating character, will not produce the electrolytic action which seems to be the occasion of destruction to iron and lead pipes.

"When asked if he intended to introduce this new underground system, he said that he had already opened negotiations with reference to its use in a large Eastern city, and that the company is now ready to take up this branch of the electric street railway business on a large scale. It is expected that as soon as the first experimental lines are laid and successfully worked, it will lead to the general introduction of the underground system in New York and other large cities.

"There are several hundred miles of railway in New York now operated by horse power which should be operated by electricity, and which the authorities there will not permit to be operated by the trolley system if a suitable and economical arrangement of underground wires can be shown to be practicable.

"W. L. Elkins, Jr., President of the Pennsylvania Iron Works Company, of Philadelphia, which is largely engaged in constructing machinery for cable roads, is now in the city going carefully into the details of the new plans."

Personal.

Announcement is made of the marriage of Mr. M. J. Sullivan to Miss Frances Read, on August 15, at the home of the bride's parents at Freeport, Ill. Mr. Sullivan has recently assumed the management of the Western office of the *Electrical World* and is well known among the electrical fraternity. The bride is an estimable young lady, and has recently acquired the acquaintance and friendship of a large number of the exhibitors in the Electricity Building, having had charge of the *Electrical World's* booth in that building.

Electric Belts.

The Electrical Exhibit at the Fair Disgraced by Their Admission.

How the Ignorant are Humbugged.

Some time ago the *Evening Post* of this city called attention to the lack of popular information in regard to the subject of electro-medical appliances, stating that even men of intelligence and education were not able to determine which of the many appliances advertised were recognized by electricians as legitimate and which were frauds. While recognizing the services performed by Electricity in exposing the humbugs, the *Post* thought that electrical journals generally should give more attention to the matter, and make it plain to the uninformed just what might reasonably be expected of the electric current as a remedial agent.

If a well-informed metropolitan journal confesses its ignorance of this subject, which is not at all to be wondered at, it is evident that the masses throughout the country can have no conception whatever of the subject of legitimate electro-therapeutics.

The electrical journals can, to a certain extent, aid in promulgating a correct understanding of the subject, but to the regular readers of these journals the matter is fairly understood, and at least the bolder frauds are already known to them.

These fakirs usually advertise their wares in the country districts and in city papers reaching the poor and ignorant, and work on a class of people who can always be relied on to patronize the medical quack, whether he be "electrical" or otherwise.

Up to a few months ago, therefore, there appeared little reason why an electrical journal should devote much space to the subject of "electric belts," etc.

The action of the World's Fair management, however, in admitting a miscellaneous lot of manufacturers of electro-medical apparatus, both good and bad, has rendered some action by the electrical press imperative.

If the matter were allowed to pass by without vigorous protest, infinite injury would result to the science and to all legitimate workers in it.

Every visitor to the Electricity Building is today justified in supposing that the manufacture and sale of electric belts is recognized as an entirely reputable branch of the electrical trade—just as much so as the manufacture and sale of Weston instruments, of standard dynamos, or of any other exhibit in the building.

The frauds have no right to be there, and even at this late day should be ordered peremptorily to withdraw. Giving them all possible credit, they are as much out of place in an exhibit of electrical apparatus as a display of patent medicines would be in the building of Manufactures and Liberal Arts. Hence, Electricity feels justified in making it plain that electricians have no desire to stand sponsor for them, and in showing their true standing. The electric belt is not one of those things regarding which "faith is a boon and unbelief a calamity," but directly the opposite.

We shall look to the daily press to aid us in the dissemination of the truth in this matter.

There is particular propriety in calling attention to the facts now, for reasons which will be apparent as we proceed.

A couple of weeks ago there appeared in a Chicago paper an account of an informal reception tendered by Dr. Alva Owen, he of the whiskers and electric belts, to the exhibitors in the Electricity Building. A few of the exhibitors accepted the invitation, and spent the afternoon at Dr. Owen's famous stock farm, near the city.

It is not known just what methods were adopted by Dr. Owen to convince his guests that electric belts were a boon to the human race, but he seems to have partially accomplished his purpose. Of one thing there was convincing proof—that the sale of these belts has been *profitable;* for no longer ago than 1885 this man Owen, according to his own statement, was "a practising physician" in St. Louis, and "sleeping on a chair in his office," trusting to a "kind Providence" for his daily bread. Providence appears to have been more kind to Dr. Owen than to the deluded purchasers of his belts.

Besides the farm and its splendid equipments, all speaking eloquently of the merits of the electric belt scheme, there may have been other evidences of the efficiency of the belts themselves. Possibly the Doctor pointed with pride to his herds of Holsteins or Jerseys, and showed how by the ingenious application of the belts the dairy industry could be revolutionized, and a perpetual supply of milk obtained without recourse to the usual methods for securing a renewal of the flow every spring.

Possibly, again, he showed how, by placing the belts on the cupolas of his house and barns, lightning rods were safely dispensed with.

Certain it is that within a few days after this reception a petition was circulated among the exhibitors and handed in to Prof. Barrett, praying that the Jury of Awards might sit on these belts. We trust that they will do so, and sit on them hard.

The petition reads as follows. It reveals about as correct an understanding of the English language as do the belts of the laws of electro-therapeutics:

Prof. J. P. Barrett,
Chief Department of Electricity.

Dear Sir: There having been more or less said against the electric belts exhibited in this building, and referring to them as fakes, we the undersigned respectfully request that said belts be submitted to a jury for them to test same for voltage, amperage and internal resistance.

We ask this to sustain you in your action in giving them a space, and also in justice to themselves as exhibitors. There are many electrical appliances and belts that are fakes, from which no current can be obtained, and those that do not have merit should be known, especially the exhibitors that you have admitted in this Electrical Building in the World's Fair.

The Jury of Awards should, and no doubt will, be extremely cautious how they handle this matter.

There are probably no belts exhibited by these charlatans which generate no current.

The phase of the subject on which the public needs enlightenment is, what diseases, if any, may be cured by the indiscriminate application of the electric current in this manner?

For an answer to this question men of common sense will naturally look to reputable physicians of unquestioned standing, who have spent years in conscientious investigation and experiment—men, for example, like Dr. W. J. Morton, of the American Electro-Therapeutical Association. Taking the results of the investigations of men of this calibre as a guide, we assert that these electric belts, electric hair-brushes, electric headache cures, electric light baths, etc., etc., are unqualified frauds upon the public, and that their admission to the Electricity Building was a disgrace and a misfortune. They are frauds, or else the therapeutical and electrical authorities are all wrong.

The glaring advertisements of these so-called physicians are indeed enough to brand them as charlatans, as the ethics of the medical profession exclude anything in the way of advertisements most rigidly, and even the most obscure practitioners are careful to avoid notoriety by this means. No physician of standing will consent to associate or consult with one of these advertising specialists, and this fact shows the standing in which they are held by the reputable members of the medical profession.

Another direction in which these outcast doctors violate the rules of the profession is in taking out patents on medical or surgical apparatus. This is never done by reputable physicians or surgeons, among whom any improvements in apparatus or appliances are considered common property for the benefit of all. To patent and monopolize an article which according to its inventor is almost indispensable to health and comfort is hardly compatible with the humanitarian spirit which pervades the literature of medical advertisements.

The circulars of a number of these fakirs are before us. One makes capital of the fact that he was awarded two gold medals at the Tasmania International Exhibition: "These medals were awarded and presented to Dr. G. F. Webb by direction of Her Majesty the QUEEN OF ENGLAND." Dr. Webb also cites authority to prove that he has been allowed to keep his bank account in the Arcade Savings Bank of Cleveland, "his checks always finding funds to meet them." Fortunate Webb! A man who always has funds to meet his checks must of course make good belts. These circulars all present imposing collections of testimonials from those who think they have been cured by the humbug appliances. That of Dr. Owen, the chief offender, may be taken as a fair sample of all. In it are enumerated the following diseases, to the cure of which his belt "is especially adapted." It is a sickening array of physical disorders, and it will be seen that there are few omissions. No one need die short of old age, if he will only wear an electric belt:

Kidney Complaints,
Urinary Diseases,
Catarrh,
Asthma,
Dumb Ague,
Throat Troubles,
Deafness,
Neuralgia,
Sciatica,
Insomnia,
Hysteria,
Melancholia,
Paralysis,
Epilepsy,
Whites,
Leucorrhœa,
Irregularities,
Suppressed and Painful Menses,
Female Weakness,
Change of Life,
Seminal Weakness,
Dyspepsia,
Torpid Liver,
Constipation,
Piles,
Wasting,
Headache,
General Debility,
Rheumatism,
Lumbago,
Gout,
Pain in Back,
Spinal Disease,
Cold Extremities,
Sluggish Organs,
Nervous Debility,
Local Debility,
Varicocele,
Sexual Exhaustion,
Impotency,
Sterility,
Epileptic Fits.

In addition to Dr. Owen's exhibit at the Fair there are those of Dr. Pratt, Dr. G. F. Webb, and the Pulvermacher Company. The "Actina" people were ordered out some time ago as the result of the exposure made by ELECTRICITY. The claims of these people, it is only fair to state, are supported by a great many people who are supposed to be intelligent, including some engaged in the electrical business, though not scientific men.

Cures may have been effected by the use of these belts, in the same manner that one may be cured of a head ache by stubbing his toe, or of a stomach ache by putting a fly blister on his left shin—that is, by diverting the patient's attention from his chronic aches and pains by giving him other aches and pains to think about.

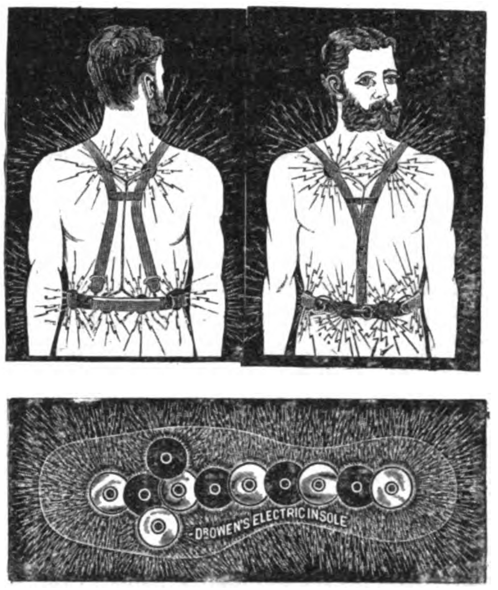
But that one and the same application will cure diabetes and deafness, epilepsy and piles, torpid liver and toothache, swelled head and cold feet, is too much to believe.

Any of the above diseases might be properly treated electrically; in none of them could an electric belt be of any real benefit. In many of them it would be a positive injury, and likely to produce serious effects.

The kind of current to be applied, the method of its application, can only be determined by a careful consideration of each special case by a competent physician.

The man who will recommend one universal treatment, of any nature, for such diseases as kidney complaint, spinal weakness, paralysis, etc., is worse than a quack; he is a criminal, in that his advice if followed may produce irreparable injury, or even the death of the deluded patient.

The following illustrations represent some of the principal electrical outfits which are offered by the medical quacks and which are generally warranted to alleviate or remove all the ills which flesh and blood is heir to. As a further guarantee of good faith and the effectiveness of these goods they are generally accompanied by a portrait of the inventor, whose features are fringed with an artificial lightning, secured by letters patent to do duty as a trade-mark.

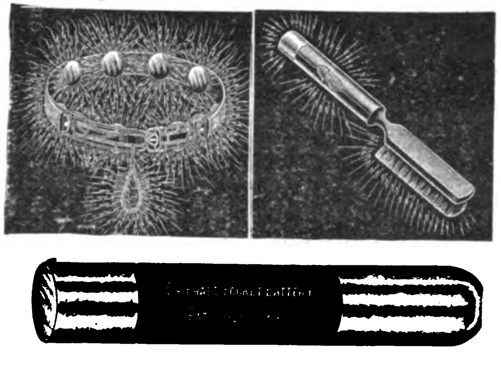


Electric Spinal Appliance, front and rear view, and Electric Insole.

These appliances all produce an electric current, and as electricity cures certain diseases it is argued that the appliances must cure the same.

Pathologists generally accept the fact that up to the present the use of electricity in medicine is largely empirical, and that the three forms of current usually employed, viz., galvanic, faradic and static, may be used to soothe or destroy according to the application, the same as with the use of drugs.

General electrozation must be considered dangerous. Deafness and paralysis have been cured by lightning discharges, but this treatment was unpremeditated, and its action remains a mystery.



Electric Belt, Electric Hairbrush, and Electric Headache Cure.

In therapeutics electricity is of considerable value, but can by no means be considered a panacea. The symptoms produced by a current cannot always be predicted, and it has no analogue in the *materia medica*.

It has produced two distinct sets of symptoms, one during and the other after application, and these are sometimes directly opposite in nature. It seems apparent from this that the application of a current to any part of the body should be made by an experienced physician, and that the promiscuous and undirected use of electricity, without distinction as to the kind of current, is more apt to be wrong than right. An article that will do injury in ten cases while it is beneficial once is not to be recommended to the public for a trial. Whatever possible good may be done by these articles is greatly outweighed by their possibly injurious effects in nine cases out of ten. The fact that no reputable physician recognizes these advertised cure-alls should be a sufficient clue to the character of the imposters who thrive upon the credulity or ignorance of the public, and while they generally pose as benefactors of mankind, are nevertheless beneath the contempt of every honorable member of the profession which they disgrace.

The World's Fair management made a serious mistake in admitting these people to the Electricity Building, thereby assisting them in the humbugging of the public, and giving to them more prestige and standing than they already had.

Those responsible for the blunder should have taken into consideration the fact that none of the promoters of these fakes would be admitted to membership either in a reputable medical society or in any of our electrical societies, and that their advertisements are not admitted either to reputable medical journals or electrical journals.

Placing these electro-medical fakes on the highest plane possible, they are on a par with quack medicines—they may be of benefit to certain people at certain times, but the manner of their sale, the extravagant claims made, and the slight foundation in fact for claiming any good whatever for them, furnish sufficient ground for pronouncing them a wholesale swindle on the ignorant public.

Men of common sense will go to a physician when they are ill, and follow his directions. And the only manufacturers of electro-medical apparatus worthy of confidence are those who sell their wares to physicians solely, and allow the physician to decide where they may and may not be of benefit to the patient.

American Institute of Electrical Engineers.

The following announcement is made from Chicago by Mr. Ralph W. Pope, Secretary of the Institute:

By request of the President, an informal meeting of the Institute will be held at the World's Fair Headquarters, Electricity Building, on Wednesday, August 23, 1893, at 8 o'clock P. M. This is intended to be strictly a social gathering, for the purpose of extending personal acquaintance between members who may be present during the week of the International Electrical Congress, August 21-26.

Members intending to be present are requested to notify the Secretary in advance at the above address, in order that they may be informed should any change in plans be found necessary.

Letters addressed in care of the Institute will be held until the arrival of those for whom they are intended, or forwarded upon request.

The rooms of the Institute are located in the south end of the gallery, and will be found a desirable resort for those who visit the Exposition.

Electric Lights for New York Central Trains.

For some time the New York Central Railroad people have been experimenting with a view to lighting their entire service by electricity. It is said that they have practically solved the problem, and that the new cars will all have an electrical outfit. The dynamo is carried in the baggage car, and is driven by belts from the car axles. An accumulator is also included in the outfit, which supplies the current when the train is not in motion.

ELECTRICITY.

The Popular Electrical Journal.

GEORGE R. METCALFE, - - - EDITOR.
R. H. WILLOUGHBY, - - ASSOCIATE EDITOR.

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Electric Belts. The suggestion that the Jury of Awards at the Fair may pass by the exhibits of electric belts, hair-brushes, and the like, is not to be tolerated for an instant.

These fake exhibits must either be at once ordered out of the Electricity Building, or they must be passed upon the same as other exhibits and the results made public.

The fakirs themselves want their wares examined, and they have the same standing as any other exhibitor. They would, indeed, have first-class grounds for an action for damages if the jury refused to pass upon them.

More than this, the profession at large, which has been disgraced by the presence of these frauds, wants them to be examined.

It would be a piece of rank cowardice to adopt any other course, and we cannot believe that the authorities, who have stamped them as reputable by the assignment of space, will try to evade their responsibility by any such weak-kneed policy.

We know not what motive inspired their admission, but whatever it was, the exhibits are there and must receive consideration.

ELECTRICITY has given them consideration this week, several columns of it, and we shall still do them further honor later on. We shall endeavor to make it plain that the more truth there is in the claims of the venders of these belts as to voltage, amperage and internal resistance, the further are the belts removed from harmlessness, and the more dangerous they become in the hands of the ignorant.

But one of two lines of action remains for those responsible for their presence: they must be examined and passed upon regularly, or they must be removed from the building. We earnestly recommend the latter, however "unpleasant" might be the developments of such a proceeding.

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Street Railway Power Plants. The performance of railway power plants of different types is the subject of an important paper read at the Chicago meeting of the American Society of Mechanical Engineers, and reproduced in abstract elsewhere.

The relative efficiencies of power plants using different kinds of equipments, such as large low-speed engines or smaller high-speed ones, condensing or non-condensing, direct driving or belting, etc., constitute an open question in engineering practice on which many and varied opinions obtain, but which has not been the subject of accurate comparative tests. The tests forming the subject of the present paper, while of considerable interest, fail to throw much light on this matter, as the plants in Minneapolis and St. Paul are not equipped with the class of machinery at present most in vogue for large stations, viz., the direct connected triple expansion engines and dynamos.

In regard to the plants tested, which consisted of two and three triple expansion Corliss engines with countershaft, and ten Westinghouse compound engines run non-condensing, the difference in efficiency was found to be slightly in favor of the former, as the Westinghouse engines were run at a somewhat lower steam pressure than the contract for the engines specified. At their normal pressure it is calculated that the latter would show an equal or better efficiency than the large engines, and the authors seem to favor the subdivided power plant on account of its more accurate regulation and the possibility of shutting down any number of engines according to the load so as to keep those in operation near their maximum capacity. The ability of the smaller engines in the line of close regulation is specially mentioned, it being found that they were capable of adapting themselves to a change of from a full load to a friction load in about four revolutions. It is to be noticed that the saving due to running the large engines at their rated load would be six and seven-tenths per cent. over the usual conditions of load.

……o……

What is a Floating Debt? There seems to be among men in the trade who are creditors of the General Electric Company a serious misunderstanding as to just what the term "floating debt" covers when applied to the liabilities of a corporation.

When the statement was made that the sale of four and a half millions of treasury assets had been arranged for to provide for the floating debt, ELECTRICITY was charitable enough to assume that this amount covered not only the loans which the company had made, but practically all of its merchandise bills as well.

Financial experts in Wall Street say that there is no precedent for using the term "floating debt" to cover merchandise bills or running expenses, and that in the absence of an explicit statement to the contrary from a responsible official of the company, the presumption is that the merchandise bills, etc., are still unprovided for.

This is certainly not the interpretation given to Mr. Coffin's statement by the trade at large, and, if correct, shows the company to be in a far worse position than was supposed.

If the last of the treasury assets were sold, even to pay merchandise bills, etc., it revealed an unsound condition—a remarkable condition for a company that has had $10,000,000 of fresh capital to spend in the first year of its existence.

But if these assets were sold to recoup two of the leading directors of the company who had advanced four millions of money and who were mentioned as the heaviest purchasers of these securities, it gives an entirely different aspect to the matter.

Accepting the interpretation of the experts, suppose that two creditors of the company had accounts against it for merchandise bills aggregating a million dollars. What prospect would there be of their getting the money?

The company cannot be earning money, and the plan of finance which it has adopted seems to call for the payment of dividends as long as the money can be raised by whatever method, and utterly without regard to the laws of conservative financiering.

Before these treasury assets are allowed to leave the treasury, a clear and explicit statement as to the use which is to be made of the proceeds should be demanded.

Where Has the Money Gone?

The first statement of the General Electric Company, filed at the Stock Exchange at the organization of the company, showed that $29,847,100 of common and $4,024,400 of preferred stock had been issued. There was reserved for future delivery against certain outstanding shares of the three underlying companies $612,900 of common and $227,600 of preferred, which the company was authorized to issue. There has been issued to date $30,459,700 of common and $4,251,900 of preferred.

There have been issued and sold $10,000,000 of debenture bonds, which, by the way, are a preferred obligation as to dividends but not a lien on the assets.

The company assumed debts of all kinds at its organization, according to its own statement, of $9,373,520.98. This debt had been reduced on January 31, 1893, to $7,961,925.92, or by $1,411,595.06.

When the company applied for the listing of its bonds at the Exchange on July 6, 1892, it made the following statement:

> "A million and a half of the proceeds of these bonds has been used toward extinguishing the floating debt, and it is intended to use the balance for the same purpose."

The first part of this statement harmonizes with the figures given above as to the reduction in debt of all kinds for the first eight months.

But it is evident that the "intention" to apply the remainder of the proceeds from the bond issue in like manner was changed somewhat, as the company, which has claimed to be making large profits, confesses now, a year later, to a "floating debt" of over $4,000,000.

This leaves $8,500,000 of the proceeds of the bond issue unaccounted for.

Where has it gone?

On April 26 last we showed in these columns, from two of the company's own statements made eight months apart, that it had lost during that period $5,922,003.44. Maintaining that rate, the company would have lost up to August 1st for the fourteen months $11,842,006.02.

This, we believe, solves whatever mystery there may have existed as to where the money from these bond sales has gone. It has gone to maintain a losing business, in the hope on the part of the officers that successful patent litigation would yet give them a monopoly by means of which they could pull through, and make up for the losses of the first year.

……o……

We wonder if the committee which has been investigating General Electric's financial condition solved the mysteries of the relations between the Jenney Electric Light Company and the Fort Wayne Electric Company. If so, what value did they place upon the stock of the latter company? It is said that the entire plant at Fort Wayne is owned by the Jenney Company, and that the Fort Wayne Electric Company is merely a paper company, like many others whose stock has been so successfully manipulated in the making up of the Trust scheme.

……o……

Our constituents could not fail to be interested in the Tracts prepared by Mr. G. Wilfred Pearce. They are worth reading.

San Francisco for the Convention.

The question of the meeting place for the next Annual Convention of the National Electric Light Association will soon come up for settlement by the executive committee.

There is little doubt that the present business stagnation will have passed away by the first of the year, and it seems to us that the Convention city should be chosen this time with especial reference to the advantages it offers, in way of location, for creating a boom in the electrical industry. If this consideration governs the choice of a meeting place, there are obviously but two sections of the country to be considered—either the South or the Pacific Slope.

One important point to be considered should be the standing of the newspapers of the various towns under discussion. The good which the Convention can accomplish from a *business* standpoint depends almost wholly upon the publicity given to the proceedings through the local papers. Therefore a town having first-class newspapers should be chosen. Either Atlanta or San Francisco would, it seems to us, fulfil all the requirements admirably.

The fact that there is to be held in San Francisco, from January 1 to June 1, an International Exposition, which cannot fail to attract a large number of visitors to that city from all parts of the West, Northwest and Southwest, gives to San Francisco an important advantage over all other cities for this year.

That prince of hustlers, Mr. M. H. de Young, is the Director-General of the California Exposition, and it cannot fail to be successful.

San Francisco's hotel accommodations are ample, her newspapers are among the best in the country, and her location is unsurpassed *from a business standpoint.*

A rousing Convention in San Francisco, with the accompanying publicity given to the proceedings by her many newspapers, could not fail of producing a decided boom in all branches of electrical development in the West, where the greatest possibilities now lie.

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The World's Congress of Electricians at Chicago next week will, without doubt, be the most representative assemblage in the history of the art. The august delegates will see, when they visit the Electricity Building, exhibits of electric belts, electric hair-brushes, electric headache cures, electric insoles, and many other electric humbugs, standing as far as is in the power of the authorities of the Fair to assist them to stand, upon exactly the same basis as the proudest products of the genius of Faraday and Siemens, of Morse and Bell, of Thomson and Weston, of Edison and Brush.

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The only reasonable plan for the enjoined lamp makers to adopt is to open their factories as usual on the morning of November 11, 1893, proceeding on the assumption that the Edison lamp patent has expired.

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A well posted electrical man stated last week that he had $100 laid away with which he expected soon to be able to buy ten shares of General Electric.

The Joliet Prison Contract.

We trust that the last has not yet been heard of the disgraceful proceedings attending the award of the contract for a lighting plant at the Joliet (Ill.) Penitentiary, notwithstanding that the papers have been signed.

The State of Illinois has courts which were created to secure justice to all her citizens, and there is abundant reason for supposing that if the courts are appealed to they will take a different view of this matter from that enunciated by Gov. Altgeld and put in practice by his direction.

The latter has treated with contempt a large number of reputable manufacturing companies, who all had a legal right to a respectful hearing.

The National Water Tube Boiler Company and various electrical companies, including the Waddell-Entz Company, the Westinghouse Company, the Standard Electric Company and the Siemens & Halske Company, have especial grounds for complaint, and they should lose no time in going into court with the matter.

Proof of actual bribery of officials, or of a divide which is the equivalent, would, of course, be almost impossible to obtain. But that bribery in some form was a part of the job is the only fair presumption.

The suspicion of having received money to influence his action does not attach to Gov. Altgeld. He is beneath it. He is an ignoramus and a blatherskite, a weak-minded egotist, who takes evident pleasure in using the high power of his office in direct opposition to decent public sentiment. The party that elected him has disowned him, and the court would begin on the presumption that Gov. Altgeld was in the wrong.

We have referred to the fact recently that when the General Electric Company was in the throes of despair, and likely to be thrown into bankruptcy, neither sympathy nor regret was exhibited in the trade. The Joliet incident shows why this is so.

The General Electric Company is not despised because it is getting more than its share of the business, for it has only got in the past year about 50 per cent. of the business which might have been expected to come to it.

It is despised because its roguery and dishonesty are displayed wherever a contract is to be let.

It will yet be the pleasure of Electricity to record, as it will of the trade at large to read of, serious disaster to this sham Trust, which does not apparently know what it means to conduct business on an honorable basis.

The death of Col. L. W. Burnham removes from the electrical trade a man who was an ornament to it, a man of great business ability and endowed with a high ideal of business honor.

The few who were favored with an intimate acquaintance with him will feel a sense of personal loss not soon to be repaired.

No Exception.

"It has for about fifteen years been Mr. Edison's chief misfortune that newspaper men fail to maintain their mental equilibrium when writing of him."—Electricity, *July* 12.

"Ah! potent wizard, you shame the records of the Arabian nights and the fabled glories of the East. We must look from these to the pictured paradises of the blest, where the gems are lit by deathless fires, and where fountains and foliage give forth eternal harmonies."—*A. and W. K. L. Dickson in Cassier's Magazine for August.*

General Electric.

What is Said of It Nowadays.

President Coffin of the General Electric Company says that, as far as he knows, there is no truth in the statement that application has been or is to be made at Providence by a Trust company which holds General Electric bonds for an order by the court to prevent the company from using assets in its treasury to pay off its floating debt.

The point has been raised yesterday that the sale of Treasury assets by the General Electric Company would interfere with the rights of the debenture bondholders. The clause in the debenture bond mortgage bearing upon the matter follows:

"The company agrees with the holder that it will not at any time mortgage or pledge any property or franchises belonging to it at the date hereof without also thereby expressly securing the principal and interest of this debenture bond [if outstanding at the time any such mortgage or pledge shall be made] ratably with any and all other indebtedness secured by such mortgage or pledge. And in the event of such mortgage by this company, the holder hereof shall, upon demand, be entitled to receive in exchange for this debenture bond a mortgage bond for the same principal sum, but bearing interest as therein expressed."—*Recorder.*

A Curious Property.

The performances of this curious property demand a moment of further attention. During the extreme depression, about ten days ago, the price touched 30 and kept persistently in the neighborhood of 35. Under the influence of the upward twist, the stock kited upward and crossed 50, and looked as though it were pluming itself for a fresh flight.

It was pretty well understood that the improvement had been brought about by Mr. Keene, acting as the market representative of Drexel, Morgan & Company.

There was a bigger crowd yesterday in General Electric on the floor of the Exchange than in any other stock. The way in which the quotations acted showed conclusively that there was something the matter. Practically, there was no market for the stock, and under offerings of stock the market shrank away as though it were burned.

The truth of the matter is that the recent financial policy of the management, taken in connection with the revelations of the condition of the property and the mystery that is faithfully observed concerning its operations, has destroyed everybody's confidence in its inherent merit. It will be remembered that late in June the company declared a quarterly dividend of 2 per cent. on the common stock, and this required for its payment on August 1 about $600,000.

During July was presented the curious spectacle of the company's agents hustling around the Street on a wild voyage of discovery for money wherewith to retire the floating debt which was pressing for payment. Finally it was decided to sell out the treasury assets and raise the necessary money, which amounted to $4,000,000. This sale of treasury assets was the second proceeding of the kind, and when it was all over it was believed that the company's treasury was practically gutted.

The idea of a company paying a dividend, and at the same time appearing in the market as a desperate borrower of funds, is analogous to the performance of the irresponsible prodigal who blows his friends off to a Delmonico dinner and turns up at a pawnbroker's the next day and pledges his jewelry in order to pay for it. If the company had passed the dividend and conserved its resources, it might have failed of a momentary and feverish prestige, but it would be enjoying now a great deal better reputation than it does, and its stock would probably be selling from 10 to 15 points higher.

As the matter stands, Wall Street and Wall Street's customers will not believe anything favorable that is said concerning it, and regard it as practically valueless, and feel that it will sell as far down as it has ever sold before—that is to say, 10 points below the present figure.—*Daily America.*

Apropos of General Electric affairs, what a marked contrast there is between official utterances now and a month or six weeks ago. Then everything was blooming and rosy, but now Drexel, Morgan & Company actually say that they have been obliged to make sacrifices to prevent the company falling into a receivership. It is the same old story, the truth about a concern is never told until the crisis comes.—*Boston Commercial Bulletin.*

Legal Notes.

The sheriff has taken charge of the office of the Equitable Manufacturing and Electric Company at 44 Broadway and the factory at 611 West Thirty-sixth street on an attachment obtained by Cravath & Houston for $29,540 in favor of Wendell Goodwin for money loaned. The company was incorporated several years ago with a capital stock of $1,000,000. Cornelius Fellowes is its president.

Attorney-General Hensel, after hearing arguments pro and con by leading lawyers, has refused the writ of quo warranto requested by certain citizens of Gettysburg to deprive the trolley line of its franchises on the battlefield. The Attorney-General decided all the points involved in favor of the trolley company.

In order to satisfy a judgment of the court the machinery and electrical apparatus of the Chicago Electric Motor Company was sold at public auction last week. The apparatus consisted of a lot of new fan motors, which was the principal article built by the company.

A California Exposition.

Something for Electrical Manufacturing Concerns to Think About.

An International Exposition will be held at San Francisco, Cal., U. S. A., from January 1 to June 30, 1894. The site of this Exposition is located in Golden Gate Park and will cover an area of about 100 acres. There will be five principal buildings for the Midwinter Fair, viz.: *(a)* Manufactures and Liberal Arts; *(b)* Agricultural and Horticultural Hall; *(c)* Mechanical Arts; *(d)* Fine Arts and Decorative Art; *(f)* Administration building. Applications are being received daily for separate and special constructions such as: State exhibits, restaurants, reproductions, side-shows, etc.

M. H. de Young, Vice-President of the National Commission, World's Columbian Exposition, Chicago, will act as Director General and President of the Executive Committee of the Winter Fair; the other members of the administration and officers are: Irwin C. Stump, vice-president; P. N. Lilienthal, treasurer; Col. A. Andrews, R. B. Mitchell, Hon. Eugene J. Gregory, Sacramento; Jacob H. Neff, Colfax; Fulton G. Berry, Fresno; J. S. Slauson, Los Angeles; Alexander Badlam, secretary; R. Cornely, assistant director general.

Information for intending exhibitors, maps of the grounds, buildings, etc., may be obtained by applying to the Department of Publicity and Promotion, California Midwinter International Exposition, Mills Building, San Francisco, Cal.

Personal.

Mr. Morris W. Mead, of Pittsburg, was enjoying an Eastern trip last week, and spent a day in going over the police and fire-alarm services of Brooklyn as guest of Mr. F. C. Mason.

Dr. Robert Newman, of New York, informs his friends that he will be in Chicago during the month of September, where all communications should be addressed to him, care Franklin H. Martin, M.D., Venetian Building.

Mr. O. W. Meysenberg, President of the Siemens & Halske Company of Chicago, spent Sunday at Manhattan Beach.

Mr. Henry Goebel, although nearly eighty years old, is still in vigorous health, and has recently travelled from New York to Chicago.

Bids Wanted.

Bids will be received up to Thursday, September 7, for supplying to the Watervliet Arsenal, Troy, N. Y., an electric lighting and power plant, including two traveling cranes of 60 and 30 tons capacity each, 12 H. P. and 15 H. P. motors. Specifications and all other information can be had on application to Major Isaac Arnold, Jr., Ordnance Department, U. S. Army, Commanding.

Practical Aspects of Low Frequency Electrical Resonance.*

BY M. I. PUPIN, PH.D.

DISCUSSION.

The President—Gentlemen, you have heard Dr. Pupin's admirable paper. Does the Institute wish to make any remarks on it?

Mr. Tesla—Gentlemen, I do not know whether I can contribute in any way to the clear and skilful exposition which Prof. Pupin has made of the phenomena of resonance. They have been familiar to me for a long time. In fact, two or three years back I began to work on lines in which an observation of some of the rules advanced by Dr. Pupin is an absolute necessity, and one of the reasons why I have only reluctantly consented to deliver a lecture on some high frequency phenomena, which I have shown on two or three occasions, was that I felt inadequate to the task, because in every experiment one has to depend on certain delicate balances, and one cannot always feel sure of succeeding in the experiment, especially in a public lecture. Dr. Pupin has admirably succeeded in performing before an audience a number of difficult experiments. I saw this marvellous experiment with the iron core, performed by him last week, I believe, and I have been much impressed with the importance of the molecular condition of the iron. Any observation relating to the iron must be of interest, as it may lead to valuable results, and since I am called upon, I may mention a few of my own experiences, though they might not be in direct connection with the subject treated by our lecturer. About two years ago I observed a curious effect which I abstained from mentioning so far, because I could not explain it to my satisfaction. It was this: I had an alternator of high frequency operating an induction coil. The secondary of this induction coil was connected to a Cardew voltmeter, and I had made the windings so as to bring the deflection into the best range of voltmeter. A condenser was connected to the alternator. I varied the amount of iron in the core of the coil and observed the rise in the electromotive force. As iron wires were added the electromotive force would continuously rise up to say 100 volts. Then there was a point at which when I added a few iron wires the electromotive force fell off about two volts. A further addition did not make any change whatever. I observed that effect repeatedly and repeatedly, but could not satisfactorily explain it. Now in the light of the experiment of Dr. Pupin and with the knowledge we presently possess, I cannot think else than that there was something of the same nature in the phenomenon. The delicate balance which, as Dr. Pupin has shown, can be easily upset by the introduction of a single iron wire in the coil, reminds me of an experience with a machine which was regulated by means of an "auxiliary or third brush," a very interesting device, but owing to the extreme sensitiveness not quite commercially available. The idea is to take a dynamo having the field magnet in series with the circuit and connect a point of the field coil or of the external circuit by means of an auxiliary brush with a point of the commutator. The sensitiveness obtainable by this means can be anything one chooses, and so great can it be made that the slightest disturbance on the machine may upset the whole circuit, and if there be arc lamps in the circuit, for instance, one may barely tap a lamp thus causing an imperceptible movement of the carbon rod, and all the lamps will go out if the auxiliary brush is in such a position and the field coil so connected that the shifting of the neutral line is an *accumulative* effect. In order to improve the action of the lamp mechanism I had the machine constructed in such a way as to give periodic impulses of a certain intensity, which produced a noticeable vibration in the field magnet, and so well did I notice the machine, operating it day and night (for at that time practically all my life was passed in the laboratory), that I could tell from these vibrations, by holding an iron bar in a certain position to the field magnet whether the machine was working properly. I noted then that sometimes all of a sudden the lights would go out. After this had occurred about a dozen times, I recognized that when I came with the iron bar near to or touched the field magnet I disturbed the field enough to displace the neutral line and the lights would go out because the machine would discharge itself.

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* A lecture delivered at the Tenth General Meeting of the American Institute of Electrical Engineers, Columbia College, New York.

Another observation which I may mention about the iron came to my attention in 1886. I then made some experiments on a so-called "thermo-magnetic" generator. This *nihil bonum* principle had no doubt occupied the time of many inventors. I had attacked the problem in quite a different way, sufficiently promising to justify an engineer to enter into an investigation and see what could be done. The method I followed was to enclose in a stove an iron core which closed the circuit of a magnet, this iron core consisting of a box of iron with small sheets of iron running through offering an enormous cooling surface. I used steam passed through the interstices to cool down the iron. My expectation was that the iron would just cool down a little so as to become magnetized when steam was admitted by means of a valve. The circuit of the magnet would then be closed and the valve was automatically shut, thereupon the iron was again heated and demagnetized. To a certain measure the valve worked well, but the vibration was too slow. It generally so happened that when the steam was admitted it would be decomposed and a greenish flame would shoot out of the stove. This indicated that the temperature of the iron was too high. I would bring the temperature of the iron down by admitting two or three times the steam in pressing upon the valve. Every time I did this the flame would shoot out of the stove. Then there would be a miss for about two or three times in succession, no flame appearing, the iron being cooled sufficiently, but upon doing it the fourth or fifth time, which took about a second or two, the flame would shoot out once more. I could not explain this phenomenon. A little later I obtained the classical work of Dr. Hopkinson on the recalescence and other properties of iron at high temperatures and plainly saw that it was recalescence. The temperature must have just been varied around the critical point. Still another fact which I recollect to have observed in experiments with high frequency currents is that an iron rod or wire, when an arc is formed through it, burns and sputters with violence, considerably more so with high than with low frequency or direct currents. It is possible that the effect is solely due to the magnetic properties of the iron, but it might be more or less produced by the increased resistance and consequently more intense heat evolution. With great magnetizing forces an iron wire inserted in a high frequency coil is instantly brought to a high temperature. This I have before pointed out, but Dr. Pupin has observed a similar thing with low frequency currents when a condenser is in circuit and resonating action takes place.

I wish to say in regard to converting to high potential, starting from a low potential dynamo, by simply combining capacity and self-induction with the circuit, that is, by resonating action, I have in my paper, which has just gone to print, dwelt specifically upon converting in this manner, and in fact I am delighted to see that Dr. Pupin has taken the views he has here expressed. My usual method was to attach to the alternator a coil consisting of a great number of sections, and to associate adjustable capacity with the coil, and then to vary the number of sections and the capacity until the best resonance was obtained. This obviated the employment of a secondary coil; but I found that in adjusting it was preferable to convert first the low tension currents to such a high potential that the necessary capacity would become extremely small, so as to be reduced merely to that of two small plates, because of the great difficulty of producing a condenser of large capacity adjustable by extremely small steps, which it is necessary to employ when the potentials are small. If we convert to a potential of say 50,000 volts then the capacity becomes very small, and we can just use a few plates immersed in oil, which permit varying the capacity by extremely small degrees, and without sudden, disturbing breaks. This is one of the reasons why I have always preferred to convert in a secondary circuit. The adjustment by varying self-induction by means of an iron core is, as Dr. Pupin's experiment now plainly shows, not always practicable. I think that the experiments we have seen here demonstrate that we are as yet far from having studied the properties of iron thoroughly, and that much remains to be done in this direction. I agree with Dr. Pupin that the condenser, which I had thought was going to be of great help in alternating work, does not really appear to have a great future in connection with apparatus with large iron cores, as motors or transformers, because of the action of the iron, and for one more reason besides, namely, that we can, especially if we have a high potential or high frequency, always wind a coil so as to take up just enough capacity to be in resonance with the circuit, in so far as the iron core will permit.

I only have to add, that I sincerely thank Dr. Pupin (which probably is the wish of all), and that I have profited very much by his lecture, which is a clear and precise exposition of the principle, as well as a most interesting experimental demonstration of electrical resonance with a dynamo machine.

[Adjourned.]

COMMUNICATED AFTER ADJOURNMENT BY DR. PUPIN.

Mr. Tesla is very kind and generous with his compliments. I do not think, however, that his statement of facts is free from ambiguity. He states that the phenomena of resonance which I have discussed were familiar to him for a long time. My discussion referred to low frequency resonance, whereas Mr. Tesla has, I think, always worked with high frequency apparatus, so that his familiarity with low frequency resonance, the subject which I discuss, is probably not based upon his own experimental investigations. At the time when the Ferranti effect called forth so much valuable discussion in England, Mr. Tesla[*] contributed some remarks to this discussion, which remarks culminated in the following: "The writer looked for a case of resonance,[†] but he was unable to augment the effect by varying the capacity very carefully and gradually, or by changing the speed of the machine. A case of pure resonance he was unable to obtain. When a condenser was connected to the terminals of the machine . . . the capacity which gave the highest E. M. F. corresponded most nearly to that which just counteracted the self-induction with the existing frequency."

Mr. Tesla states also in this article that the highest value of the augmentation of the potential which he was able to obtain by connecting a condenser in series to the armature of his high frequency (10^4 periods per second) machine wa *only four or five times the impressed* E. M. F. What then could Mr. Tesla infer from this result in regard to resonance effects with low frequency? Certainly nothing that was encouraging.

At no other time did Mr. Tesla, as far as I am aware, approach the subject of resonance any closer than in the article just referred to.

Perhaps Mr. Tesla means that he was acquainted with the phenomena of low frequency resonance which I discussed from the investigations of other men, like Fleming, Kapp, Glazebrook, Swinburne, Lodge, Blakesley, etc.[*] I appreciate fully the value of the labors of these men, but still I fail to see a very close relation between their work and mine, excepting in one point, and that is, that they as well as I have shown theoretically that it is possible to produce a high rise of potential by a combination of self-induction and capacity. *I have shown it experimentally also.* But I think that I have pointed out very clearly in the course of my lecture that I did not regard the resonant rise of potential as an end, but simply as a means to an end, the end being harmonic analysis of E. M. F.'s behavior of iron and dielectrics under the inductive action of resonant currents of low frequency, weeding out of harmonics by means of resonance, etc. With these phenomena Mr. Tesla does not appear to be familiar, either from his own experimental investigations or from investigations of others, excepting those phenomena which Dr. Duncan had investigated some time before me and which I mentioned in the course of my lecture.

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[*] *Electrical World*, N. Y., Feb. 21, 1891.

[†] The meaning of this term Mr. Tesla did not explain.

[*] See *London Electrician* for 1889, 1890 and 1891, also "Fleming's Alternate Current Transformer," Vol. II., p. 401.

Users of Infringing Lamps Sued in Detroit.

The Edison Electric Light Company of New York and the Edison Illuminating Company of Detroit have begun suits in the United States Circuit Court in that city against the Huyett & Smith Manufacturing Company and the Detroit Confectionery and Fruit Tablet Company to restrain further infringement of the Edison lamp patent and to collect damages for past infringements.

The Congress Special.

Additional Arrangements for the Pleasure of its Patrons.

Mr. W. A. Grant, General Manager of the Niagara Falls Park and River Railway, has extended an invitation to the Congress delegation, which is to leave New York on the special train Saturday evening, August 19, to take a ride over his road on Sunday morning, before the train proceeds to Chicago from the Falls. The invitation has been accepted by the management.

The road is operated by Niagara water power, and has a route of twelve miles in view of the Falls and Rapids. It was described at some length in a recent issue of the *Electrical Engineer*.

Receiver for the Pueblo Road.

Mr. Sunny's Famous Deal Goes Wrong.

The Pueblo City Railway Company (Consolidated), owning and operating five separate lines of electric roads in Pueblo and suburbs, has passed into the hands of a receiver, H. E. Chubbuck having been named by the United States Court to act in that capacity.

This road was equipped with Thomson-Houston apparatus, for which $175,000 in second mortgage bonds were taken in payment.

It was eventually learned that there was a large floating debt hanging over the road, which was, further, losing money rapidly. Finally to protect themselves it is understood that the Thomson-Houston people bought up nearly all claims against the company, and installed as manager Mr. Chubbuck, who has made an unsuccessful effort to pull the road out of a hole.

Mr. L. W. Burnham.

When in February of the present year we published an illustrated historic account of the rise, growth and present prosperity of the Electric Gas Lighting Company of Boston, including a brief biographical sketch of its vice-president and general manager, whose name appears at the head of this article, we little thought that ere long it would become our sad duty to pen an obituary of one who was widely known, universally respected, and whose life had been varied, useful and successful. Yet so it has proved to be. Col. Burnham, after two weeks' sickness, was called to his rest on Wednesday last, at his pleasant home in Dorchester, in the presence of his wife, daughters and son. For some time past he had been contemplating a visit to the World's Fair, accompanied by his youngest daughter, the day for their departure having been fixed for Wednesday, July 26. During the night previous Col. Burnham was seized with an attack of what proved to be partial paralysis, rendering him semi-conscious, with the loss of control over his muscular organization. At first his physicians believed he would soon rally, though they predicted even in that event that he would require care and attention for a long time to come. Their belief, however, was not sustained, for he had a relapse and gradually sank until the end came, calmly, peacefully, on Wednesday last.

Col. Burnham was only in his sixty-third year—by no means a great age—and he might have been expected, in the ordinary course of life, to enjoy many more years of usefulness. This, however, was scarcely expected by those who knew him most intimately. His absorption in the business he built up, which is a lasting monument to his energy and industry, had been a severe tax on his active mental faculties for many years; and so completely did he devote himself to the responsibilities of his position that his health had given way several times during the last two or three years. More than once have his physicians warned him when treating him for physical ailments that he should be careful lest his mental powers should give way under the severe strain he was subjecting them to. That these warnings were the utterances of well-grounded fears and indications subsequent events proved, for those who have known him intimately and been associated with him in business some months ago discovered that there were unmistakable symptoms of his mental powers being somewhat impaired, manifesting themselves in eccentricities of manner unusual with Col. Burnham when in his own true and genial form. As his final sickness showed, his brain was unequal to the task imposed upon it and he succumbed. The funeral service was held at the home of the deceased, where his remains lay—his countenance placid and serene as if he had dozed off into sleep—enclosed in a black draped casket embowered in foliage and appropriate floral emblems. Many friends and acquaintances were present as a mark of respect to the memory of one whom to know was to esteem. The services were impressive and beautiful.

Subsequently the remains, accompanied by Mrs. Burnham and family, were removed to Palmer, Mass., where they were interred in the family lot. W. S. K.

Association of Edison Illuminating Companies.

At the annual meeting of the above Association in Chicago last week, the following officers were elected for the coming year:

C. A. Edgar, president; G. H. Finn, vice-president; W. S. Barstow, secretary; Wilson S. Howell, treasurer. Executive Committee: John I. Beggs, chairman; F. P. Gilbert, E. R. Weeks, Wm. D. Marks, J. W. Pryor, C. L. Edgar (ex officio).

The retiring officers were thanked by a vote of the Association.

The next meeting of the Association will be held in Boston.

ALL VISITORS to the World's Fair will be welcome at the booth of ELECTRICITY, Section Y, Northwest Gallery, Electricity Building.

The Joliet Contract.

Crookedness Carries the Day, and the General Electric Company Gets the Contract.

Contracts for the electric light and power plant at the Joliet Penitentiary have been awarded by the Commissioners. The electric light plant was awarded to the General Electric Company for $51,000.

The result of the awarding is not only interesting to the electrical fraternity, but has also aroused considerable interest in the political parties. As related in this paper some weeks ago, several of the Chicago agents for different electrical concerns became aware of the fact that a contract was to be let. By various schemes some of the agents were able to secure specifications and drawings. Five of the representatives put in bids for the apparatus called for in the specifications, or apparatus which they manufactured as nearly like that called for in the specifications as was possible. Upon examining the General Electric Company's proposal for the plant, it was discovered that their bid was not in accordance with the specification which the other companies were expected to base their figures on. This fact was more conspicuous when it was discovered that the plans were drawn up in the General Electric Company's own office in Chicago. The main difference between the propositions made by the General Electric and the other companies was in one machine and a large switchboard being left out of the former company's bid.

In order that the actions of the Commissioners and Warden Allen might be brought directly before the Governor, a number of telegrams were sent to him, asking when he could be seen by the representatives of the companies outside of the Trust. Some of the agents formed their complaints into a petition asking Governor Altgeld to investigate the proposed manner of letting the contract.

Gov. Altgeld replied with a number of misstatements, showing conclusively his ignorance of the whole subject of electrical companies and their products and his utter incapacity to appreciate the question of propriety involved in the controversy. The Governor's statement closed as follows:

"Having spent nearly three weeks in investigation and in hearing statements the Commissioners and the Warden found that the concerns that were making all of the fuss did not handle the kind of machinery the State wanted. I said to them that the newspapers cannot run the penitentiary. They are not responsible for its management, and we are. If there is anything to be gained or to be saved by advertising, I wanted them to advertise, otherwise let these contracts at once and waste no more time; I want that plant completed before cold weather sets in. I therefore directed the Warden to proceed at once to close these contracts, being convinced that at present it is the best we can do."

Mr. C. A. Daigh, of the Siemens & Halske Company, makes the following reply to the Governor's statement:

"He states that he told us that he would investigate the matter at once. There is no truth in this statement, as we have never heard from him in any way, shape or form up to the time his interview was published in the *Herald*.

"His statement is not correct when he says that the Siemens & Halske Company could not furnish the belted machines, as we manufacture that type of machine, and are preparing to supply it with reasonable promptness.

"The statement that we had no plant in operation in the West except at the World's Fair is certainly far from correct, as if he had taken the trouble which he states he has, to thoroughly investigate the matter, he would have ascertained that right here in Chicago at the Auditorium Hotel we have in use a very much larger plant than the one proposed to be installed at Joliet, and furthermore where we are replacing General Electric Company's machinery.

"As to charging the Commissioners with dishonesty the word was first used by the Governor himself, therefore the public may draw their own inference.

"If the Governor really desires to act in the best interests of the State, I would say this much—that if he will re-open the matter I will guarantee that he will not only secure lower bids for the complete outfit than he has, but if he will place the matter in the hands of competent parties, the State will be the gainer in many thousands of dollars."

The Traction Company is All Right.

It is announced that the Traction Company of Philadelphia, which has been hampered somewhat in its operations this summer from lack of funds, has negotiated a loan of $2,000,000, and will carry out all its obligations promptly, including many improvements to its system.

Boston Notes.

At North Abington, Mass., a few days ago, a gang of men in the employ of the electric street railroad company were about to begin laying rails across the track of the Old Colony Railroad, when the officials of the latter road becoming apprised of the fact dispatched a locomotive to the scene and kept it running up and down the track rendering it impossible for the rail-layers to work. After this had continued for some time the officials of the two roads held a consultation, the outcome of which was that the work was suspended, although the electric railway men still contend that they have a legal right to cross the Old Colony tracks.

Work has been suspended on the branch roads of the Lowell, Lawrence and Haverhill Street Railway, in order that the entire force may work on the completion of the main track, between Haverhill and Lawrence, that is to be opened in September.

The factories of the General Electric Company at Lynn are running to fill cash orders alone, the directors having determined during the present financial stringency to do no more business on their usual lines, that is, putting in railway and lighting plants at their own expense and holding a lien on them until such times as local capital can be influenced to purchase said plants or subscribe for stock. Of course, many hands have been laid off and the rest are working short time.

Last Friday the new electric railway between Abington and Rockland, Mass., was opened amid great enthusiasm, and no less than 2,790 passengers were carried the first day, though the two towns are but small in population. It is expected that the new road will give the district a big boom.

During the past year the mails between Camden and Rockport, Me., have been carried by electric cars, improving the service very materially. The citizens of those and neighboring towns who have thus been well served are up in arms because the postal authorities have let the contract for the coming year to a carrier who has returned to the old style of using horses for carrying the mails, thus delaying their delivery by several hours.

The novel and beautiful electric fountain which is to be erected in the Frog Pond on Lynn Common will be constructed by the Franklin Electrical Company of Kansas City, Mo., whose design has been accepted, and who has bid $2,000 for the entire work. When completed it will be the most attractive work of its kind in New England, and a striking feature of ornamentation on Lynn Common.

Some time ago the directors of the Boston and Newton Street Railway Company petitioned the State Board of Railway Commissioners for authority to increase the capital stock of the company by $40,000, to enable them to make certain necessary extensions, also to fix the exact price per share for the new stock. The commissioners, after some deliberation, have granted the requisite authority, and determined that the shares shall be $100 each.

There is an increasing demand for a first-class efficient brake, one that will always work with no possibility of failure, on electric cars. Of late there have been several somewhat serious accidents by brakes refusing to work at the right time. The most recent of these mishaps occurred in Malden on Thursday, when, in descending a somewhat steep incline, the motorman discovered his brake wouldn't act. A short distance ahead was a sharp curve on top of an embankment twelve feet high. The car had a number of passengers inside. One by one they jumped as the car gained speed, and were each bruised more or less, including both motorman and conductor, who stuck to their posts. To add to the approaching danger a loaded car was coming in the opposite direction. In taking the curve the now empty runaway car jumped the track and went down the embankment, being reduced instantly to matchwood. Had it kept the track and collided with the loaded car, there would have been a frightful loss of life.

There was a lively meeting of the Cambridge Board of Aldermen, Thursday evening, arising out of a message sent by Mayor Bancroft, in which he vetoed an order passed a week ago by the aldermen, granting authority to the West End Railroad Company to lay electric car tracks along Brattle street, one of the high-toned streets of the University City. The subject has been under discussion for a long time, the residents of that thoroughfare having protested against the classic privacy of their neighborhood being ruthlessly invaded by the supposed vandalistic electric cars. The Mayor's veto was sustained by many citizens, and finally, after a warm discussion, by the aldermen too, who, however, proceeded to pass a fresh order of similar import, which is pretty sure to be vetoed as was its predecessor. The movement in favor of a storage battery road in Cambridge is likewise blocked for the time being.

The notification to 700 of the employees of the General Electric Company a few days ago that their services were no longer required was an error according to Mr. E. W. Rice, Jr., general superintendent of the factories. It was intended only to lay off 300 men, and it is hoped that there will be no further necessity for discharging more hands. It is intended to reduce the working hours of those still employed, should occasion demand, rather than lay off more men.

The Schuyler Electric Company of Middletown, Conn., has had to reduce its staff of employees nearly one-half owing to the present stringency in finance.

From Monday next the entire clerical staff connected with the motor, mining and lighting departments of the General Electric Company will be located at 44 Broad street, New York, the New England district offices remaining as at present, at 620 Atlantic avenue, Boston.

Canadian Notes.

The St. Clair Tunnel Company are considering the advisability of adopting electric transit through the tunnel, and have secured estimates from the Canadian General Electric Company for such an equipment. The smoke from the engines is having a most serious effect upon the interior of the tunnel, and Chief-Engineer Hobson is greatly concerned over the matter. The question of cost, however, is yet to be overcome before any definite action is taken.

The first car was run over the Peterboro Electric Railway last week, and the inauguration of the service was in every way satisfactory. The Canadian General Electric Company had the contract for equipping the road, which promises to be a most paying concern.

D. Thompson, of the Hamilton Electric Light Company, has severed his connection with that institution. Mr. Thompson has been in charge for several years past, and was formerly connected with the Royal Company of Montreal. He has a high standing in Canada as a capable working electrician.

The death of Mr. T. Griffiths, late Manager of the Hamilton Street Railway, has removed a most capable and popular man, whose loss is widely felt. He has been succeeded by his brother.

Great preparations are on foot in connection with the Convention of the Canadian Electrical Association to be held in Toronto next month. A great number of papers are in course of preparation by capable members of the Association, and a most attractive programme is being prepared for the visitors. One day will be devoted to a trip across the lake, where the Queenston Power House of the new Niagara Electric Railway will be inspected and the tunnel on the American side. A ride over the new road to the Falls and Chippewa will also be taken in.

The two arc light companies in London, Ont., have been recently acquired by a syndicate of Toronto capitalists, who propose spending $30,000 or $40,000 in remodelling the plant, introducing the incandescent light and an electric railway. A new power house is in course of erection, and a very favorable franchise has been secured from the city.

D. Thompson and Geo. Black, of the G. N. W. Tel. Co., Hamilton, have been invited to take part in the Electrical Congress which will meet in Chicago this month. D. Keely, Deputy Superintendent Government Telegraphs, Ottawa, has also been invited to take part.

The cable between St. Paul's Island and Meat Cove has been interrupted for the last two weeks. It is reported to the Public Works Department that the steamer Harlaw is responsible for the interruption, she having, it is alleged, fouled the cable in one of her recent trips to Newfoundland. The line will be repaired as soon as the services of the Government steamer Newfield can be obtained. The Newfield is now repairing the cable between Gaspé and Magdalen Islands.

General News.

What is Going on in the Electrical World.

McKeesport, Pa.—The Versailles Traction Company has been granted the right to lay its track in Locust street.

Binghamton, N. Y.—The Binghamton Electric Company has just added $12,000 worth of new machinery to its plant.

Batavia, N. Y.—The board of aldermen have deferred the matter of opening the bids for the new electric light building for two weeks, or until the 22d inst.

Lafayette, Ind.—The Physicians' Electrical Supply Company of Lafayette has assigned to Isaac Russell. Inability to collect money due is said to have forced the assignment.

Kansas City, Mo.—The electric lights in this city, which owing to some difficulty with the city officials have been shut down for some time, will be turned on again on August 28.

Bayonne, N. J.—The city council has passed an ordinance authorizing the Jersey City and Bergen Point Railroad Company to operate its road in the limits of Bayonne with electricity.

Norwalk, Ohio.—The stockholders of the Sandusky, Milan and Huron Electric Railroad have determined on the speedy completion of the road. In a few days the road will be in good running order to Norwalk.

Chester, Pa.—No fewer than five electric railway companies are now asking for privileges in this city. There are already twenty-eight miles of railway in the Chester system, with nine miles under construction to Darby.

Biddeford, Me.—It is understood that the York Light and Heat Company are negotiating with the Biddeford and Saco Railroad Company for a combine with a view to extending and operating the electric street railway.

Glyndon, Md.—The Baltimore Traction Company is to build an electric line to Glyndon. The road will be ten miles in length. It will be run from Pikesville to Reisterstown, and from there to Glyndon. A single track will be laid.

Tarentum, Pa. — A company of Allegheny men propose to build an electric road connecting Natrona and Parnassus. A bridge will be built over the Allegheny at Kensington, and a branch line will be run out to the fair grounds at Tarentum.

Nutley, N. J.—Preparations are making for lighting the town with electricity. Poles are being placed in position in the prominent thoroughfares, and by the first of October it is promised the township will be equipped with electric lights.

Youngstown, Ohio.—The Lanterman's Falls Improvement and Street Railway Company and the Youngstown and Canfield Street Railway Company have been consolidated, and the combination will be known by the name of the latter company, with a capital stock of $65,000.

Detroit, Mich.—It is said that the plans of the lighting commission for underground conduits are so arranged that whenever the city should decide to go into the business of supplying light to private consumers there will be no changes necessary in the ducts.

Salt Lake, Utah.—The Salt Lake and Ogden Gas and Electric Light Company have mortgaged the property and franchises of the company in Salt Lake and Weber Counties to the Farmers' Loan and Trust Company for $1,500,000, to secure the payment of 1,500 6 per cent. 25-year bonds of $1,000 each.

Mt. Vernon, N. Y.—The Union Electric Railway Company, of New York, has been granted a franchise to run to and through Williamsbridge, South Mt. Vernon, Mt. Vernon, Pelham and New Rochelle. It is the purpose of the company later to extend the road to Port Chester, taking in Larchmont, Harrison, Mamaroneck, Rye Beach, Milton Point and Rye.

Brooklyn, N. Y.—The Long Island Electric Construction and Equipment Company has been organized by Brooklyn men for electrical construction work in Brooklyn and on Long Island. W. J. Hayden is the general manager of the company.—The Franklin Avenue line of street railway has been converted into a trolley line, and the horse cars are no longer used on a portion of it.

Cincinnati.—About $5,000 damage was done by an accident at the Avondale Electric Railway power station, on Reading road, a few days ago. The accident was caused by a small piece of steel, not two inches long, slipping from its place, where it connected the governor of the engine with the cut-off. The speed of the machinery increased at a furious rate until finally everything literally flew to pieces and bits of broken wheels and shafts were hurled in all directions. Fortunately none of the workmen were hurt.

Toledo, O.—The new compound condensing engine added to the plant of the Toledo Electric Light Company is a mammoth piece of machinery, weighing about 95 tons. The fly-wheel, over which an 80-inch belt is driven, is 18 feet 4 inches in diameter, with an 82-inch face, and weighs 50,000 pounds. The steam is supplied by a battery of four Hammond vertical boilers, each tested to 150 pounds pressure. About 1,500 pounds of coal per hour is required by each boiler, but only two are necessary to furnish steam for the mammoth engine.

Philadelphia.—The new trolley road in Wissahickon and Manayunk is nearly completed and is expected to be ready to start early next month. The track is laid over the whole route and the greater part of the iron poles are in place. The new power-house at the Wissahickon depot is nearly finished and equipped with engines, dynamos, etc.—The Traction Company has applied to the Board of Highway Supervisors for permission to open all streets over which its Seventh and Ninth Streets and Market Street cable systems and its Union line extend, also Fifteenth street, from Mifflin to Jackson, for the purpose of trolley construction.

Syracuse, N. Y.—The Syracuse Consolidated Street Railway Company, which for three years has conducted all of the street railways of the city excepting the North and South Salina Street line and the main line of the People's Railroad, has virtually gone out of existence as all of the company's roads, franchises, rolling stock, and the property have been leased to the Syracuse Street Railroad Company for the term of the Consolidated Company's existence. The Syracuse Street Railroad Company is the company which was organized by the syndicate several months ago to operate all of the street railways of the city. Its capital stock is $4,000,000. The terms of the lease are the receipt by the stockholders of the Consolidated of an equal amount of stock in the Syracuse Street Railroad Company, and the assuming by the new company of nearly $200,000 of debt which the Consolidated Company owed at the time the syndicate secured control of that company.

Utica, N. Y.—Upon the solicitation of one of the chief promoters of the scheme to utilize the extensive water flow at Trenton Falls in generating electricity, A. Saunders Morris, chief engineer for the Westinghouse Electric and Manufacturing Company, visited the falls, and after a thorough inspection of the place reports the scheme practicable and a good one for Utica and near-by towns. Mr. Morris says: "In the dryest season I estimate that there will be 33,000 cubic feet of water per minute, which we can utilize. With a 20-foot head this will generate 5,000 horse-power. The loss through transmitting the power to Utica, a distance of 17 miles, will be about 20 per cent There would be sufficient for lighting the streets as well as furnishing power for the street car service and for factories. At Pomono, Cal., the power comes a distance of 14 miles, and also lights San Bernardino, 28 miles away."

Catalogues Received.

We are in receipt of a trade catalogue issued by the Westinghouse Electric and Manufacturing Company, devoted entirely to artistic reproductions of their standard electrical apparatus. The book contains forty-nine handsome half-tone illustrations, and is entirely artistic in style, the descriptions of the cuts and all matter of an advertising nature being omitted in this work. For those desiring further information on any of the apparatus illustrated separate pamphlets have been prepared which will be furnished on application.

The cuts include their various types of direct current dynamos for lighting and railway work, arc and incandescent machines, alternators, Tesla motors, electrical instruments, station appliances, incandescent lamps and other apparatus manufactured by the Westinghouse Company.

The "Electrical Engineering Company" of Minneapolis.

The Electrical Engineering and Supply Company, formerly of St. Paul, have removed their entire stock and business to Minneapolis, where they are located at No. 249 Second Avenue, South, occupying four floors and the basement of the Lincoln Block, which is being rapidly filled from top to bottom with the largest and best selected stock of electrical supplies in the Northwest.

Following are some of the specialties handled by this company in the Northwest:

National Incandescent Apparatus, Standard Arc Apparatus, Eddy Motors, Holtzer-Cabot Motors, Paranite Rubber Covered Wire, Grimshaw White Core, O. K. Weatherproof, Holmes, Booth & Hayden's Underwriters', Syracuse Sockets, Cutouts and Switches, and Packard Lamps.

Since moving to Minneapolis the company has, for convenience, shortened its name, and is now known as the "Electrical Engineering Company."

COMMERCIAL PARAGRAPHS.

The Electrical Engineering Company of Minneapolis report having just completed the installation of a 2,500 light alternator and transformer for the city of Brainerd, Minn., and are at present installing one 800 light incandescent machine, two 50 light standard arc machines, and two 40 light standard arc machines in the new department store being completed for S. E. Olson & Company, of Minneapolis.

Current from the incandescent machine will be furnished for running two passenger elevators, one freight elevator, and the cash railway system.

The Central Electric Heating Company, 26–28 Cortlandt street, New York City, have issued Catalogue No. 1, illustrating electric heating apparatus of every description for cooking and for domestic and industrial purposes generally, and for heating cars, buildings, steamships, etc., which is made under patents of the American Electric Heating Corporation.

Mr. J. Holt Gates, Western Manager of the Waddell-Entz Company, has recently moved his office into a suite of rooms on the eleventh floor of the new annex to the Monadnock Building, Chicago. For the benefit of his patrons and in order to more readily explain the merits of the Waddell-Entz dynamos he has installed a 3½ K. W. machine and connected it to the Edison mains.

The Abendroth & Root Manufacturing Company are sending out neat and handsomely printed descriptions of their standard boilers. The illustration showing Root boilers in process of construction at the Fair is particularly instructive and interesting.

Messrs. A. L. Ide & Son, the well known engine builders, of Springfield, Ill., have lately issued a set of new catalogues, illustrating their various types of Ide and Ideal engines, power transmitters, etc.

INCORPORATIONS.

The St. Charles Light and Fuel Company, St. Charles, Mo.—to deal in gas and electric light. Capital stock, $20,000. Promoters: John Dell, G. R. Blackford, Jos. F. Wash, St. Louis.

The Electric Company [incorporated in West Virginia], New York City—to acquire and dispose of patents and patent rights, and to construct tramroads, railways, etc., etc. Capital stock, $1,000,000. Promoters: Alfred Knisber and Edward Ayres, New York City; Samuel Sloan, Brooklyn, N. Y.

The Automatic Telephone and Electric Company, Jersey City, N. J.—to manufacture, construct, build, purchase, sell, lease, license, mortgage, loan upon and deal in and use electric machinery, etc. Capital stock, $250,000. Promoters: T. F. Goodrich, W. L. Trenholm, C. F. Cox, E. S. Wallace, New York City; C. H. Scrymser, Brooklyn, N. Y.

The Gray Electrical Transit Company has filed its certificate of incorporation with the County Clerk at Paterson, N. J. Its principal business will be carried on in Passaic and New York. The capital is $75,000, all paid in.

The Consolidated Machine Manufacturing Company, New York—to manufacture and sell electrical toys. Capital stock, $5,000. Directors: William R. Pope, Joseph Duff and Abraham Goldstone.

The Weaverville Electric Company, Weaverville, Cal.—to erect, equip and maintain electric plants, deal in and operate water rights, ditches, flumes and machinery. Capital stock, $10,000. Promoters: S. L. Blake, S. M. Gibson, T. E. Jones, C. W. Smith, J. W. Bartlett, all of Weaverville.

The Western Electric Heating Company of St. Paul, Minn. Capital stock, $1,000,000. Incorporators: Frederick P. Hager, Frederick P. Luther and Charles T. Johnston.

The Economy Novelty Manufacturing Company, Charleston, W. Va.—to manufacture, buy and sell electrical supplies, sell patents, etc., under patent of J. H. Lee Holcombe, No. 491,426. Capital stock, $100,000. Promoters: J. Duncan Harrison, Edw. G. Legg, Baltimore, Md.: J. H. Lee Holcombe, Washington, D. C.

The Wilcox Electric Company, Newark, N. J.—to buy and sell electrical patents, to manufacture and sell electrical railway appliances and to build and equip electrical railways. Capital stock, $150,000. Incorporators: Theo. B. Wilcox, Henry Wilcox, Ed. R. Dimick, T. P. Hoffman, of Newark; William Gibson, Charles E. Peet, Gouverneur M. Thompson, George J. Peet and William B. Smith, of New York; and J. W. Hinkley, of Poughkeepsie.

The Franklin Electric Street Railway Company, Franklin, Pa.—to construct and maintain an electric railway in Franklin. Capital stock, $24,000. Promoters: Alex. H. McKelvey, Jas. H. Donly, Geo. S. Davis, Warren, Pa.

The International Novelty Company, Newark, N. J.—to make and vend mechanical, chemical, electric, magnetic, scientific, artistic and other toys, puzzles, etc. Capital stock, $10,000. Promoters: Wm. S. May, Glen Ridge, N. J.; Eadley Hanley, Wm. H. Dean, New York City.

The Franklin and Oil City Electric Street Railway Company, Franklin, Pa.—to construct and maintain an electric railway in Venango County, Pa. Capital stock, $45,000. Promoters: J. H. Donly, A. H. McKelvey, Geo. S. Davis, Warren, Pa.

The Central Light and Power Company, Rochester, N.Y.—to produce electricity for light, heat and power. Capital stock, $25,000. Promoters: J. DeWitt Butts, Frank W. Elwood, Geo. Wilson, Rochester.

The National Street Railway Construction Company, New York City—to manufacture and sell all kinds of electrical and railway supplies. Capital stock, $5,000. Promoters: Edward S. Perot, Yonkers, N. Y.; Cornelius Gallagher, 218 E. 32d street, New York City; Jas. P. McQuaide, Plainfield, N. J.

The Citizens' Electric Light, Heat and Power Company, McDonald, Pa.—to supply light, heat and power by electricity in the borough of McDonald, Washington County, Pa. Capital stock, $12,000. Promoters: S. S. Johns, W. A. Jamison, R. M. McCastney, C. R. Buchheit, McDonald.

The Suburban Railway Company of West Chester, Pa., Philadelphia—to construct and maintain an electric street railway from West Chester. Capital stock, $400,000. Promoters: Wm. Jenks Fell, Wm. S. Kirk, Mahlon M. Childs.

The Portland and Hillsboro Railway Company, Portland, Ore.—to construct and operate electric light plants at Forest Grove and Hillsboro or elsewhere, and furnish electric light and power for public use. Capital stock, $1,500. Promoters: Theo. H. Liebe, F. J. A. Mayer, Frank Jobson, Portland.

The Queen City Electric Light Company, Denver, Col.—to furnish light, heat and power by means of electricity. Capital stock, $25,000. Promoters: Chas. E. Skillen, Frank J. Hango, Wm. Thorn, Denver.

The St. Louis and Kirkwood Electric Railway Company has applied for a decree of incorporation. The capital is $100,000, and the directors are Dr. John Pittman, George D. Edwards and George W. Taussig, of Kirkwood; Jeremiah Fruin, of St. Louis, and J. D. Housman, Sr., of Windsor Springs. It is the purpose of the company to operate an electric road from Forest Park to Meramec Highlands, two miles southwest of Kirkwood.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JULY 18, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

501,488. Regulating Electric Locomotives. J. B. Blood, Lynn, Mass. Filed Nov. 16, 1892.
501,548. Trolley Wheel. E. M. Tousley, Jamestown, N. Y. Filed July 16, 1892.
501,676. Electric Railway Conduit. I. J. Cook, Newark, N. J. Filed April 23, 1892.
501,701. Electric Controlling and Locking Mechanism for Railway Switches and Signals. C. M. Wilder, Cincinnati, O. Filed Oct. 17, 1892.

ELECTRIC LIGHTS AND APPLIANCES.

501,485. Incandescent Lamp Socket. H. P. Ball, Schenectady, N. Y. Filed Aug. 3, 1892.
501,491. Incandescent Electric Lamp. E. E. Cary, Boston, Mass. Filed April 6, 1893.
501,502. Incandescent Lamp Fixture. A. T. Gifford, Hopedale, Mass. Filed Nov. 28, 1890.
501,524. Surgical Lamp. W. G. Morgan, Fryeburg, Me. Filed July 27, 1892.
501,529. Incandescent Electric Lamp. W. E. Nickerson, Cambridge, Mass., and E. E. Cary, Boston, Mass. Filed March 29, 1892.
501,530. Incandescent Electric Lamp. W. E. Nickerson, Cambridge, Mass., and E. E. Cary, Boston, Mass. Filed March 31, 1893.
501,531. Incandescent Electric Lamp. W. E. Nickerson, Cambridge, Mass. Filed April 6, 1893.
501,580. Electric Lamp Socket. G. Sachs, St. Louis, Mo. Filed April 27, 1893.
501,737. Electric Arc Lamp. S. Bergmann, New York, N. Y. Filed Jan. 10, 1893.
501,758. Carbon Holder for Electric Arc Lamps. S. Bergmann, New York, N. Y. Filed March 20, 1893.
501,788. Electric Arc Lamp. T. T. Dempster, Summit, N. J. Filed Feb. 13, 1893.
501,884. Electric Arc Lamp. W. H. Klees, Susquehanna, Pa. Filed June 10, 1892.

DYNAMOS, MOTORS, ETC.

501,532. Device for Regulating Constant Current Dynamo Electric Machines, O. Offrell, Middletown, Conn. Filed Dec. 12, 1892.
501,842. Electric Motor. M. W. Long, Harrisburg, Pa. Filed March 23, 1891.

BATTERIES.

501,550. Electric Body Battery. H. C. Wagner, Cleveland, O. Filed Sept. 1, 1892.
501,723. Secondary Battery. F. King, London, England. Filed March 16, 1893.

TELEPHONE AND TELEGRAPH APPARATUS.

501,600. Ear-Phone Attachment. C. W. Farr, Chicago, Ill. Filed April 14, 1893.
501,610. Transmitter for Telephones. J. A. Brown, Moline, Ill. Filed April 26, 1893.
501,847. Multiple Switchboard for Telephone Exchanges. C. E. Scribner, Chicago, Ill. Filed July 30, 1892.
501,859. Method of Preparing Cables for Multiple Switchboards. O. A. Bell, Brooklyn, N. Y. Filed Nov. 7, 1892.

MEASURING INSTRUMENTS.

501,589. Electrical Measuring Instruments. R. M. Hunter, Philadelphia, Pa. Filed Feb. 10, 1893.

SIGNALS AND ALARMS.

501,631. Electric Circuit Connection for Signalling or Telephone Boxes. J. E. Smith, New York, N. Y. Filed Feb. 24, 1893.
501,653. Automatic Fire Alarm. J. Havard, New Bedford, Mass. Filed May 10, 1893
501,777. Burglar Alarm. C. J. Fisher, Chicago, Ill. Filed April 5, 1893.
501,905. Electric Fire Alarm. C. Bernhardt, Chicago, Ill. Filed October 3, 1893.

MEDICAL APPARATUS.

501,558. Electro Medical Apparatus. J. A. Cabot, Cincinnati, O. Filed Aug. 24, 1892.
501,849. Electric Belt. B. H. Standish, Evansville, Wis. Filed Oct. 24, 1892.
501,861. Electric Belt. A. D. Berliner, Rock Island, Ill. Filed June 23, 1892.

METAL WORKING APPARATUS, ETC.

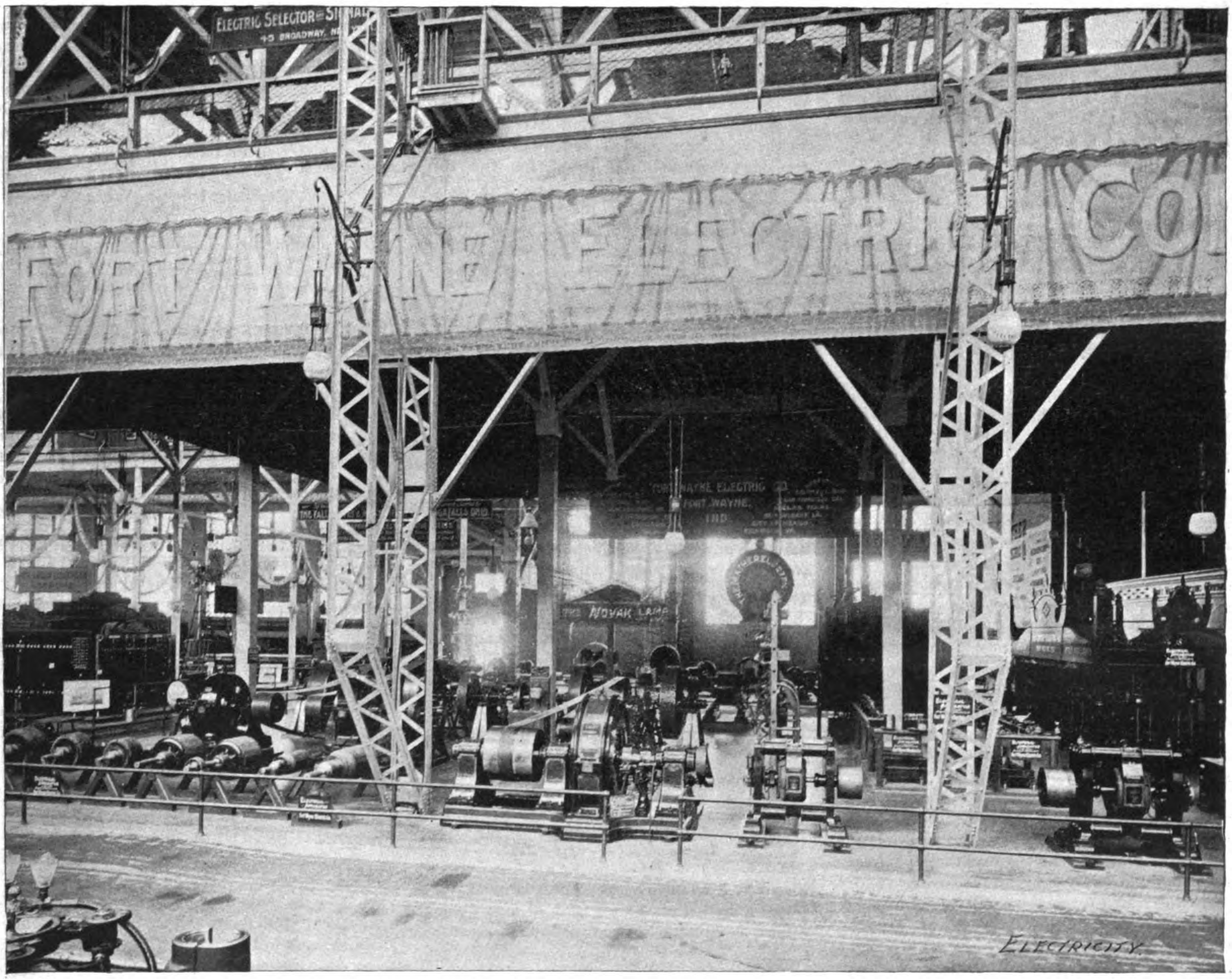
501,546. Automatic Chain Welding Machine. E. Thomson, Swampscott, Mass., and C. E. Harthan, Lynn, Mass. Filed Jan. 8, 1891.
501,547. Shaping and Spinning Metals by Electricity. E. Thomson, Swampscott, Mass. Filed Jan. 8, 1891.
501,755. Method of Forming Coal Cutters. F. Bain, Chicago, Ill. Filed May 31, 1892.
501,825. Method of and Apparatus for Heating, Welding or Working Metals Electrically. C. L. Coffin, Detroit, Mich. Filed Feb. 9, 1893.

MISCELLANEOUS.

501,519. Method of and Apparatus for Extinguishing Fires. J. G. Lorrain, London, England. Filed March 18, 1892.
501,540. Electrical Musical Instrument. P. E. Singer, London, England. Filed June 16, 1892.
501,541. Electrical Musical Instrument. P. E. Singer, London, England. Filed June 16, 1892.
501,542. Electrical Musical Instrument. P. E. Singer, London, England. Filed June 17, 1892.
501,543. Electrical Musical Instrument. P. E. Singer, London, England. Filed Feb. 21, 1893.
501,565. Gas Lighting Apparatus. G. Gorldt, Kissingen, Germany. Filed Dec. 10, 1892.
501,578. Method of Manufacturing Varnish and Apparatus Therefor. H. Pfanne, Rixdorf, Germany. Filed Aug. 29, 1892.
501,628. Apparatus for Depolarizing in Electrolysis. J. C. Richardson, London, England. Filed Jan. 26, 1893.
501,707. Electric Switch. W. H. Dingle and J. M. Urquhart, London, England. Filed April 23, 1892.
501,708. Lightning Arrester. F. H. Doane, New York, N.Y. Filed May 31, 1893.
501,732. Method of and Apparatus for Purifying Water. H. Roeske, Philadelphia, Pa. Filed Oct. 15, 1892.
501,783. Method of and Apparatus for Electrolyzing Solutions. E. Hermite, Paris, France, and A. Dubosc, Rouen, France. Filed July 9, 1892.

ELECTRICITY.

VOL. V. NEW YORK. AUGUST 23, 1893. CHICAGO. No. 6

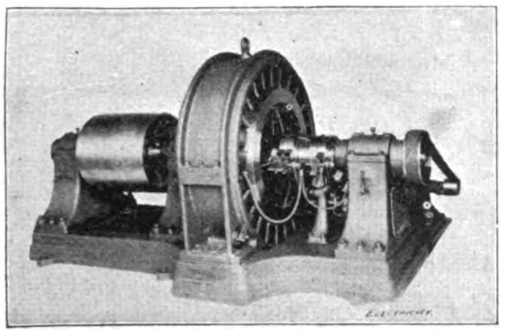


FORT WAYNE ELECTRIC COMPANY'S WORLD'S FAIR EXHIBIT (SEE PAGE 62.)

World's Fair Notes.

The Fort Wayne Company's Exhibit.

The exhibition of dynamos, motors and other electrical apparatus made by the Ft. Wayne Electric Company in the Electricity Building is certainly one of the most interesting displays, from the student's point of view, to be found in the Electrical department. The exhibit occupies a space near the middle of the west side of the building, on the main floor, and includes nearly all kinds of electrical apparatus built by the Ft. Wayne Company. A line of shafting and pulleys occupies the middle of the space. All the dynamos are belted directly from the pulleys, which can be thrown in and out of operation by the means of clutches. The line shafting is run by two motors belted to each end of the shaft. The motors are of the Wood type, one being of 90 horse-power at 220 volts pressure, and the other 125 horse-power and operating a 500 volt circuit.



THE WOOD IRON-CLAD ALTERNATOR. (FIG. 1.)

Besides these machines the company have the following dynamos in operation: Three Wood alternators, having a capacity respectively of 1,200, 1,500 and 3,000 lights each, three 2,000 C. P. arc light machines of 40, 60 and 80 lights capacity, and one dynamo rated at 120 arc lights capacity, using 1,200 C. P. lamps.

In connection with these machines all of the principal parts which make them complete are exhibited on tables arranged within the company's space.

A recent addition to these machines has just been placed in the exhibit, which consists of a new iron-clad alternator, shown in Fig. 1, to which a slow speed exciter is attached. This machine contains some novel points in its design which render it of interest. The parts are all made of comparatively small pieces to facilitate easy handling, and the shunts are placed in one pillow block where they are free from dirt and mechanical injury. There are two pairs of brushes, one of which can be removed or adjusted while the machine is running, and these are supported on an independent pedestal and shifted by means of a hand-wheel. The bearings are self-oiling and the armature is designed to permit good ventilation.

The current of air from the revolving armature is utilized to ventilate the crown of the machine, the pillow blocks and other parts.

The air is forced into the crown of the machine and out through channels connecting with the bearings, and in this way a constant circulation of air is kept up, causing the machine to run perfectly cool under any condition of load.

The wall which forms the north line of the company's exhibit has been tastefully decorated with incandescent lamps and a few telling signs which inform the visitor that the company's machines are used in the largest electric light station in the world. A number of Slattery meters are also mounted on the wall, and are connected up to the dynamos to measure the current used in the exhibit.

A very interesting part of the display is the rack of lamps, which shows 26 different styles of Wood arc lamps as manufactured by the Ft. Wayne Company.

Currents for and from the different machines are distributed by means of three switchboards, one for arc lights, one for direct current incandescent lamps, and the other for alternating currents. It is understood that one of these switchboards has already been sold and is to be shipped to the Philippine Islands.

Included in the exhibit are two very large search-lights, one of which is connected up and is shown in actual operation.

Besides this exhibit, the Ft. Wayne Company have a plant of 17 dynamos and generators in Machinery Hall which are used for lighting part of the grounds and buildings of the Exposition.

The company had the honor of having its machines selected by the Committee on Awards to furnish current for the tests of the electrical apparatus to be judged.

Geometrical Proof of the Three-Ammeter Method of Measuring Power.[*]

BY FREDERICK BEDELL AND ALBERT C. CREHORE.

The methods, now well known, for measuring power by three voltmeters or three ammeters, first shown by Professor Ayrton and Dr. Sumpner,[†] are applicable to the measurement of power of any circuit irrespective of the nature of the impressed electromotive force, and the general proof of the methods is given in the paper referred to. In the case of a harmonic electromotive force the methods are capable of simple geometrical proof. The writers have shown this [‡] for the voltmeter method, and in this note will give the corresponding proof for the three-ammeter method.

Let $R_2 L_2$, Fig. 1, be an inductive circuit whose power is to be measured, and R_1 a non-inductive resistance in parallel with it.

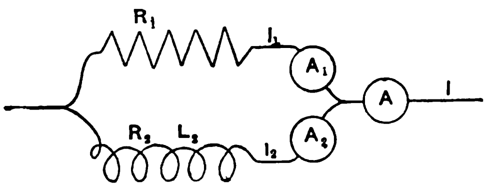


FIG. 1.

If the maximum values of the main and branch currents be denoted by I, I_1 and I_2, respectively, they may be represented as shown in Fig. 2. The current I_1 is in phase with the impressed electromotive force E; the main current, I, lags behind it by an angle θ; and the current I_2 lags behind it by an angle θ_2. The tangent of θ_2 is $\frac{L_2 \omega}{R_2}$; and the tangent of θ is $\frac{L' \omega}{R'}$, where R' and L' denote the equivalent resistance and self-induction of the parallel circuit,[‖] and ω is 2π times the frequency.

The power expended in the inductive circuit is $W_2 = \frac{1}{2} EI \cos \theta_2$. From the geometry of the figure

$$\cos \theta_2 = \frac{I^2 - I_1{}^2 - I_2{}^2}{2 I_1 I_2};$$

whence

$$W_2 = \frac{E}{4 I_1} (I^2 - I_1{}^2 - I_2{}^2),$$

where E, I, I_1 and I_2 represent maximum values. Writing virtual or square root of mean square values as obtained from ordinary measuring instruments, the expression for the power becomes:

$$W_2 = \frac{\bar{E}}{2 \bar{I}_1} (\bar{I}^2 - \bar{I}_1{}^2 - \bar{I}_2{}^2).$$

The power in the non-inductive branch is

$$W_1 = E I_1;$$

and the total power in the two branches is

$$W = \frac{\bar{E}}{2 \bar{I}_1} (\bar{I}^2 + \bar{I}_1{}^2 - \bar{I}_2{}^2).$$

The method is thus geometrically established for harmonic currents, which may be represented by lines in a vector diagram. For an alternating current, not harmonic, the proof does not hold unless we assume the current to be equivalent to a harmonic current, and the question then arises as to what will be the equivalent harmonic current. The equivalent harmonic current must be such that its square root of the mean square value and the expenditure of energy in the circuit are the same as in the case of the given current which was not harmonic.

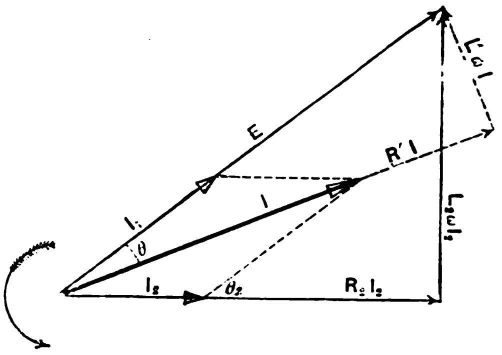


FIG. 2.

Melting Iron in Water.

Among recent electrical experiments made on either side of the Atlantic, that of melting a bar of iron immersed in cold water has perhaps excited more popular interest than any other.

The process is as follows: The apparatus used is a vessel of glass or porcelain, provided with a sheet lead electrode, connected to the positive pole of a continuous-current generator; the vessel contains sulphuric acid and water. A flexible cable from the negative pole is connected to a strong pair of pliers with insulated handles. Taking in the pliers a piece of metal of any kind, iron, for instance, and immersing it in the acidulated water, the liquid is seen immediately in ebullition near the iron rod or plate, which latter is rapidly heated and brought to a dazzling white in a few seconds, and soon begins to melt in spark-like drops. The heating is produced so quickly locally that neither the water nor the body of the metal rod have time to become hot.

So rapid an evolution of heat necessarily means a tremendously high temperature. In a very short time as high as 7,000 degrees Fahrenheit have been developed, which is proven by using a carbon rod instead of a metal one, when in a few moments amorphous carbon fragments are seen dropping off. The inventors claim to have attained with large currents the enormously high temperature of 14,000 degrees Fahrenheit, or nearly five times hotter than molten iron.

The first suggestion for the practical utilization of the discovery was for welding purposes, to which it is evidently particularly well adapted. Another application which the experiments would seem to lead toward is the tempering of one edge or one extremity only of steel-cutting tools. The hardening of the skin surface of large pieces of metal, such as armor plates, offers another inviting field. Krupp, it is stated, is already trying this new method of electric heating for tempering the superficial surface of large guns.

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[*] From "Physical Review," July-August, 1893.

[†] The Measurement of Power given by any Electric Current to any Circuit. Proc. Roy. Soc., Vol. XLIX., p. 424.

[‡] Alternating Currents, p. 230.

[‖] Equivalent Resistance, Self-Induction and Capacity of Parallel Circuits with Harmonic Impressed Electromotive Force. Bedell and Crehore, "Phil. Mag.," September, 1892.

On the Carrying Capacity of Electric Cables, Submerged, Buried or Suspended in Air.

BY A. E. KENNELLY.*

The general laws that control the temperature elevation of electrically active wires, when buried or submerged, seem to have been fully ascertained, but the application of the theory to practical conditions has not perhaps been sufficiently developed. Professor George Forbes has, however, in his paper on the heating of conductors, read before the London Institution of Electrical Engineers in March, 1884, considered the cases of wires in air and water, as well as of wide horizontal plane strip conductors buried underground. It is here proposed to further develop the subject with the aid of a series of measurements made at the Edison laboratory on particular samples of Siemens cables, manufactured at the Schenectady Works of the General Electric Company. These measurements are described in Appendix I.

We may commence with the simplest case of a solid cylindrical conductor of radius r cms. carrying a steady current of C amperes with a resistivity at the working temperature of D ohms. The conductor is covered to radius R cms with a solid insulating material, closely fitting over which is a tube or cylindrical sheathing of lead or other metal. The electrical resistance of the conductor per centimetre of length is $P = \frac{\alpha}{\pi r_2}$ and the heat generated by the current in the same unit length is C^2P joules per second, corresponding to a thermal activity of C^2P watts.

If the surface of the cable's sheathing is kept at a constant temperature t degrees centigrade by the action of flowing water, it can be shown that in the copper conductor there will be no sensible difference of temperature between the centre and the surface for all cases that are likely to occur in practice. Similarly the difference of temperature between the interior and exterior surfaces of the leaded sheath will be negligible, so that finally, after the current has been kept steadily flowing through the conductor for what would be strictly an infinitely long time, but for practical purposes might be an hour, we may consider that while the sheath would retain throughout a uniform temperature t° C., the copper would have reached a steady temperature of $t + \theta$ throughout its substance, θ being the temperature elevation of the conductor due to the current it conveys.

This temperature elevation θ depends upon the thermal resistance offered by the insulator to the transfer of C^2P joules of heat energy across unit cable length of its substance per second. With infinitely great thermal conductivity or infinitely small thermal resistance, the insulator would transfer heat under an infinitely small temperature elevation ; and generally, if S is the thermal resistance of a body between two surfaces whose difference of temperature or thermal potential is θ° C. (referred, strictly speaking, to the centigrade scale of the air thermometer), the transfer of heat in the permanent state between those surfaces will be

$$H = \frac{\theta}{S} \quad . \quad . \quad . \quad (1)$$

heat units per second.

It is customary to express H in gramme-calories, i. e., water-gramme-degrees centigrade. but for the purpose here in view it is preferable to express the heat in terms of its equivalent mechanical energy, with the joule as unit.

The thermal resistance of a body depends upon its form and its thermal resistivity, in complete analogy with the corresponding electrical quantities. A homogeneous isotropic substance possesses therefore unit resistivity when a centimetre cube with 1° C. difference of temperature maintained between two opposite faces allows one joule of heat energy to pass between them, in the permanent state, each second. If δ denotes the thermal resistance of the insulator in the cable of radii r and R, the thermal resistance of the covering per centimetre of length of cable is

$$S = \frac{\delta}{2\pi} \log\varepsilon \frac{R}{r} \quad . \quad . \quad (2)$$

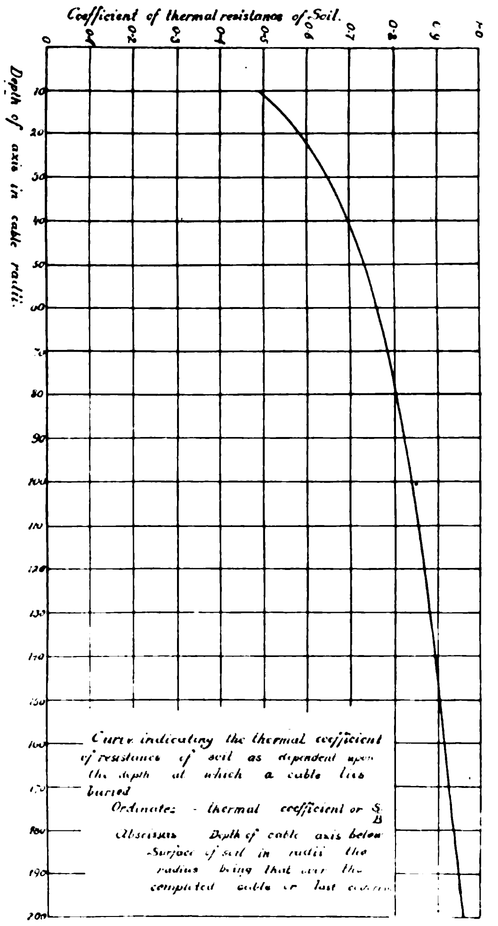
and by analogy with Ohm's law, the temperature elevation will be the product of this resistance and the energy current H or (C^2P) developed in each centimetre.

$$\text{Thus, } \theta = H\,S \quad . \quad . \quad (3)$$

$$\text{and } C = \sqrt{\frac{\theta}{P3}} \quad . \quad . \quad (4)$$

This relation (4) determines the limiting current strength for the cable when the radii and resistivity of the insulator are given and the temperature elevation has been decided upon.

The temperature elevation permissible in the conductor of a cable is generally limited by the attendant diminution of insulation resistance, or the softening of the insulating material. For Siemens cables, 60° C. may be taken as a fair limit in this respect, and since the normal temperature of air or soil may reach 35° C. in summer, the safe limit of temperature will be 25° C. or 46° Fahr.



With this value of θ in equation (4)

$$C = \frac{5}{\sqrt{P\,S}} \quad . \quad . \quad (5)$$

$$\text{or developing } C = 5\,r\sqrt{\frac{2\,\pi^2}{\alpha\,\delta\,\log\varepsilon\frac{R}{r}}} \quad . \quad (6)$$

A and δ being the electrical and thermal resistivities, P and S the electrical and thermal resistances per cm. of length, R and r the radii, and the conductor a solid cylinder.

This shows that if the thickness of the insulating cover maintained a constant ratio to the diameter of the conductor, the limiting current strength would be directly proportional to the radius, that is, to the square root of the cross-sectional area of the conductor. In that case, doubling the diameter of the wire would quadruple its cross section but only double the carrying capacity. It is evident, however, from an examination of the dimension tables for any kind of electrical cable, that the thickness of insulator does not usually increase in proportion to the diameter of the wire. and consequently the carrying capacity will generally increase faster than the radius and slower than the cross section. For the standard Siemens cables it appears that quadrupling the cross section of the conductor increases the carrying capacity about three times.

The resistivity of copper at 60 degs. C. may be taken as two michroms, and from the measurements of the samples of Siemens cables tested the mean thermal resistivity of the insulator was 750 units.

As an example, suppose a No. 4 B. & S. wire 0.2043″ (0.52 cm.) in diameter, covered with Siemens compound to a thickness of 0.1″ (0.254 cm.), lead sheathed, and submerged in water. Required the safe carrying capacity.

In equation (2) $\delta = 750$ $R = 0.514$ $r = 0.26$

$$\frac{R}{r} = 1.977 \quad \log\varepsilon\left(\frac{R}{r}\right) = 0.6816$$

$$\therefore S = \frac{750}{6.283} \times 0.6816 = 81.36$$

$$\text{Also, } P = \frac{0.000002}{3.1416 \times 0.26 \times 0.26} = 0.000009417$$

$$\therefore C = \frac{5}{\sqrt{81.36 \times 0.000009417}} = 180.7 \text{ amperes.}$$

STRANDED CONDUCTORS.

If the copper conductor consists of a strand of copper wires, equations (4) and (5) remain applicable, but (6) is no longer reliable. Taking (5), the resistance of the conductor per cm. can be determined in the ordinary way, and the thermal resistance of the insulator can be best found by taking its mean internal diameter for r in (2). The insulating cover surrounding and conforming to such a strand is no longer simply cylindrical, but the slight additional accuracy in determining the thermal resistance for the new interior outline would not repay the additional labor of computation.

BURIED CABLES.

The case of buried cables differs from that of cables submerged only in the fact that the external surface of the sheathing is not maintained at the normal temperature of the environment. The ground, in fact, interposes an additional thermal resistance to the flow of heat from the active conductor. Denoting this ground resistance by G, the fundamental equation (1) becomes

$$H = \frac{\theta}{S + G} \quad . \quad . \quad . \quad (7)$$

so that it is only necessary to increase the thermal resistance of the insulator by that of the soil to revert to the same method of treating the problem.

Assuming that the cable lies buried at a uniform depth below the level surface of the ground, the thermal resistance G of the soil will for a given external cable diameter depend only upon this depth and upon the thermal resistivity of the soil. We may consider that the temperature of the surface of the ground remains normal, and that, owing to the combined actions of radiation, convection and wind, the heat flowing upwards from the buried cable is entirely dispersed and dissipated at this surface. This is, of course, not strictly true, for the surface temperature of the ground immediately over the cable will rise appreciably when powerful currents are steadily carried beneath. It may be shown, however, that with the depths at which cables are usually buried, the assumption involves an error that is practically small, while it renders amenable to simple numerical treatment a condition that would otherwise be too complex to ordinarily compute.

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* Read before the Association of Edison Illuminating Companies.

If, for example, a cable buried at a depth of one metre were of such dimensions as to carry safely a steady current of 750 amperes, the final elevation of temperature at the surface of the ground over it would be less than 20° C., even ignoring the great reducing influence of wind, and the ground surface, which by assumption should remain at normal, could nowhere exceed the normal by two degrees centigrade, a discrepancy whose consequence upon the carrying capacity of the cable would be negligible, and whose tendency would be to slightly underestimate the temperature elevation of the conductor.

On this assumption, then, the surfaces of heat flow are cylindrical, and the isothermal surfaces are also cylinders eccentric to the conductor. The thermal resistance

$$G = \frac{g}{2\pi} \log \varepsilon \left(n + \sqrt{n^2 - 1} \right) \quad . \qquad (8)$$

where g is the thermal resistivity of the soil, and n is the ratio of the depth of the cable's axis to the cable's radius, or in other words, the depth of the centre of the cable in external radii. From this formula the following table and the curve in Fig. 1 are obtained.

n	Coefficient of g	n	Coefficient of g	n	Coefficient of g	n	Coefficient of g
10	0.4760	60	0.7620	110	0.8584	160	0.9181
20	0.5871	70	0.7865	120	0.8730	170	0.9277
30	0.6516	80	0.8077	130	0.8850	180	0.9368
40	0.6975	90	0.8265	140	0.8968	190	0.9454
50	0.7330	100	0.8433	150	0.9078	200	0.9536

From these curves it appears that at depths of fifty radii a quadruple increase—to 200 radii—only changes the resistance per centimetre of length from 0.7339 to 0.9549, an increase of about 30 per cent.

(To be continued.)

Electricity in Artillery Practice.

The Eddy Electric Manufacturing Company of Windsor, Conn., have perfected an electric motor attachment for the control of Gatling guns which is a conspicuous step forward over previous efforts in this direction, and is regarded by the Ordinance Department as very near to perfection.

The motor does not protrude at the side of the gun base, but is, when attached, a part of the gun, being afforded the same protection as the mechanism of the gun itself.

It occupies a space of fifteen inches in length, with a diameter the same as that of the gun, being of 1 H. P. capacity. A maximum of 2,000 shots per minute can be attained.

Electricity in Gardening.

By the use of electric light the Hon. W. W. Rawson, of Arlington, Mass., claims he makes a gain of five days in each of his three crops of lettuce; that is, two weeks in a season. That the gain on one crop pays all the expense of the electric lighting for the season, thus giving him the gain on the other two for extra profit. His attention was first called to the usefulness of the light by the advance made in the growth at the ends of his greenhouses next the street and in the glare of the electric light. This was so marked that he introduced the light through his lettuce and cucumber houses. Dr. Bailey, of Cornell University, says, as the result of his own experiments, that the influence of the light is greatly modified by the interposition of a glass roof. Plants injured by a naked light were benefited by the protected light. Five hours' light per night at a distance of twelve feet hastened maturity a week or ten days, but proved injurious to young plants and those newly transplanted.

Carbon and its Uses in Electrical Engineering.*

BY CLARENCE M. BARBER, C. E.

In the year 1810, Sir Humphry Davy connected the poles of a battery of 2,000 elements by two charcoal points, and produced one of the most brilliant artificial lights that had doubtless ever been seen.

So little value was attached to this experiment that it was merely entered in the note book of the great physicist, and remained there apparently unnoticed until 12 years later, when it appeared as a communication to the Royal Society. Scarcely do we find a more striking example of the great advancement in electrical science than when we note that this bright spark has grown in strength and beauty, until now there are required to feed its ever-spreading rays 200,000,000 of carbon pencils for the present year in the United States alone.

In electrical engineering, the term carbon is used to designate an artificial solid, which, through mechanical or chemical means, is derived from some of the natural forms of carbon. It is moulded under great pressure into cylindrical pencils for arc lighting, or into rectangular blocks or plates for battery or other uses. It is not the purpose of this paper to describe minutely the process of making carbon, nor is it necessary, as there are published descriptions which cover the ground fairly well. However, an outline of the general principles may not be out of place.

The materials usually employed are coke and pitch. The coke should be as free from solid impurities as is obtainable. Petroleum coke is largely used, although other varieties are often sufficiently pure for the purpose. It is ground to powder, and the volatile components are driven off by heating in retorts. Melted coal tar pitch is then thoroughly mixed with it, and for some kinds of carbon lampblack is also added. The mixture is then cooled, again ground to powder, and is then ready to be moulded or forced.

The process of moulding consists of filling the material into steel moulds, which are made in two equal parts, so arranged that the lower half of the mould will contain a sufficient quantity of the material for the entire charge. The upper half is then placed in position upon its counterpart, the mould is placed in a furnace and heated sufficiently to soften the fusible ingredients. It is then put under a pressure of about 400 tons, after which the 16 pencils, or carbons as they are called, are removed from the mould. After cooling they are ready for the next process, which consists in handling the carbons one by one, examining and trimming of the webs which usually occur between the individual pencils as they lie in the mould; they are then packed in furnaces holding from 30,000 to 50,000, where they are baked at a high temperature for about 100 hours. After cooling for a like period they are sorted for straightness. A portion are then sent to the consumer, but a large portion are first coated with copper.

The process of forcing is proximately the same as that of moulding until the material is ready for the moulds; then, instead of being moulded, it is heated and made into cylindrical plugs, which are placed in a heavy iron cylinder, and, by means of a plunger driven by hydraulic pressure, the plastic material is forced through a steel-bushed orifice and comes out in the shape of a continuous cylinder, which is cut to the lengths desired. The carbons are then sent to the furnaces, and from this point the process is the same as for the moulded.

The forcing process permits of a wide range of shapes, as by changing the size of the steel-bushed orifice, cylindrical carbons can be forced having a diameter of 1-16 in., and from this size up to or even above 4 ins in diameter. Many other shapes besides cylindrical can also be made, such as plates that are not much over 4 ins. wide and of a thickness of from ⅛ to 1½ ins. or over. These are cut into short lengths and used for dynamo or motor brushes. Plates as small as ¼ x ⅛ in. are also forced for small generator or motor brushes.

There is a great difference in density and structure between moulded and forced carbon. The pressure under which moulded carbon is made is about 8,300 lbs. per square inch, while by the forcing process the pressure required is double or three times as great. By the method of forcing, the material is crowded together as it is pressed toward the small end of a conical chamber and is finally forced out at the vertex, thus giving a combination of lateral and end pressure.

By the method of moulding, the carbons receive side pressure only. Under the side pressure, the material tends to laminate in planes parallel to the axis of the carbon; while under end pressure, the planes of lamination are at right angles to the axis. As usually made, the pressure is not sufficient to produce distinct lamination; but it is evident that the structure of the material is inclined toward this class of formation, as in the case of slate rock which is laminated in planes at right angles to the lines of pressure. Under certain conditions, lamination may be observed both in moulded and forced carbon.

Carbons, as they are usually made for arc lamps, are about 7-16, ½ or ⅝ in. in diameter, by about 12 ins. in length. In some cases pairs are used, a carbon 7 ins. and one 12 ins. usually constituting a pair. Besides those there are several other sizes in use; for searchlights and for many of the large lighthouses, carbons as large as 1½ ins. in diameter, and often larger, are employed.

In addition to the ordinary pencils, many other forms may be moulded, such as cups or crucibles, or almost any design where the material can be retained in moulds and submitted to great pressure. Plates are made 12 to 14 ins. square, and in thickness from 1-32 in. to over 1 in.; and even larger sizes are often made.

In its physical properties carbon varies greatly, the variation depending upon its composition and treatment in the process of manufacture. The hardness may be from that of chalk to that of crockery, and its specific gravity may vary to about the same extent. It is quite brittle, and this property is retained through all its stages of hardness. The tensile strength and resistance to crushing increase with the hardness.

For cutting carbon the emery wheel is generally employed; it can be drilled or cut in the lathe with steel tools, but its effect is to wear them away very rapidly; even diamonds can be used as cutting tools but a short time. On the hardest specimens these operations are performed with difficulty even with the best of tools.

As applied to electrical engineering, the most important and interesting use of carbon is in the arc lamp; here we find phenomena that are wonderful even in the light of the most advanced science. If two ½-in. carbon pencils be placed with their points in contact, and are included in electric circuit having a current of 10 amperes, a slight amount of heat will be developed in the body of the pencils, which will be greatest at the point of contact; if, while the current is still passing, the pencils be separated a few millimeters, an arc of great luminosity and heat will be formed. If the poles of a voltmeter be connected with the pencils, the voltage due to the resistance of the arc will be seen to vary directly as its length, or nearly so; at about 20 volts the arc will be scarcely visible, and will increase in brilliancy and heat as the points are separated until the voltage reaches about 50, when the light will appear to be the most brilliant. At a point somewhere above this voltage, possibly 70 or higher, the arc will go out with a snap.

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* Read before the International Engineering Congress of the Columbian Exposition, 1893.

In the above case, if the current be maintained constant, of course the watts required will vary as the voltage, and this variation of the total watts is employed by all makers of arc lamps as a means of moving the feeding mechanism. This, in some lamps, may be so delicately adjusted as to move the carbons toward each other when the distance between the points has increased an amount corresponding to 1 volt, while many lamps require an increment of 5 volts to cause the teeding device to respond.

One of the most notable points in regard to the burning of the carbon arc is that the temperature in the positive carbon rises much higher than in the negative. It is noticed that when we extinguish the arc by turning off the current, the point of the positive carbon remains incandescent after the negative point has become black; the intensely heated crater formed on the positive carbon radiates far more light than the incandescent point which is formed at the end of the negative. The consumption of the positive is about twice as great as that of the negative when burned in the air; if burned in a vacuum, then the positive only is consumed. These facts seem to indicate that the larger part of the energy of the current is expended upon the positive carbon. A large part of the energy expended upon the arc is doubtless used in maintaining a counter electromotive force, and another portion is absorbed in the conversion of solid carbon into vapor.

The arc may be colored by the introduction into the carbon of almost any foreign substance, and the color is characteristic of the substance employed, as in the case of the Bunsen flame; and as there are but few substances which are not volatile in the electric arc, the range of color is very large. The intensity of temperature is, without question, highest in the centre or inner portion of the flame and lowest toward the outer circumference; for this reason the vapors of substances arrange themselves in concentric envelopes—those which volatilize at the highest temperature taking positions nearest the centre, those which volatilize at the lowest temperature becoming the outer envelope.

The carbon flame affords one of the best subjects for spectrum analysis; it is therefore of great value for this purpose, and by its use the field of the spectroscope has been greatly enlarged.

It is perhaps important to note that, aside from the color effect of foreign substances in the carbon pencil, there is in most cases a reduction of the light and generally a lengthening of the arc; this may be accounted for on the supposition that foreign substances usually volatilize at temperatures lower than carbon and hence supply vapors which radiate less light, and, volatilizing more rapidly, the quantity of the vapor is increased and a corresponding reduction of voltage may also be noted. If the foreign substances are not homogeneously incorporated with the carbon, the arc will be unsteady and the light will be unsatisfactory.

In the burning of arc-lamp carbons, there is always a quantity of carbon dust that falls from the burning points; this is not a product of combustion, but particles of carbon, which are detached and thrown off from the highly heated points by calcination. Many attempts have been made by inventors to reduce or prevent the loss of life of carbons due to this cause. Some degree of success has been attained by introducing into the carbon ingredients in the shape of substances which, fusing at a comparatively high temperature, become slag and mix with the detached particles and prevent them from falling off; and retaining them until they are consumed, the life of the carbon is prolonged to a very marked degree.

The hissing sound so frequently observed in the arc-light carbons is a matter of importance. There seems to be a strong current of air and vapor moving between the highly heated points; when this current impinges in a certain manner against the point toward which it flows, hissing will be the result. To illustrate: if a jet of air be blown from a small tube, at high velocity, against a solid substance, a hissing sound will or will not be produced, depending upon the velocity of the air, the nearness of the solid and its configuration.

Many experimenters have endeavored to obtain a quiet, steady arc by the introduction into the carbon of foreign matter, which, by producing vapor more easily than carbon, will so modify the conditions as to prevent hissing; and, with a view of holding the arc in the centre, a core is used. This core is simply a centre, which may be 1-16 inch or more in diameter, of a material that is different from the body of the pencil and contains more or less of the foreign matter.

Some of the most quiet and steady-burning carbons that are in use have been obtained by the use of foreign matter and a core. Carbons are also made with hollow centres, through which solutions of salts are simply poured, a sufficient quantity being left therein to produce the desired result.

As early as 1867 M. Carré coated carbons with metals, such as zinc and tin; and about the same time Mr. Joseph Van Malderon experimented with carbons electroplated with copper. Carbons have, therefore, been electroplated almost from their first introduction, and copper has been the metal used. The only reason the writer has seen assigned for this use of copper is that it reduces the resistance, conveying the current to the end of the pencil with but little loss of energy. The life of the carbon is increased by coating with copper from 8 to 10 per cent.

The total resistance of an uncoated pair of ½-inch carbons, in a newly trimmed lamp, is about .20 ohm, while the total resistance of the lighted lamp is about 5 ohms. It is evident, therefore, that the resistance of the carbons is about 4 per cent. of the total resistance of the lighted lamp. The resistance of the lamp coils may be 2 per cent. The decrease of resistance due to copper coating will not account for the increase of the life; this is due, in the writer's opinion, to the fact that the copper tends to support and retain the particles of carbon that are detached from the points by calcination; to some extent, also, the fused copper forms in liquid beads, and, by absorbing the calcined carbon dust, tends to prevent its loss.

A comparatively new use for carbon is found in the carbon brush for dynamos and motors; here carbon is substituted for the copper brush, and hence retains the name, which appears like a misnomer. Carbon brushes reduce the cutting of the commutator and the sparking to almost nothing. The same commutator may be used for years with carbon brushes which, if copper were used, would be worn out in a few months. The quality of the carbon brush is of great importance; it must be of fine texture, sufficiently hard, and should act in some degree as a dry lubricant, and it should not give a squeaking noise. These are points that can be provided for by the manufacturer. Much difficulty is sometimes experienced by heating. This, of course, is a question of conductivity, and can usually be remedied by making the brush larger, or by coating it with copper, or by doing both.

The telephone is indebted for a large measure of its great success to artificial carbon. Here its value depends upon the principle that an increase of pressure produces a decrease of resistance. The writer is inclined to think, with Mr. S. P. Thompson and others, that the increase of pressure simply makes a more perfect contact. As the resistance of carbon is higher than that of metals, it is, in some cases, an excellent material for this purpose, and especially where moderate resistance is required

Among the advantages of carbon for electrical resistances, we may note the fact that it can be heated almost to a red heat and held at this temperature, without undergoing any change whatever, and being practically infusible it will stand for a short time very high temperatures, even in the atmosphere, without suffering any deterioration. If held long at a red heat, however, in the air, it will calcine and sometimes oxidize. Carbon has also the remarkable property of showing a reduction of resistance as the temperature rises. At high temperature this is very marked; for example: the decrease in resistance of an incandescent lamp filament at a white heat may be one-third of its resistance when cold. At temperatures below a red heat, however, the change of resistance is of comparatively little importance.

Some of the difficulties that attend its use as a resistance material are as follows: the resistance of carbon varies between wide limits; two carbon pencils ½ inch in diameter and 9 inches in length could be selected, of which one would have a resistance of .20 ohm and the other .07 ohm. The forced carbon being more dense is always lower in resistance than the moulded, other conditions being the same. The resistance, however, may be largely controlled by variations in the manufacture.

The connection between carbon and a metal conductor often becomes a troublesome point, especially if high temperatures are to be used. For low temperatures the carbon may be electroplated with copper and the metal conductor may then be soldered; but for high temperatures the connection must be made by some form of clamping device.

Carbon is not used as a resistance where calibrated resistances are required, owing to the difficulty of predetermining its exact resistance. For resistance purposes, carbon is used in the form of pencils as small as ⅛ inch in diameter; larger sizes are also used; it has also been used in the granular form and as a powder.

As a contact piece, where contacts must be made and broken frequently, carbon has a great advantage in many places over metals; and frequently, where metals are used in switches for contacts for large currents, carbon blocks are successfully used as a last point of contact. In such places as these last mentioned, carbon often gives a long arc, but even where one pole is metal, instead of burning the metal the current seems to expend its energy on the carbon, which suffers but little and is renewable.

Carbon is almost universally used in primary open-circuit batteries for the positive pole, and for this purpose it is made in the form of cylinders or plates. It is not acted upon at ordinary temperatures by any acid or other liquid known to chemistry, and in batteries it is easily depolarized. Carbon is also used, to a limited extent, for crucibles; and, when mixed with clay, stands very high heats without oxidation.

It is remarkable that while carbon is made in a variety of forms its uses are almost entirely confined to electrical engineering; and as we note the rapid advancement of this new department of scientific work, we may also note, as one of the changes it has brought to our century, this new industry—the manufacture of carbon.

A slight idea of its growing magnitude in the United States may be gained from the fact that it claims an investment of over $1,500,000.

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International Electrical Congress.

Before this issue of ELECTRICITY is in the hands of its readers the International Electrical Congress will have commenced its sessions in Chicago. This congress will undoubtedly constitute the most important assemblage of electricians which has ever taken place in the history of the science, and the representative character of its members and its wide international scope render it an occurrence which is unlikely to be repeated for many years to come.

The general congress is divided into three sections which will each consider special phases of electrical work. The first section will take up questions involving pure theory, such as electric waves, conduction, magnetism, etc.; the second section is on theory and practice and will constitute the most interesting part of the proceedings to the general electrical engineer. The third section will be devoted to pure practice, including telephony, telegraphy, traction, etc.

In addition to these sections there is also to be a smaller body known as the Chamber of Delegates, composed of representative delegates from different Governments, whose work will consist in considering the proposed new electrical units and their values, with a view to having the same legalized by the Governments represented.

The subjects to be considered by the Chamber of Delegates relate principally to electrical nomenclature and standard values of units, and on these subjects considerable variance of opinion exists among the representatives of different Governments which will probably call forth extended discussion. For example, the "henry," which has been generally accepted by American and English electricians, is objected to by French authorities, this same unit having been styled a "quadrant" at the last electrical congress in Paris. The reciprocal of the ohm for which "mho" has been suggested, and several other units which have been found desirable are likely to be the subjects of considerable discussion by this body.

The business of the three sections of the general congress will include the reading and discussion of some thirty papers by a number of the most eminent men in the electrical profession. During the sessions, which take place from August 21 to 25 inclusive, public lectures by prominent members, including one by Mr. Tesla, will be delivered.

The discussions of the papers read, which will cover a large range of highly important topics, promise to be of unusual interest, and arrangements have been made by which readers of ELECTRICITY will be furnished with prompt and complete reports of these important proceedings.

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ELECTRICITY has no apologies to offer for its twelve-month attack on the sham Electric Trust, nor its results. If the latter had been different, there would now be scores of independent manufacturers and dealers on the verge of bankruptcy, instead of the General Electric Company. We have made our fight for a principle—free competition and honest competitive methods—and we have won. The events of the hour are ample confirmation of our most serious accusations.

The Uses of Carbon.

A suggestive paper, by Mr. Barber, on the uses of carbon in electrical engineering, will be found elsewhere. The extent to which this element has found application in electrical work and the peculiar properties possessed by it, which are found in no other material, make it of special interest to the electrician, by whom the manufacture of carbon has been called into existence.

Electric lighting, both arc and incandescent, is dependent upon the use of carbon almost absolutely, and in this field it stands without a rival or substitute. Both of these methods of illumination have given rise to large industries in the manufacture of carbon, and no commercial form of electric lighting without carbon has been discovered.

The telephone is perhaps the next most important electrical device demanding the use of carbon. The microphone, which is the fundamental component of the telephone, depends upon a property of carbon which is peculiar to this material alone. The principle of the microphone, discovered by Hughes in the early history of applied electricity, is the subject of some dispute as to whether the variations in the resistance of the circuit are due simply to the change of contact with the carbon with pressure, or whether this pressure varies the resistance of the whole mass of carbon. As this phenomenon is only noticeable with carbon, however, the latter assumption has been generally credited.

In electric primary batteries carbon has been found invaluable, and the carbon-zinc couple are now far more generally used than any other element. In this capacity carbon has replaced much more expensive materials, and in general is better adapted to use in batteries than any other of its substitutes, on account of the property, which it alone possesses, of resisting any chemical action in all kinds of battery solutions.

Most dynamo machines, except those of low voltage, are now supplied with carbon brushes, which have increased the life of commutators many times above what was possible with copper brushes. In all cases where sparking occurs at carbon and metal contacts the metal is comparatively untouched and the carbon wears away evenly leaving the contact surfaces smooth. For this reason its use in switches and other pieces of apparatus containing sliding contacts is found of special advantage. Its use as a resistant, although of value in some cases, is not general owing to its great variation in conductivity under different conditions. The facility with which manufactured carbon may be turned out with any desired degree of density or hardness also adds greatly to its value in electrical appliances.

Considering the manifold uses to which manufactured carbons have been applied in electrical work, this material may fairly rank as one of the most useful to the electrical engineer and one upon which the great industry of electric lighting depends absolutely.

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THERE is every probability, as we go to press, that sensational developments in General Electric will be announced before the end of the month.

There is no doubt that Thomas A. Edison will be again an active factor in an electrical enterprise before January 1, 1894. It would not be strange if Mr. Edison should make his new venture exclusively in the manufacture of incandescent lamps. He is fully prepared.

……o……

THE TRUTH IS COMING OUT. There are three theories by which we can account for the emphatic statements concerning General Electric published in a Boston paper and reprinted elsewhere in Electricity.

The first is that the editor has just escaped from a lunatic asylum.

Second, that he questioned his ability to earn a livelihood during a long period of financial depression and endeavored to make a sure thing of breaking into jail.

And third, that the outbreak was instigated by some one who has tried to divert public attention from his own deceptive tactics by throwing mud at those who have found him out; that the writer obtained information from a high official in the General Electric Co., and that he has a guarantee against any serious prosecution; that the matter was, in fact, inspired by a man who has been thoroughly beaten at a game in which he considered himself an expert, but in which he was only an unprincipled novice, and who has so far lost his head as to believe that he can by such methods place all the odium for the wholesale slaughter of the innocents in General Electric upon those who have found him out, and who will yet expose him to the public.

Electricity subscribes to the latter theory.

We are aware that there are some statements in the article which are inconsistent with this view of the case, but the gentleman referred to is a New Englander, and no doubt a disciple of Emerson, who believed that "consistency is the hobgoblin of weak minds."

The annual report, which is characterized as "false from beginning to end," was prepared by Mr. Joseph P. Ord, a Drexel & Morgan protege, sure enough; but it was signed and presented by the president of the company, Mr. C. A. Coffin, himself.

No newspaper man, however venal, as well-informed as the *Telegram* man seems to be, would make such misstatements as appear in regard to the affairs of the Edison General Company unless he had been deceived by a man in whom he had confidence or *in whose service he was working.*

The directors and bankers of the Edison General Company knew it to be bankrupt, and they made no secret of the fact.

But the Edison General Company was in infinitely better condition than the Thomson-Houston Company, except for ready cash. It had ten times more *bona fide* assets than the Thomson-Houston Company, assets which have not vanished, and which have proved salable. The Edison assets were not, like the Thomson-Houston assets, largely made up of stocks of paper companies or manufacturing companies which were all losing money. There was no fraud upon the part of the Edison people.

There was misrepresentation on the other side, systematic misrepresentation, juggling with figures, and base deception.

The system of bookkeeping adopted by the Edison Company was the best known in the commercial world; only one set of books was kept for both the officers of the company and the public, and deception was a practical impossibility upon those who had access to the books.

This was not the case with the Thomson-Houston Company.

That Mr. Pierpont Morgan has put Mr. C. A. Coffin to sleep, there is little doubt. But the actual facts of history cannot be perverted in this manner for whatever motive.

More than one of the New York directors were grossly deceived, among them Mr. D. O. Mills and Mr. Pierpont Morgan. That they decided some weeks ago to teach Mr. Coffin a lesson in the art of financiering is beyond question. They were hypnotized for a season, but the spell wore off.

Mr. Coffin's high reputation when he entered the electrical business carried him through for ten years in New England, but served his purpose for a brief year only in New York.

Electricity has no sympathy for any member of the General Electric's Board of Directors, and nothing but condemnation for their conduct. That men like Twombly, Mills and Morgan should allow their names to be used in connection with a concern of whose affairs they were ignorant, is scarcely less culpable than the studied deception of the man who engineered the scheme to humbug the public.

We shall expect the *Telegram* to produce the facts, if it has any. Few will be found to believe its unsupported assertions.

Secrecy in the affairs of any company like General Electric is unpardonable, and when such secrecy is studiously maintained in the face of a situation like the present, the public is justified in believing that something is wrong. The extent of that something is a matter of opinion.

The whole truth is coming out soon, and Mr. Coffin's New England friends, who have stood by him with a loyalty far more credit able to their hearts than to their intellects, will yet be compelled to admit their error.

Violent outbreaks like the one referred to may be wholesome in effect by hastening an investigation of the company's affairs by disinterested parties.

The collapse of the company, which may be announced at any moment, will be a serious blow to the trade, but it is inevitable and necessary. The benefit, however, will overbalance the injury if the lessons taught are heeded by those who will come into the management of the enterprise.

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The interests of the *Street Railway Gazette*, it is announced, will hereafter receive the undivided attention of Mr. C. E. Stump, who needs no introduction here. Mr. J. W. Dickerson is also added to the editorial staff. Great things will now be expected of the *Gazette*, and Electricity believes there will be no disappointment.

His name is Charles Ausgespielt Coffin; and we could pity him if we could forget that it was he who said: "*We are going to do this business, and you may as well fold your tents and get out.*"

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A leading banking house of Philadelphia was semi-officially advised last week that a receivership for the General Electric Company was inevitable unless the plan to provide for the floating debt was speedily consummated; and moreover, that the probability of the plan's success was doubtful, which seems now to be confirmed by the many changes made in the plan.

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Electricity does not believe the plan will be successful, for obvious reasons. If the bondholders of the company are not extremely complacent people they will not allow the assets to leave the treasury in any manner yet proposed; and if the merchandise creditors are not even more complacent, they will have something to say before the collection of their accounts within a reasonable length of time is rendered impossible by legal complications.

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The recent troubles between France and England over the former's possessions in Siam have brought out the fact, which is viewed with considerable uneasiness by the French, that England controls nearly all the sub-marine cables of the globe. During the Siam flurry telegrams addressed to the French Government were sent to the British Foreign Office three or four hours in advance. Of twenty-eight cable companies two are French, one Danish, three North American and three South American. These companies have, all told, 125,000 miles of cable, three-fourths of which are under English control.

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We would like to know what the *Electrical Engineer* means in ascribing to London *Punch* certain comments of the London *Electrician* on a note on "Calculating Boys," etc., which appeared in the *Engineer* some weeks ago.

"The Book of the Fair."

It is fortunate that so able an historian as Mr. Hubert Howe Bancroft should take up the labor of preparing a complete history of the World's Fair. The work is to be published in twenty-five parts of about forty pages each, folio size, by the Bancroft Company of Chicago and San Francisco.

The literary world has been amazed at Mr. Bancroft's capacity for work. He has barely concluded a series of twenty-five or thirty volumes of Western history, a work which has few blemishes, and which has stamped its author as a marvel of industry and ability.

Mr. Bancroft's work is the more remarkable from the fact that he was well along in years before he undertook any literary work. He was a bookseller in San Francisco who had amassed a fortune which has now been spent in the collection of materials for his histories.

His labors on the histories of the Western States and of Mexico, which are the standard works on their respective subjects, and his large fortune were virtually contributed for the public benefit.

It is to be hoped that "The Book of the Fair" will meet with the success it deserves. It is handsomely printed, and it will be, beyond its historic value, an ornament to any library.

GENERAL ELECTRIC.

What is Said of It Nowadays.

(From the Boston Evening Telegram.)

GENERAL ELECTRIC ROBBERY.

New England Mulcted for *$50,000,000*. The History of the Most Daring Swindle of Modern Times.

HOW NEW YORK BEAT NEW ENGLAND. $70,000,000 SHRUNK TO $25,000,000, AND STILL SHRINKING.

Common Stock from 120 to 30; Preferred from 120 to 70; Bonds 105 to 60—Will New England Be Further Robbed ?

NO ! BONDHOLDERS WILL ENJOIN DIRECTORS FROM COMPLETING THE WORK OF GUTTING THE TREASURY.

HOW PIERPONT MORGAN PUT COFFIN TO SLEEP.

The *Telegram* has put its agents to work, has started its machinery of investigation, and in a short time will be able to lay before the startled community the following facts : The General Electric Company is an illegal Trust, founded upon a conspiracy to swindle its stock and bond holders.

That the conspiracy was hatched up before the consolidation of Edison and Thomson-Houston Companies.

That the Edison was hopelessly and palpably bankrupt, and that its directors and bankers knew it to be so.

That false statements of its condition were made to the Thomson-Houston people, and that upon such false statements the consolidation was brought about.

That a floating debt of over eight million dollars was not upon the books of the company.

That after consolidating, upon its discovery, bonds of the General Electric Company to the amount were used to pay it.

That the stockholders of the General Electric Company were deceived as to the purpose of the issue of these bonds, and to-day suppose, and have been led to believe, by the directors that the bonds were used for other purposes.

That the floating debt of the General Electric Company to-day is over twelve million dollars.

That its entire assets will not pay its floating debt and forty cents on its bonds.

The inside New Yorkers, or old Edison crowd, sold their stock to the New England holders at over par.

That they sold thousands upon thousands of shares short at par and bought it back at thirty to forty.

That one agent, a Boston operator, sold for them over seventy thousand shares.

That they are preparing to take what is left and then turn the balance or the worthless shell over to a receiver.

That the annual report is false from beginning to end.

That the company is hopelessly bankrupt.

That it has not been able to meet its obligations for the past six weeks.

That the bondholders and unsecured debt holders will ask the courts to enjoin the transfer of the treasury assets and the appointment of a receiver.

That if a receiver is not appointed, New England will not receive one cent on a dollar for its investment.

That the conspiracy has gone so far that President Coffin, the representative of New England interests, has already been replaced by Twombly the New Yorker.

That he has got to join McLeod and the long list of men who have pulled Morgan chestnuts from the fire.

The Armour Institute.

Special Preparations for the Electrical Course.

The Armour Institute at Chicago, which opens September 14, will have a course in electrics which it is believed will place it at once on a par, in this respect, with the best technical schools in the country. The Institute has been a liberal purchaser of laboratory apparatus at the Fair, and its selections have generally been marked by good judgment. Some mistakes seem to have been made in certain apparatus, which, however, can be easily corrected.

Mr. W. M. Stine, the director of this department, is quoted as follows :

"We have bought many thousand dollars' worth of the best apparatus to be purchased, and our laboratory will be beyond doubt not only a model of its kind but the leading collection of electrical test instruments in this part of the world.

"One specialty that we will make is that of measuring instruments, and while foreign apparatus has been generally conceded the best in this line, we also include all apparatus of American manufacture that is good and serviceable."

We would like to know who makes this concession. Certainly not the foreigners, nine out of ten of whom are free to admit that the instruments designed and perfected by an American, Prof. Edward Weston, are the standard throughout the world.

The Mather Electric Company's Election of Officers.

At a recent meeting of the Mather Electric Company of Manchester, Conn., the following officers were elected : Directors—B. A. Simmons, Hartford ; C. N. Knox, Hartford ; Charles B. Whiting, Hartford ; C. T. Welles, Hartford ; F. C. Rockwell, West Hartford ; M. S. Chapman, Manchester, and A. D. Claflin, Boston. At a subsequent meeting of the directors B. A. Simmons was chosen president, M. S. Chapman vice-president, and C. T. Welles secretary and treasurer.

Performance of Street Railway Power Plants.

(Continued.)

BY WM. A. PIKE AND T. W. HUGO.*

Summary of Results, Test. No. 1.

Time of beginning test	4.20 A.M., March 5, 1892
Time of closing test	1.50 A.M., March 6, 1892
Duration of test	21 hours 30 minutes
Engines in use	Two tri-cylinder condensing Allis engines
Boilers in use	Nos. 1, 3, 4, 5, Babcock & Wilcox boilers
Total water as evaporated	525,487 lbs.
Less 1½ per cent. average moisture	517,601 lbs.
Water collected from separator No. 1	5,778 lbs.
Water collected from separator No. 2	1,896 lbs.
Water collected from both	7,674 lbs.
Steam condensed in empty Stirling boiler No. 1 (leaky valve)	3,024 lbs.
Water collected from jackets	47,129 lbs.
Total dry steam used in engines not including jackets	459,773 lbs.
Total oil used	44,245 lbs.
Average temperature of feed water	123.4 degs.
Average steam pressure in boiler room	122.4 lbs.
Average temperature of flue gases	385 degs.
Average temperature of boiler room	82.5 degs.
Average draught in flue	¾ inch
Average height of barometer	28.77 inches
Average temperature of oil	101.7 degs.
Average moisture in steam	1½ p. c.
Average temperature of injection water (about)	38 degs.
Average revolutions per minute, engine No. 1	62.26
Average revolutions per minute, engine No 2	63.00
Average horse-power, engine No. 1	705.88
Average horse-power, engine No. 2	621.23
Maximum horse-power at any time, engine No. 1. [at 7.50 P.M.]	1,097.30
Maximum horse-power at any time, engine No. 2 [at 5.50 P.M.]	1,040.96
Maximum horse-power at any time, both engines [at 5.50 P. M.]	2,046.2
Average total horse-power during run, both engines	1,237.9
Average horse-power used for lighting purposes	33.4
Average total horse-power during run available for car use	1,204.5
Average horse power used by condenser engines	13.66
Average electric horse-power	1,088.00
Ratio of horse-power of condenser engines to horse-power of main engines	1 1-10 p. c.
Ratio of total steam used in jackets to steam used in cylinders	9 15-100 p. c.
Loss by friction between engines and line, obtained by taking the difference between steam and electric horse-power	149.00
Loss by friction in per cent	12 2-10 per cent.

The power used by the condenser engines was practically constant under all variations of load on the main engines.

In calculating the ratio of steam used in jackets to that used in the cylinders of the main engines the water collected by the separators was deducted from the amount chargeable to the boilers, also the leakage from the leaky valve before noted.

Average water used in Stirling boiler for condenser engines, pumps and heating system, per hour	5,837.6 lbs.
Average water used in main engines, without jackets, per hour	21,385.0 lbs.
Steam used in cylinder per horse-power per hour, as evaporated	17.29 lbs.
Steam used in cylinders per horse-power per hour, from and at 212 degs	19.54 lbs.
Steam used in cylinders and jackets per horse-power per hour, as evaporated	19.05 lbs.
Steam used in cylinder and jackets per horse-power per hour, from and at 212 degs	21.52 lbs.
Evaporation of water per pound of oil, as usual	11.87 lbs.
Evaporation of water per pound of oil, from and at 212 degs	13.50 lbs.
The oil analyses show a possible evaporation of water from and at 212 degs. of	20.64 lbs.

Taking 20.64 lbs. as the evaporative power of the oil and 15 lbs. as that of standard coal, the above evaporation is equivalent to 9.79 lbs. of water per pound of coal, from and at 212 degs.

Standard oil is considered to have an evaporative power, from and at 212 degs., of 22.00 lbs.

Cost per Horse-Power.

Cost of fuel oil for main engines, using steam of 1½ per cent. saturation, with fuel oil costing $0.0226 per gal., weighing 6 3-10 lbs. per gal., per day	$157.85
Cost of fuel oil for main engines, if using dry steam, and with condensation in main steam-pipe deducted	154.06
Cost of fuel oil for condensers, pumps and heaters	39.05
Cost of labor per day, exclusive of chief engineer and electrician	51.50
Cost of lubricating oil and waste [figures from office]	14.71
Total cost per day, exclusive of any water purchased	$263.11
Cost per hour of run	12.24
Cost per total horse-power per hour	0.0099
Cost per horse-power per hour on the line	0.01125

Cost of Power per Car Mile, per Car Hour, and per Passenger—Minneapolis, March 5, 1892 :

Total cost per day	$263.11
Total mileage [from auditor's office]	17,451
Cost per car mile	$0.0151
Total car hours	2,435.16
Cost per car hour	$0.108
Total number of passengers [auditor]	66,990
Cost per passenger	$0.00392

In comparing these figures with those obtained in the other tests, it should be remembered that the cost of heating the building and fuel oil is herein included.

TEST NO. 2—ST. PAUL, MARCH 23, 1892.

The plant at St. Paul consists of three tri-cylinder cross connected engines of similar design to those used in "Test No. 1," but with 48 inches stroke of pistons, and six Babcock & Wilcox boilers; two boilers, however, supplying the steam to the main engines exclusively, of similar dimensions to those used in "Test No. 1," and in all but a few cases, specially referred to, the conditions were the same as in "Test No. 1."

From the fly-wheel pulley on each of the engines two belts 40 inches wide run over 40-inch by 40-inch tightener pulleys, on the slack side of the belt, to pulleys 48 inches diameter by 40 inches face. These pulleys are on 6-inch shafts, making 540 revolutions per minute. Driven by each 48-inch by 40-inch pulley is a generator attached to the pulley shaft by two 6-arm clutches, by which they can be disconnected at will.

Pantographs were used, instead of the pendulum motion of "Test. No. 1."

No separators were used, and the steam piping was all overhead.

Summary of Results—Test No. 2, St. Paul.

Time of beginning test	4.40 A.M., March 23, 1892
Time of closing test	2.00 A.M., March 24, 1892
Duration of test	21 hours 20 minutes
Engines in use	Two tri-cylinder condensing Allis engines
Boilers in use	Nos. 1 and 2 Babcock & Wilcox
Total water evaporated	315,755 lbs.
Less 4-10 per cent. average moisture	308,177 lbs.
Less 1,748 lbs., collected from header	306,429 lbs.
Water collected from jackets	40,909 lbs.
Total dry steam used in engines [not including jackets]	265.520 lbs.
Total oil used	25,850 lbs.

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* Abstract of paper read at the Chicago Meeting of the American Society of Mechanical Engineers.

Average temperature of feed water	155 degs.
Average steam-pressure in boiler room	128 lbs.
Average temperature of flue gases	342 degs.
Average temperature of boiler room	77 degs.
Average draught in flue	$\frac{5}{8}$ inch.
Average height of barometer	28.64 inches
Average temperature of oil	66 degs.
Average moisture in steam	2 4-10 p. c.
Average temperature of injection water	41.3 degs.
Average revolutions per minute, engine No. 2	69.8
Average revolutions per minute, engine No. 3	69.4
Average horse-power, engine No. 2	418.47
Average horse-power, engine No. 3	427.53
Maximum horse-power at any time, engine No. 2, [6 20 P. M.]	822 3
Maximum horse-power at any time, engine No. 3 [8.00 P. M.]	807.0
Average total horse-power during run available. for car use	756.2
Average total horse-power used by condenser engines	11.51
Average total electric horse-power	694.7
Ratio of horse-power of condenser engines to horse-power of main engines	1 52-100 p. c.
Ratio of total steam used in jackets to steam used in cylinders	13 4-100 p. c.
Loss by friction between engines and line, obtained by taking difference between steam and electric horse-power	131.5 H. P.
Loss by friction in per cent	17 4-10 p. c.

It is believed that the loss in friction here given, as obtained by difference between mechanical and electrical horse-power, is too low, as it will be seen, by reference to the diagram, that during the early morning and late at night, when the engines are running light, the difference between the two is very small, and even occasionally minus. This, it seems to the writers, is due to the imperfect regulation of the engines, it appearing to be a fact that the steam required under these circumstances is admitted in occasional puffs, as the governor occasionally opens the admission valve too wide, then remaining nearly closed for a much longer period. In this way, the cards obtained would be likely, as a general thing, to indicate less power than the engines are really exerting, and hence the friction loss would generally appear less than it really is.

Several sets of friction cards have been taken from these engines since the test, giving a loss of about 137 H. P. to each engine and the line shaft and generators run by it. This would give as an average loss by friction for the whole run 258 H. P., or a little over 20 per cent., which amount will be used later in comparing these engines with those at the Thirty-first Street Station, Minneapolis.

Average water used in auxiliary boiler for condensers, pumps and atomizers, per hour, as evaporated	2,673.1 lbs.
Average water used in main engines, as evaporated, per hour, without jackets	12,447. lbs.
Steam used in cylinders, per horse-power per hour, as evaporated	16.46 lbs.
Steam used in cylinders, per horse-power per hour, from and at 212 degs	18.15 lbs.
Steam used in cylinders and jackets, per horse-power per hour, as evaporated	19.00 lbs.
Steam used in cylinders and jackets, per horse-power per hour, from and at 212 degs	20.95 lbs.
Evaporation of water per lb. of oil, as used	11.54 lbs.
Evaporation of water per lb. of oil, from and at 212 degs	12.73 lbs.

Cost per Horse-Power.

Cost of fuel oil for main engines, using steam of 2 4-10 per cent. saturation, with fuel oil costing $0.0226 per gallon, and weighing 6 3-10 lbs. per gallon, per day	$92.21
Cost of fuel oil for main engines, if using dry steam	90.00
Cost of fuel oil for condensers, pumps and atomizers	19.39
Cost of labor, exclusive of chief engineer and electrician	23.83
Cost of lubricating oil and waste [figures from office]	7.82
Total cost per day, exclusive of any water purchased	143.25
Cost per hour of run	6.71
Cost per total horse power per hour	0.00687
Cost per horse power on the line, per hour	0.01014

Cost of Power per Car Mile, per Car Hour, and per Passenger—St. Paul, March 23, 1892.

Total cost per day	$143.25
Total mileage [from auditor's office]	9,848.
Cost per mile	$0 01443
Total car hours	99,055.
Cost per car hour	$0.1446
Total number of passengers [auditor]	28,825.
Cost per passenger	$0.004969

TEST NO. 2*b*—ST. PAUL POWER HOUSE, MAY 12, 1892.

Object of Test:

This test was made to ascertain the steam consumption of the condenser engines used in tests No. 1 and No. 2. The steam from one Babcock & Wilcox boiler supplied the two condensing engines exclusively, and the water was weighed, as usual in these tests.

Duration of test, in hours	7.11
Total water used, as evaporated	7,859.00 lbs.
Moisture in steam	2 8-10 p. c.
Total dry steam, as evaporated	7,640.00 lbs.
Dry steam per hour, as evaporated	1,074 5 lbs.
Average total horse-power	14 03
Average temperature of feed water	160 degs.
Average pressure of steam	127.4 lbs.
Dry steam per horse-power per hour, as evaporated	76.58 lbs.
Dry steam per horse-power per hour, from and at 212 degs	88.14 lbs.

TEST NO. 2*c*, USING COAL — ST. PAUL, MINN., MARCH 28, 1892.

Average moisture in steam	4.8 p. c.
Total coal	35,750 lbs.
Total ash	2,451 lbs.
Coal burned	33,299 lbs.
Feed water	224,564 lbs.
Average temparature feed water	82.15 degs.
Average steam pressure	121.5 lbs.
Feed water, less 4.8 per cent	213,735.
Feed water, from and at 212 degs	250,769.8
Water per pound coal evaporated	6 4
Water per pound coal, from and at 212 degs	7.5
Extra cost over oil for labor per day, burning coal	$8.37
Extra cost during thirteen hours' run	$5.10
Cost of labor, lubricating oil, and waste as usual for thirteen hours' run	$19.29
Total cost of labor, lubricating oil and waste, burning coal thirteen hours	$24.39
Cost of coal at $4.85 per ton	86.69
Add proportion of coal for condensing engines, pumps and atomizers as evaporated	18.69
	$129.77
Cost to evaporate 1 lb. water	0.000423
Cost per indicated horse-power per hour	0 010659
Cost per average horse power on line	0.01294
Ratio of cost of power burning coal to cost burning oil 120 : 100, or coal cost more than oil	20 p.c.

Relative Cost of Power Burning Oil at $0.0226 per Gallon and Burning Coal at Prices Varying from $2.00 to $4.85 per Ton, Assuming an Evaporation from the Coal of $7\frac{1}{2}$ lbs. Water from and at 212 degs.

Coal at $2.00 per Ton.

Cost per horse power per hour	$0.005631
Saving over oil	37 1-10 p.c.

Coal at $2.25 per Ton.

Cost per horse-power per hour	$0.006099
Saving over oil	31 9-10 p.c.

Coal at $2.50 per Ton.

Cost per horse-power per hour	$0.00655
Saving over oil	26 9-10 p.c.

Coal at $3.00 per Ton.

Cost per horse power per hour	$0.007452
Saving over oil	16 7-10 p.c.

Coal at $3.50 per Ton.

Cost per horse-power per hour	$0.008354
Saving over oil	6 6-10 p.c.

Coal at $4.00 per Ton.

Cost per horse-power per hour	$0.009256
Cost above oil	3 4-10 p.c.

Coal at $4.50 per Ton.

Cost per horse-power per hour	$0.010158
Cost above oil	13 5 10 c.p.

Coal at $4.85 per Ton.

Cost per horse-power per hour	$0.01069
Cost above oil	19 5-10 p.c.

From these figures the relative economy of any coal, the evaporating power of which is known, can be computed.

For example, a coal which has an evaporating power of only $\frac{4}{5}$ of that stated would be equivalent to coal at $\frac{5}{4}$ the price.

Thus, if coal that can be bought for $2.00 per ton requires $1\frac{1}{4}$ tons to evaporate as much as (1) ton of Youghiogheny, it is equivalent to coal costing $2.50 per ton, or the saving over oil would be $26\frac{9}{10}$ per cent.

TEST NO. 2*d*—ST. PAUL POWER HOUSE, JULY 23, 1892.

Object of Test.

This test was made to ascertain the relative value of hard coal screenings (with about $2\frac{8}{10}$ per cent. of bituminous screenings) at $1.40 per ton, and oil at $0.0258 and $0.0261 per gallon; and to obtain the efficiency of the engine, when one engine was doing all the work, more generators having been added to each engine.

Duration of the Test.

The test began at 9.15 A.M. and closed at 7.15 P.M., a period of ten hours.

The boilers were in good condition and the fires left at the close in the same condition as at starting. Besides the observations taken in the boiler room, indicator diagrams were taken on the tri-cylinder condensing engine No. 3, which was furnishing power to the road; also ammeter readings to obtain the useful or electric horse-power.

Summary of Results.

Total water furnished boilers	201,928 lbs.
Percentage of moisture	2 66-100
Net water evaporated	196,582 lbs.
Average steam pressure	127 lbs.
Average temperature of feed water	178.4 degs.
Equivalent water from and at 212 degs	212,154 lbs.
Total coal consumed	34,318 lbs.
Water as evaporated per pound coal	5.72 lbs.
Equivalent water from and at 212 degs	6.18 lbs.

Indicator Records taken from 10 a. m. to 5.20 p. m.

Average horse-power for whole period	859.73
Total water for this period, less 2 66-100 moisture	138,695 lbs.
Water per hour	18,912 lbs.
Water as evaporated per horse-power per hour.	21.99 lbs.
Water from and at 212 degs. per horse-power per hour	23.74 lbs.

Period from 3.20 to 5.20.

Average horse-power	892.36
Total water evaporated	35,472 lbs.
Water as evaporated per horse-power per hour	20.42 lbs.
Water from and at 212 degs. per horse-power per hour	22.05 lbs.

Average Electrical Horse-Power.

From 10 A.M. to 5.20 P.M	737.35
From 3.20 to 5.20 P.M	812.20

Horse-Power Used in Friction: Obtained by Taking Three (3) Sets of Cards for Each Case.

No load on generators	164.43
Generators dead	187.51
Clutches thrown off	150.96
Per cent. of friction to total horse-power, 164.43 : 859.73	19.12 p. c.

It will be noticed in this connection that more horse-power is required after the "clutches are thrown off" than when the "generators are dead"; that is when the switch on the generator is thrown and no electricity is being generated. This feature has been observed so often that unless it be due to some effect of the magnetism of the fields the inertia of the moving parts will possibly be responsible.

Extra Help Required to Handle Coal.

Four firemen at $2.00 per day, per month	$240.00
Two coal-handlers at $55 00 per month	110.00
Extra per day	11.66
Extra per hour, 21 1-3 hours per day	0.55

Cost per Horse-Power per Hour.

34,318 lbs. coal, as above, at $1.40 per ton......per day	$24.02
Cost per hour for coal	2.40
Cost per hour for labor, as usual	1.12
Extra for labor, as above	.55
Waste and lubricating oil per hour	.36
Total cost per hour	$4.43
Cost per horse-power per hour	$0.00515
Cost per horse-power per hour, burning oil at $0.0261 per gallon, from Test No. 2	.009952
Saving over oil as above, when burning screenings	48 3-10 p.c.
Cost per horse-power burning oil at $0.0258 per gallon	$.00986
Saving	47 8-10

Effect on Efficiency of Running Engine Nearer its Rating than in Test No. 2.

Total water per horse-power per hour, including condensers, atomizers, etc., as above	23.74 lbs.
Total water for same, from Test No. 2	25.43 lbs.
Saving due to proper loading	6 7-10 p.c.

TEST NO. 2*e*—EFFECT OF STEAM-JACKETS ON STEAM CONSUMPTION.

On the 28th of March a run of 13 hours was made without steam in the jackets, and the total water consumed was 211,461 lbs., or an equivalent of 232,812 lbs. from and at 212 degs.

The average horse-power for the 13 hours was 1,018.6, giving consumption of water, as evaporated, 16.00 lbs. per horse-power per hour, or an equivalent of 17.62 lbs. from and at 212 degs., as compared with a consumption of 20.95 lbs. per horse-power per hour from and at 212 degs., with steam-jackets in operation, and the steam used therein charged up to the engine.

This shows that under those conditions the engines were more efficient by 15.54 per cent. without the jackets, and this accords with the observations of the engineers of the plant.

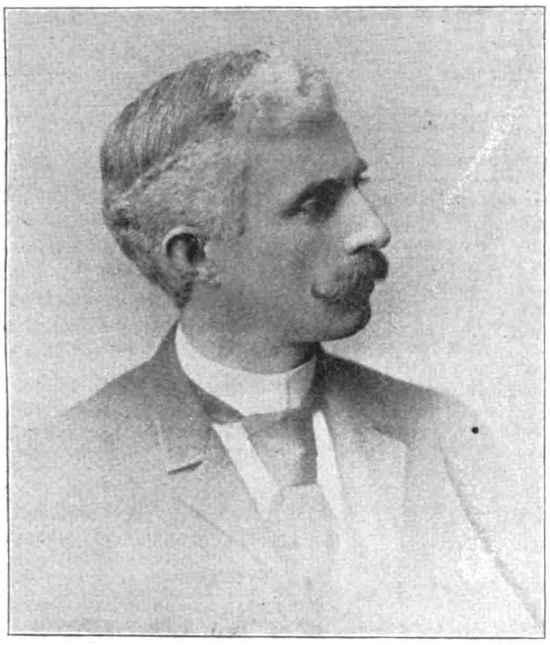
The only objection to these results is the fact that this test did not include the parts of a full day's run when the power was least, and therefore when the engines were least efficient. It is not believed, however, that this would overcome the difference stated above, and the conclusion is forced upon us that under the conditions as then existing the jackets are of no value.

The water of condensation from the steam-jackets was, at the Minneapolis plant, collected in barrels with one platform scale for each jacket, as it was considered possible by having two barrels to handle the water, and it was so done, but entailed considerable manual labor.

Profiting by this experience, a different plan was adopted at St. Paul, which worked perfectly. Two platform scales, each with a barrel on it, was provided for each jacket trap and so arranged that each could be filled separately; and after being weighed, the water was drawn off into a drain under the scales through a pipe and valve inserted in the bottom of the barrel, and while being emptied the other barrel was being filled. The time when each barrel began to receive water, when emptied, and the weight, was noted for each jacket.

With a tight cover on the barrels it was not thought necessary to use cold water to cool the jacket water, and it is not thought that the moisture contained in the slight amount of escaping steam would materially alter the result. Still, when it can be done, it will be found still more satisfactory to cool the water of condensation while being weighed.

(To be continued.)



William E. Nickerson.

Edward E. Cary.

Progressive Woonsocket.

A Large New Building to be Heated by Electricity.

The Woonsocket, R. I., Electric Machine and Power Company already have plans drawn for an imposing brick business structure to be located near the centre of the town. The building will be a two-story structure, 29 feet high. The front will be a pleasing combination of pressed and ornamental brick, copper trimmings, plate glass, handsome stores and imposing entrances, the building having a frontage of 143 feet and a depth of 35 feet.

There will be five stores in the lower story. The upper floor will be devoted to office uses.

The building will be heated throughout by electricity, and is probably the first large building in the State to adopt this method.

Movement for an Electrical Exchange in Cincinnati.

At a meeting of electrical engineers and contractors in Cincinnati last week, steps were taken to organize an electrical exchange in that city. A temporary organization was effected by the election of A. J. Baker as president, and D. J. Hauss as secretary. The secretary was instructed to open correspondence with several Eastern cities where exchanges are already established.

The "New Beacon" Lamp.

The Beacon Vacuum Pump and Electrical Company of Boston, which was engaged in the manufacture of the "Beacon" incandescent lamp until restrained by an injunction granted last February, after a most plucky fight against the General Electric Company, is again to the front offering a new lamp which the makers claim is entirely free from any feature that can be construed into an infringement of any existing lamp whatsoever.

It has been named the "New Beacon" in perpetuation of the title that had become so well known.

In this new lamp the enclosing globe is not made entirely of glass, inasmuch as no glass is used in closing the neck of the lamps, neither do the leading-in wires pass through the glass. These lamps are giving great satisfaction, being already in extensive use.

The "New Beacon," it is claimed by the company, has not been devised merely for the purpose of evading existing patents, but possesses such merits that the company would not now revert to the manufacture of the old style lamps were it free to do so.

No platinum is used in the construction of the "New Beacon." The cost of manufacture is reported less than that of the lamps it supersedes, and it is particularly neat in design.

The Beacon Company is confident in its belief that in its new lamp it has a device against which the charge of infringement cannot be reasonably brought in view of the decisions of the courts up to date.

Having thus produced such an efficient lamp, the Beacon Company has signified its willingness to license other manufacturers to make this new and improved lamp on a basis that will enable them to manufacture—royalty added—at a less cost than the Edison type can now be made, at the same time assuring such manufacturers that their output would be greater than now with the same facilities.

The "New Beacon" lamp is the joint invention of William E. Nickerson and Edward E. Cary, the former the mechanical and chemical expert, the latter the electrical expert of the Beacon Company, and from these joint inventors the company has acquired control of the patent rights, which are said to be comprehensive and controlling.

Inventors of the "New Beacon" Lamp.

Mr. William Emery Nickerson.

The entire electrical fraternity will feel a lively interest in the "New Beacon," and cannot fail to have a desire to get some personal information about the inventors. In the hope of gratifying that wish, we publish herewith portraits of the two gentlemen.

William Emery Nickerson comes of good old New England stock, being born in Provincetown, at the extreme end of Cape Cod, Mass., November 5, 1853.

His earliest school education was obtained in that town, graduating from the High School at a comparatively early age. He subsequently attended classes at the Massachusetts Institute of Technology, where he graduated in 1876 in the Department of Chemistry.

For several years Mr. Nickerson filled the position of Instructor in the Chemical Laboratory of that institution, and was private assistant to Professor Nichols, now deceased, for whom he did a large amount of work on the analyses of water from many different parts of Massachusetts and of air from schools, prisons and railway trains, in the interest of the State Board of Health.

During the years 1877-1886 Mr. Nickerson gained a high reputation among the leather manufacturers of Boston and surrounding districts as an expert in matters pertaining to the leaching of tan bark, the estimating of tannic acid, and other matters incidental to the manufacture of fine leather in its purely scientific aspects.

Although educated as a chemist he has had a wide and varied experience in applied mechanics, having designed and built a number of machines and mechanical appliances for various purposes.

Much attention has been given by Mr. Nickerson to inventions and improvements, so it is not surprising that his name appears more than a hundred times in the list of American patentees. He is quite familiar with Patent Office practice, and always prepares his own patent specifications as well as many for intimate friends, he being well known for his unusual success in drawing specifications and claims which thoroughly define and cover the invention.

It was this gentleman who discovered the principles on which the non-mercurial vacuum pump of the Beacon Company operates, and he is the perfecter and chief inventor of that now well-known machine.

The Beacon Company relies on Mr. Nickerson's genius and skill principally for the solution of its mechanical and chemical problems He does not claim to be an electrician, yet he is exceedingly well posted in many electrical matters.

He is an inventor by nature, his genius constantly running in the direction of producing something new and better in the industrial arts.

Mr. Edward E. Cary.

Edward E. Cary, who, in conjunction with Mr. Nickerson, has evolved the "New Beacon" lamp, first saw the light in Albany, N. Y., February, 1866. His early life was passed in New York City and Brooklyn. In 1884 he graduated from the Brooklyn Polytechnic Institute, and was during 1883-1885 private assistant to Professor Robert Spice, of Brooklyn. The following three years Mr. Cary acted as assistant in Mr. Edward Weston's laboratory at Newark, N. J. In 1888 Mr. Cary identified himself with the Westinghouse Electric Company, and spent three years in the lamp factory of that company at Pittsburgh. During 1891 he was engaged on special filament work in the factory of the Westinghouse Electric Company, at that time located on Twenty-third street, New York City. While thus employed he saw an opportunity for future advancement with the Beacon Vacuum Pump and Electrical Company of Boston, and accepted a flattering offer from that company to take charge of its lamp manufacturing department, a position he still holds.

Mr. Cary, though still quite young in years, has had an unusually fine experience in the art of incandescent lamp making; indeed, he is esteemed as one having no superior in the manipulation of incandescent filaments, his natural talent, thorough education, and wide and varied experience having made him complete master of the art. The standard of excellence attained by the "Beacon" lamp was due in no slight degree to the high-class work done in his special department.

The "New Beacon" lamp is being manufactured with filaments made under Mr. Cary's direction, and as the bulbs are exhausted on the patented pumps owned by the Beacon Company, no further guarantee would appear to be necessary to assure the public that the "New Beacon" will prove an important factor in the situation.

Description of the "New Beacon" Lamp.

The accompanying diagram shows the general construction of the "New Beacon" lamp, and careful reference to the cut and following description will show that the glass globe of the lamp A is provided with a shoulder at B upon which rests a thin disk of mica C. The disk serves as a support for a body of cement D, the composition of which is not disclosed, which is poured, in a fused state, upon it, and completely fills the upper part of the neck of the lamp. This cement is of a novel composition and is not only absolutely impervious to air itself, but makes an equally air tight union or joint with the glass surface of the lamp neck. It is able to withstand the temperature to which it is subjected in the operating lamp without leaking or giving off any gases or vapor whatsoever. It achieves results which although often sought have never before been accomplished. The leading-in wires E E, which are of iron throughout, pass through this cement and through the mica disk C, but nowhere touching the glass of the enclosing globe, and are connected with the filament or burner F at G G. A second disk of mica H is located within the neck of the lamp globe and rests upon the shoulder K. The disk H acts as a reflector, and throws back the heat of the filament, thereby keeping the cement plug from being affected.

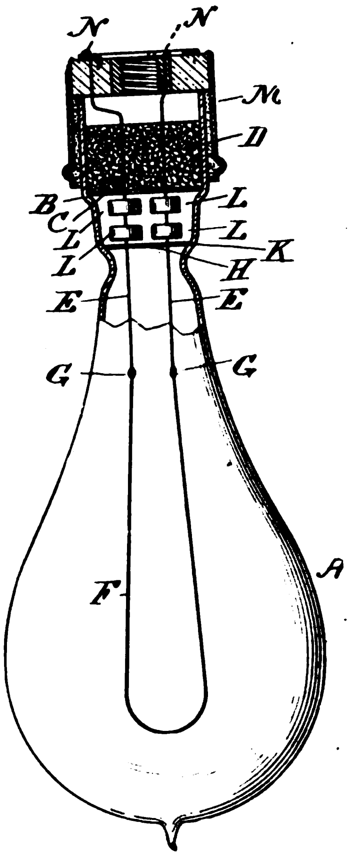
Upon the leading-in wires between the two mica disks are placed small bodies of metal L L L L, called radiators. They are so called because they take up the heat of the leading-in wires and disperse it by radiation, preventing it from being carried into the cement plug. They are a very neat and effective device for the purpose which they accomplish.

The lamp neck is surmounted by a cap or base M of the ordinary kind, fastened in place by plaster of Paris, and to which the leading-in wires are attached by soldering at N N.

While the lamp is burning the cap and socket are nearly as cool as when it is not in operation, a phenomenon not known in other lamps, and the candle power holds up in the same remarkable manner as it did in the old "Beacon" lamp.

The new lamp cannot be excelled for cheapness of manufacture, and with its unsurpassed qualities can scarcely fail to become a popular favorite.

The inventors as well as the Beacon Company are justly proud of the achievement, and believe that they have very nearly attained perfection in the development of an economical and efficient lamp of the modern incandescent type.



The New Beacon Lamp.

Boston Notes.

The dispute between the Old Colony Railway and the Abington and Rockland Electrical Street Railway Companies as to the right to lay tracks across the railway assumed a decidedly sanguinary turn on Wednesday afternoon. Early this week the Old Colony Company engaged nearly 200 Hungarians, Poles and Italians, and kept them in cars near the scene of action under command of an official who had orders to prevent the men employed by the Electric Railway Company from laying tracks across the steam road. Wednesday morning work began and so did the battle, in which nearly 300 men took part. It was no silk-glove fight either, for picks, shovels, axes, clubs, stones and finally revolvers were freely used; some ugly blows were given and received, frightful gashes were made in heads, faces and limbs, the officials having to be carried from the field half killed; blood flowed copiously on both sides and a police force had to be sent from Boston, 19 miles away, to quell the riot. The local hose companies, however, did valiant work in allaying the excitement, for they were summoned to the scene and turned on several powerful streams of water which soon cooled the ardor and courage of the belligerents on both sides. The selectmen of Abington ordered the acting officials of the Old Colony to be arrested, and they were bailed out by the company. Over a dozen men were seriously injured, the doctors being kept busy during and after the melee. Much property was also damaged. The question of who has the right on its side will now be settled by the courts.

The chief offices of the General Electric Company in this city now have a forlorn and somewhat empty aspect about them, as much of the furniture and the clerical staff has been removed to New York, or dispensed with entirely. At the Lynn factories, too, there is a tired feeling apparent, for about one-half the entire staff of workmen have been laid off, those that remain working only three days a week. Under these circumstances, as may be imagined, there is a gloominess prevailing that is decidedly unpleasant, and everybody is wondering what the end will be. Unfortunately for the company so many misleading and contradictory reports have been allowed to issue and be reported that the public now declines to give credence to anything and everything that is either said or printed, it having been painfully realized that "there is a lying spirit abroad." For the sake of the vast number of employees thrown out of work, at any rate, it is generally hoped that a change for the better may take place ere long in the business of this mammoth concern.

The customers of the Malden and Melrose Gas Light Company have petitioned the State Board of Gas and Electric Commissioners with a view to compelling a reduction in charges.

Should the experiments now being made to purify water by electricity at Brewsters, N. Y., prove successful, the system will be adopted for purifying that part of Boston's water supply that is taken from the Mystic River.

The Woburn Electric Light Company, which does extensive business in supplying light and power to several towns and cities and owns a very fine plant, is in a peculiar predicament, its plant having been advertised for sale at auction on Sept. 6, under a foreclosure of mortgage held by Dr. John M. Harlow, of Woburn. The mortgage is said to be for $35,000, the interest on which is long past due.

Suit has been begun at New Haven, Conn., by the General Electric Company against the Winchester Avenue Street Railway Company of New Haven, for damages and profits arising out of the use of a trolley feed wire the patent on which the plaintiff company claims belongs to it exclusively.

The city of Lynn and town of Wakefield will soon be connected by an electric street railway. It will form part of the Lynn and Boston system.

The committee appointed by the City Council of Lynn has formulated an ordinance providing for the placing of all telegraph, telephone and electric light wires underground in that city.

The Maine Street Railway Association was formed in Portland, Me., on Tuesday last, its members including representatives of the ten street railway companies now in operation in that State. Mr. W. B. Wood, of Portland, was appointed president, and Mr. Newman, of that city, secretary and treasurer. The association will take care of the legal and other interests of the different roads.

The incandescent lamp department of the General Electric Company is to be removed from Lynn to Harrison, N. J., and be there included in the former Edison plant.

The Boston and Maine Railroad Company is said to be negotiating with certain electric street railway companies in Maine for the purchase of their roads, with a view to extending them and connecting them with the steam railways at various points, where they will act as feeders.

Mr. Henry Kaliske, the wide-awake manager of the Beacon Vacuum Pump and Electrical Company, reports that the demand for the "New Beacon" lamp is already assuming more than satisfactory proportions. The lamp is now in extensive use and giving unbounded satisfaction. A reason why the lamp was not put on the market earlier was a desire on the part of the company to make every possible test in the laboratory and factory that would prove the efficiency of their new lamp, preferring to defer its introduction to the public until there was not a shadow of doubt remaining that it was as perfect as a lamp could possibly be made.

General News.

What is Going on in the Electrical World.

Omaha, Neb.—The Albright horse car line is to be changed into an electric line.

Syracuse, N. Y.—The Salina street car line will discard horses for electricity after September 4.

Jamaica, L. I.—The trustees of the village have been visiting Hempstead and other places to investigate their arc lighting systems with a view to the introduction of electric light in this village.

Shenandoah, Pa.—The Schuylkill Traction Company expect to have that part of their system lying between Shenandoah and Mahanoy City finished and in operation by the middle of October.

Passaic, N. J.—Nearly two miles of the track has been laid between the county bridge at Passaic and Carlstadt for the new electric railway in that section. The work is being pushed as rapidly as possible.

Bordentown, N. J.—The city councilmen are considering the question of erecting an electric light plant for arc and incandescent lighting of the city and dwellings, and furnishing power to manufacturers.

Dubuque, Iowa.—The Dubuque Light and Traction Company promise to improve their present equipment by additions and otherwise, so as to give the public a street car service that will be satisfactory.

Atchison, Kan.—There is no longer any doubt of the construction of the electric railway. The council has passed the necessary ordinances and a site for the power house has been purchased. Work will begin at once.

Tonawanda, N.Y.—The village council intends to bring proceedings against the Buffalo, North Main Street and Tonawanda Electric Railroad Company to compel them to fulfil the conditions of their franchise.

Dunkirk, N. Y.—As the injunction which prevented the city from putting in the incandescent system of lighting has been removed by the courts, the Water Board, to whom the matter is entrusted, is now at liberty to go on with this municipal enterprise.

Washington, D. C.—Two receivers have been appointed for the Potomac Electric Company—J. G. Darlington at Georgetown, and C. C. Carlin on the Virginia side—the plant and power house being in Alexandria County, Va., and the wires of the company in Georgetown.

Detroit, Mich.—Hereafter all firms which string lighting wires in the streets will have to secure a permit from the city electrician. There are fifteen firms in the city altogether in that kind of business, and a notice has been sent to each embodying certain provisions of the city charter in regard to the supervision to be exercised by the lighting commission.

New Haven, Conn.—The wiring of the Whitney avenue and State street roads is nearly finished, and all that now remains to be done is to stretch the trolley wires. The electric cars will be running before the first of December. The company will begin at once to lay the rails through Lombard and Ferry streets in Fair Haven and then equip that branch of the road.

Milwaukee.—At a meeting of the directors and stockholders held a few days ago a change in the motive power of the Milwaukee and Wauwatosa motor line, was strongly advocated, and will probably be made. The cost of changing the line from steam to electricity, with equipments complete, will be in the neighborhood of $6,000. The company has been talking of making the change for some time.

Louisville, Ky.—The electric suburban service of the Kentucky and Indiana Bridge Company has just been put into operation. Although there is but a single track on the bridge a schedule has been made out to pass over it 565 trains a day, 200 of which are electric suburban trains and the remainder steam trains. The electric trains have two twenty-five horse-power motors each, and are mounted on double steel trucks.

Haverhill, Mass.—An electric railroad scheme is being considered here, connecting Haverhill with Nashua, N. H. It would be a trunk line, with power station at Salem Depot, and branch lines extending to Manchester, Lowell, Lawrence, Chester and desirable points, also a continuation of the line through Winter street in Haverhill to West Newbury and Newburyport. Near Salem Depot are two lakes of great beauty, and the lands around them might easily be made attractive pleasure grounds for the people of the Merrimack Valley.

Evans, Iowa.—The American Coal Company is putting in an electric underground haulage system. The plant includes one 100 horse-power automatic Ide engine, one thirty horse-power and two fifteen horse-power motors and 11,000 feet of trolley wire. When completed this will be the largest plant of its class in Iowa or the West. The daily output of the company will be upwards of 1,600 tons. The haulways of the mines extend over two miles. The plant will have cost when ready for operation over $30,000.

San Diego, Cal.—The San Diego Electric Street Railway Company continues to make additions to the system in spite of dull times. The steam motor which has heretofore supplied means of transit between the ferry and Hotel del Coronado, has been taken off, and the track prepared for electric cars. Poles are being erected and wires stretched, and in a couple of weeks cars between the ferry and hotel will be run by electricity transmitted under the bay from the electric power-house on the San Diego side.

Easton, Pa.—H. S. Cavanaugh, of Easton, counsel for the Philadelphia and Allentown Electric Trunk Railway Company, chartered recently with a capital of $1,000,000, has notified the department of internal affairs at Harrisburg that the whole project had been abandoned because of the lack of funds needed for construction. Mr. Cavanaugh says no part of the road has been or will be built, and that all franchises acquired by the company have become void. It is understood that ex-Mayor Grace, of New York; Thomas J. Swift, of Poughkeepsie; ex-Sheriff Fulmer, of Easton, and others were interested in the project.

Norristown, Pa.—The Norristown Passenger Railway Company were serenaded by the Germanic Band in honor of the introduction of the trolley system in the city. The serenade was given at the Taylor House.—Application was made to the borough council for permission to lay electric railway tracks in several streets here as a part of the proposed line to Philadelphia via Newtown Square, and for which a charter has already been granted with W. J. Fell as president. The charter includes a number of points, namely: Wilmington, Glen Loch, Exton and Kennet Square. The projectors agree to complete and operate the line within two years.

COMMERCIAL PARAGRAPHS.

The interesting World's Fair exhibit of the New England Butt Company of Providence, recently described in Electricity, is attracting throngs of visitors, to many of whom this class of machines is a revelation.

The Standard Electric Company of Chicago, which secured a large slice of the contract for lighting the Fair, has in addition to its service plant an attractive exhibit in the Electricity Building. The machines built by this company are in keeping with its name, as they are in reality Standard Arc Machines.

Mr. W. R. Brixey, manufacturer of Day's Kerite wires and cables, is sending to his customers the Official Catalogue of the Exhibits in the Electricity Building.

The Weston Standard Instruments have naturally been selected by the Jury of Awards at the Fair for making all tests of electrical apparatus.

INCORPORATIONS.

Dr. F. C. Miller, of Tacoma, Wash., Henry Raymond and Eugene H. Lewis, of Portland, Ore., have filed articles of incorporation of the Tacoma Mining and Milling Company. The head office is located in Tacoma. The capital stock is $1,000,000. The trustees for the first six months are Dr. C. Miller, Henry Raymond, Eugene H. Lewis, W. F. Sargent and John S. Stansbury. The company proposes to smelt the iron ore located on the ocean beach near Gray's Harbor by the electrical process of the B. L. and A. Reduction Company.

The Turner Zephyr Stove Company, Indianapolis, Ind.—to trade in natural and artificial gas, electricity and machinery for accomplishing said business, etc. Capital stock, $20,000. Promoters: A. F. Kleinschmidt, Wm. Henry Turner, Wm. Hyde Turner, Indianapolis.

The Domestic Electric Power and Light Company of Baltimore City is the name given to a company recently formed in Baltimore for the purpose of manufacturing and selling Hanson's primary battery, of which Walter Hanson, of England, is the patentee. The company is capitalized at $50,000.

The Telluride Electric Light Company has filed with the Secretary of State of Colorado a certificate amending its articles of incorporation so as to provide for a board of five directors, consisting of R. F. Wrigley, C. W. Corbin, H. R. Woodall, S. R. Fitzgarrald and Wm. Story, and allow the operations of the company to be carried on in San Miguel County.

Las Animas Light, Power and Manufacturing Company, Trinidad, Col.—to increase the lighting facilities of the town of Trinidad, etc. Capital stock, $100,000. Incorporators and directors: Thomas B. Stearns, J. T. Eskridge, Charles F. Lacombe, Henry W. Hobson and Edmund C. Lockwood.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JULY 25, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

501,968. Electric Railway Trolley. Elmer A. Sperry, Chicago, Ill., assignor to the Sperry Electric Railway Company, Cleveland, Ohio. Filed April 1, 1892.

502,058. Sanding Device for Cars. Nicholas Seibert, Boston, assignor, by direct and mesne assignments, of nineteen twenty-fifths to George F. Malcolm, Allston, and Oliver Eliot Simmons and Siegmund Leipziger, Boston, Mass. Filed Nov. 3, 1892.

502,088. Trolley Wire and Hanger. Earl P. Wetmore, Helena, Mont. Filed Dec. 23, 1892.

502,216. Conduit System for Electric Railways. Frank Wynne, London, England. Filed April 3, 1891.

502,229. Connector for Track Circuits. Edward H. Goodman, Pittsburg, assignor to the Union Switch and Signal Company, Swissvale, Pa. Filed Nov. 1, 1892.

502,243. Electric Railway Trolley. Charles J. Van Depoele, Lynn; Albert Wahl and Charles A. Coffin, executors of said Van Depoele, deceased, assignors to the Thomson-Houston Electric Company, Boston, Mass. Filed Aug. 9, 1888.

ELECTRIC LIGHTS AND APPLIANCES.

501,911. Carbon Holder for Electric-Arc Lamps. Sigmund Bergmann, New York, N. Y. Filed Oct. 22, 1892.

501,988. Carbon Holder for Electric-Arc Lamps. Frederic D. Hazelton, New York, N. Y., assignor to Sigmund Bergmann, same place. Filed Jan. 10, 1893.

502,166. Electric-Arc Lamp. Patrick J. Barrett, Boston, Mass., assignor of one-half to John J. Frawley, as president of the Boston Society of Redemptorist Fathers, same place. Filed April 5, 1893.

DYNAMOS, MOTORS, ETC.

501,961. Means for Regulating Electric Motors. Charles H. Richardson, Philadelphia, Pa., assignor to the S. S. White Dental Manufacturing Company, same place. Filed Jan. 16, 1893.

502,020. Electric Locomotive. Elmer A. Sperry, Chicago, Ill., assignor to the Sperry Electric Railway Company, Cleveland, Ohio. Filed Oct. 23, 1891.

502,098. Electric Motor for Rotary Drilling Machines. Robert M. Jones, Salt Lake City, Utah. Filed Dec. 22, 1892.

TELEPHONE AND TELEGRAPH APPARATUS.

502,091. System of Telephonic Intercommunication. Frank R. Colvin, New York, N. Y. Filed Oct. 15, 1892.

502,262. Telephone Cable. William R. Patterson, Chicago, Ill., assignor to the Western Electric Company, same place. Filed July 30, 1892.

MEASURING INSTRUMENTS.

502,022. Electric Measuring Instrument. Elihu Thomson, Swampscott, assignor to the General Electric Company, Boston, Mass. Filed Feb. 17, 1893.

502,077. Electrical Measuring Instrument. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company of Connecticut. Filed March 28, 1893.

SIGNALS AND SIGNALING APPARATUS.

502,207. Electric Signal for Fire-Alarms. Joseph Sachs, New York, N. Y. Filed April 10, 1893.

ELECTROLYTIC APPARATUS.

501,996. Electrolytic Bath. Stephen H. Emmens, London, England. Filed June 17, 1889.

501,997. Apparatus for the Electrolytic Extraction of Metals. Stephen H. Emmens, London, England. Filed July 18, 1889.

MISCELLANEOUS.

501,960. Commutator-Brush. Henry G. Reist, Lynn, assignor to the General Electric Company, Boston, Mass. Filed March 15, 1893.

502,007. Illuminated Sign. Arthur L. McCormick, Port Huron, Mich. Filed Feb. 17, 1893.

502,040. Rheostat. Charles A. Hussey, New York, N. Y. Filed May 23, 1892.

502,083. Junction-Box. Edward J. McEvoy, New York, N. Y., assignor of one-half to the William Cramp & Sons Ship and Engine Building Company, Philadelphia, Pa. Filed Jan. 3, 1893.

502,103. Musical Instrument. Konstantin Polenoff, Nishue Taguilsk, Russia. Filed Sept. 7, 1891.

502,104. Electric Switching Apparatus. Arthur R. Roe, Duluth, Minn., assignor of one-half to George J. Northrop, Marquette, Mich. Filed Sept. 24, 1892.

502,105. Electric Switching Apparatus. Arthur R. Roe, Duluth, Minn. Filed Oct. 28, 1892.

502,156. Self-Winding and Synchronizing Clock. Arthur G. Wiseman, St. Louis, Mo. Filed Oct. 28, 1892.

502,157. Electric-Clock Synchronizer. Arthur G. Wiseman, Webster Grove, Mo. Filed April 29, 1892. Renewed March 24, 1893.

502,215. Electric Winding Attachment for Clocks. Arthur G. Wiseman, St. Louis, Mo. Filed July 30, 1892.

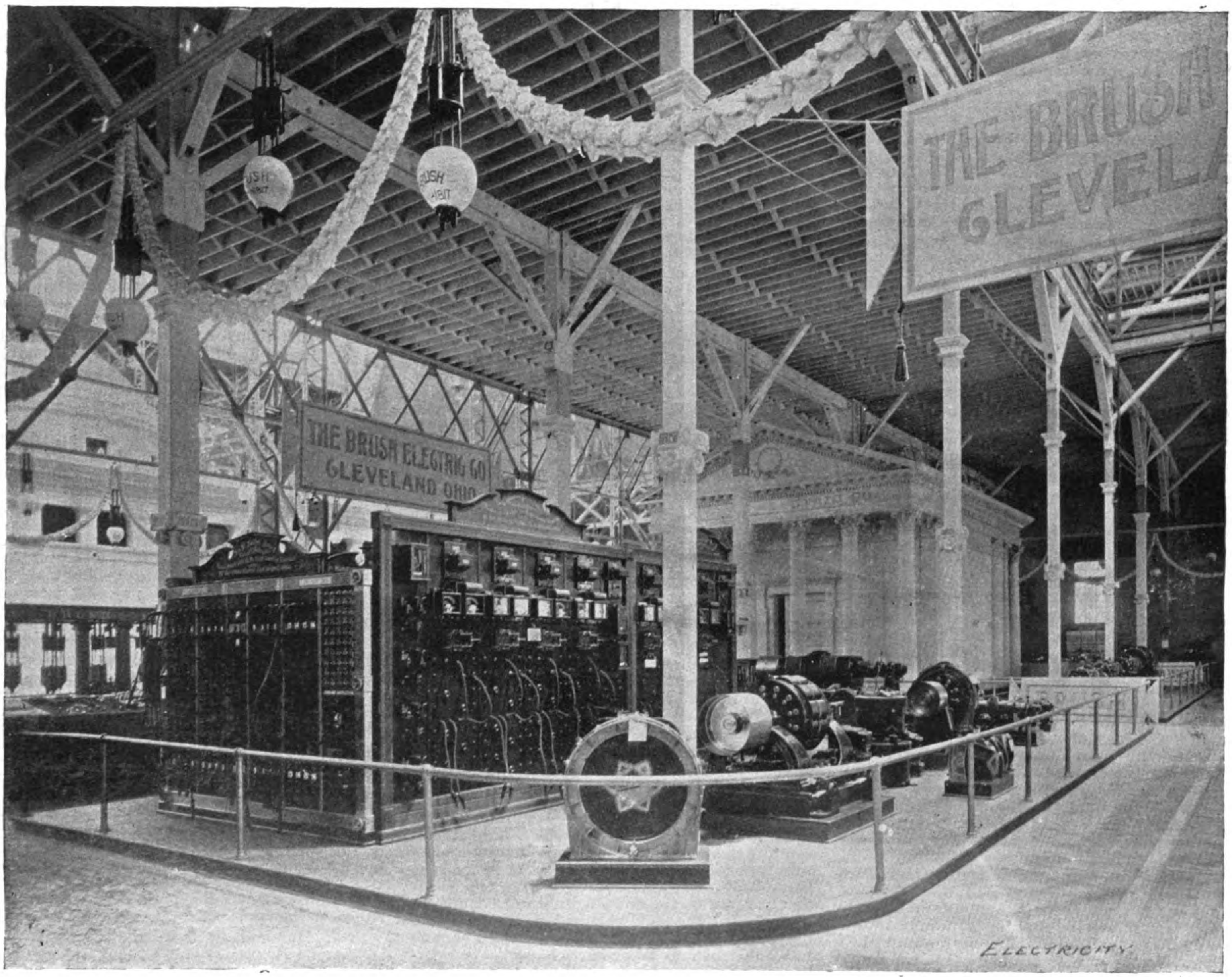
502,246. Combined Phonograph and Coin Operated Mechanism. William S. Burnett, Milwaukee, Wis. Filed Aug. 18, 1890.

RE-ISSUE.

11,354. Dynamo or Motor. Ralston C. Kintzing, Brooklyn, N. Y., assignor to the Crocker-Wheeler Electric Company of New Jersey. Filed Jan. 25, 1893. Original No. 470,057, dated March 1, 1892.

ELECTRICITY.

VOL. V. NEW YORK. AUGUST 30, 1893. CHICAGO. No. 7



THE BRUSH ELECTRIC COMPANY'S WORLD'S FAIR EXHIBIT (SEE PAGE 83.)

WORLD'S ELECTRICIANS.

The International Electrical Congress in Session at Chicago.

A NEW EPOCH IN THE PROGRESS OF THE ART.

Synopsis of Proceedings That Will Be of Historic Importance.

ORGANIZATION AND ELECTION OF OFFICERS.

MONDAY, AUGUST 21.

About 2 o'clock P. M. the Art Institute in Chicago was thronged with electricians of almost every nationality, who could be distinguished by a small ribbon badge with the inscription "International Electrical Congress, Chicago, 1893," which decorated the coats of all the members.

At 3:15 Dr. Elisha Gray, chairman of the Committee on Organization, accompanied by Dr. von Helmholtz, ascended the platform in the Hall of Columbus, and was followed by the United States and foreign delegates, and after calling the meeting to order Prof. Gray made a short address, in which he said in substance:

I esteem it an honor of the highest distinction to be permitted to call this International Congress of Electricians to order, coming as you do from all parts of the world, and distinguished, as many of you are, for your contributions to the world's progress through the medium of science, theoretical and applied.

The time and place for the assembling of this Congress are both most opportune. Men who represent the best thought and the best work of the world are here. The scientists who seek to unlock the secrets of nature, and open up to man new fields for research, and further add to the sum of the world's knowledge, are here.

We have here to day men who represent almost every phase of electrical work; men who come from the school, the college, the university, the laboratory of the scientist, and from the commercial walks of life. And then we have with us that other much abused but necessary citizen, the inventor, the man who is, in some degree, a combination of all the rest, and is the product of daylight toil and midnight oil. It is fitting that these varied capacities should come together in a great convention like this.

The rapid strides that have been made in electrical science and electrical invention in the last twenty-five years have marked a new era in our civilization, and this age may well be denominated the Electric Age. Who knows what the next quarter of a century will bring to us through the medium of electricity? To some people it seems as if the limit were nearly reached; but who knows?

The grand results that have thus far been attained were not accomplished by any one nation or individual. We, as Americans, are proud of our native land—the land of Franklin, Morse and Henry; but we are also proud of our fatherland, and we believe that the fatherland is just a little proud of us—although we neither of us say this too often or too loud. The fatherland of America is all the civilized world outside of its own borders. We are proud of an ancestry from which sprang such men as Faraday and Lord Kelvin; such men as Ampere and De la Rive; such men as Galvani and Volta; and last but not least, we are proud of an ancestry that produces such men as our honored guest—Dr. von Helmholtz.

My work as head of the Organizing Committee ends here, and I now surrender this Congress into your hands, feeling assured in advance that the work will be well done; for bad work coming from such an able and distinguished body of men as this is would be an incongruity that is unthinkable.

Upon the conclusion of Prof. Gray's address, Mr. William H. Preece, of London, proposed for temporary chairman the name of Prof. Elihu Thomson, who was unanimously elected. In accepting the nomination he addressed the Congress briefly, after which, on motion of Prof. Cross, Prof. F. B. Crocker was unanimously elected temporary secretary of the Congress.

The next business was the appointment of a Committee on Permanent Organization, and in accordance with the suggestion of the chairman, the following gentlemen were unanimously appointed on this committee:

Dr. T. C. Mendenhall, Washington, D. C.; Prof. Benjamin F. Thomas, Columbus, Ohio; Dr. Louis Duncan, Baltimore, Md.; Dr. S. P. Thompson, England; Prof. E. Hospitalier, France; Dr. A. Lindeck, Germany; Dr. A. Pallaz, Switzerland.

Prof. Thomson then called upon Prof. William E. Ayrton of London, England, who was received with warm applause as he came forward to respond. He addressed the Congress as follows:

There is one thing, ladies and gentlemen, which I certainly am not, which Prof. Thomson has told you I was—namely, a foreigner; for no Englishman can possibly be a foreigner in America.

In asking me to say a few words about a stranger's—not a foreigner's—impression of the electrical display at the Exposition, I imagine that the Committee of the Congress considered it was desirable to precede the more solid meal of mathematical technicalities which we electricians are compelled to feed upon by something a little light; and, therefore, it has fallen upon me to supply the radishes and the caviare which form the first course of the intellectual banquet which the committee have provided for you.

In order that one may judge of this country, it is most important to free oneself from the conservative prejudices so common in an inhabitant of the Old World. I have, therefore, endeavored as far as lay in my power to look upon things here with an open mind. If by chance any of my conclusions may seem a little pointed, I ask you to remember that caviare is made intentionally a little piquant to stimulate your appetite for the more solid dishes that will follow.

Chicago is a long way from the sea, and therefore a vast territory has to be crossed before one can get here. The stranger's impressions of the electrical display of America begin to be formed long before he arrives at the White City. The glow-lamps which he sees lighting even your scattered houses, the arc lamps which he sees burning in your country lanes, the electrical tramways rapidly carrying the working population of your cities into healthy suburbs in the evening when their day's work is over—all these fill the stranger with admiration, and he feels pleased to know that you have no Board of Trade to control your affairs. However, when in a city like Baltimore he finds that the roads which are destined to become electric have been converted into Alpine mountain passes by the construction of electric tramways, when he sees jumbled up in the same posts, telephone, telegraph and high pressure electric light wires, sometimes with insulation a little defective, he becomes reconciled again to the dominion of Whitehall, and he takes comfort to himself in the thought that high pressure transformers are not stuck like flies on the house-walls in his own country. When he learns that the load on the down-town electric mains in New York is at a maximum at 2 in the afternoon, his mouth waters at such a paying load-line, and he would rush to take shares in such a prosperous undertaking except for the recollection that one or a ten per cent. dividend comes to much the same thing when there is no currency whatever to pay the dividend declared. In Pittsburg, Cleveland, Lynn and Schenectady, the stranger is much astonished at the courtesy with which he is shown every detail in a factory as well as at the magnitude of the undertakings. His expectations are roused to such a pitch that he expects when he gets here in Chicago to find an electrical display which will cast all previous electrical exhibitions into the shade.

Well, take this stranger into the Electrical Building blindfolded, so that his judgment may not be warped by the glories of the outside surroundings and leave him there for awhile, if he be candid and if he can muster up courage to say a word which might cause pain to those whose kindness has made them dear to him, he will say that he is a little disappointed. He is disappointed that the world has not better answered the invitation to show in Electricity Building what it could do. If he is an Englishman, he is not only disappointed but rather ashamed of his country. Even looking at the Electricity Building from a purely American standpoint, if you will allow me to say so, I do not think the exhibits inside quite do this country justice. We have all heard of the arrangements that are being made to utilize 300,000 horse-power at Niagara, the greatest engineering feat probably that the world has ever seen; but in the exhibition I think I am right in saying that not a model or a plan can one find of the work that this country is doing, and which will when accomplished redound to its praise. It might seem a small thing, compared with that, to transmit a little over a hundred horse-power 109 miles with a commercial efficiency of 75 per cent.; but at Frankfort the stranger really did see that done; and although that was but a small thing compared with what America is doing at Niagara, one would like to have seen something on the spot. In other words the stranger feels that the real electrical display of America is not in Electricity Building, but in every street where there are trolley wires, in every town and village where there are electric lamps; and where is the town in this country where there are none?

But, if the stranger be thoughtful, he is not disappointed. At Frankfort it was what was inside the Electrical Building that dazzled his mind. At Jackson Park it is what is outside the Electrical Building that rivets his attention One feared that the bustle and hurry of this country would not allow time for the appearance in the programme of its development the cultivation of those charms that Americans come to Europe to witness; but when I saw your Exhibition, when from the top of the Manufactures Building I looked down at night on that "Court of Honor," on that tracery of electric lamps, more beautiful in its realization than could have been even the dream of the writer of the "Arabian Nights," then I felt sure that in that great living hospitable heart which throbs in the breasts of the all-practical, go-ahead people of this country, there must be some nook where lurks the belief that powerful as is machinery, all-powerful as is electricity, the song, the poem, the echo of the statue that lives when the bones of its creator have crumbled into dust, are even more powerful still in forming the history of humanity.

But your Exhibition makes me hope that the love of art and beauty for their own sakes, which we have hitherto regarded as the heritage of poor and oppressed races like those of Italy, Hungary and Russia, will become the heritage of this great free nation.

There is one exhibit in Electricity Building which struck me very forcibly—an exhibit which does not appear in the catalogue—and that is the young American electrician. Deeply interested as I am in the teaching of the application of science to industry, nothing could have pleased me more that to see the value that you electrical engineers of this country attach to the bright lad who has has good college training, and while great feats have been achieved and are being achieved by veterans like Edison, Gray, Elihu Thomson, Westinghouse and others, you trust the development of your electrical enterprises in the hands of those whose skill merits your confidence, whose youth does not cause you distrust.

As one grows older, age, like electric self-induction, wipes out the minor ripples in the current of one's past life, but certain prominences, though rounded with time, are never obliterated. In the current of my life there will ever be one epoch towering far above all others—the epoch labled "Chicago, 1893."

Prof. Mendenhall, from the Committee on Permanent Organization, reported the following officers, who were appointed by a unanimous vote:

Honorary President, His Excellency Dr. H. von Helmholtz, of Berlin, Germany; Permanent Chairman, Dr. Elisha Gray, of Chicago; Vice-Presidents, Edward Weston, United States; W. H. Preece, F.R.S., Great Britain; Prof. E. Mascart, Member of the Academy of Science, France;

Dr. Voigt, Germany; Prof. J. Sahulka, Austria; Prof. Galileo Ferraris, Italy; Prof. H. Weber, Switzerland; Permanent Secretary, Prof. F. B. Crocker, New York.

The list of Vice-Presidents as above given is incomplete because of the non-arrival of some representatives from other countries who have signified their intention of being present. Upon their arrival the list of Vice-Presidents will be completed.

Chairman Thomson escorted to the President's desk Dr. von Helmholtz, the Honorary President elect, who was received with cheers and a rising salute by the Congress, to which he responded in a brief address. After formally accepting the chairmanship of the Congress, Dr. Gray introduced Mr. Preece, who said in part:

> I feel very highly honored in having conferred upon me the position of vice-president for that very tiny little spot on the ocean that is called "Great Britain." This is not the first time that I have crossed the Atlantic. This is not the first Congress that I have attended in America. This is my third visit here, and I have never yet left these shores empty handed. I have always taken something away with me; not surreptitiously, for I think it will be acknowledged that we in England have always handsomely paid for that which we have taken from you.
>
> I have the greatest possible hopes for the success of this Congress. Congresses do an infinity of good. They make us all travel on the same track. We never get shunted into wrong quarters if we rely upon the ideas that have been inculcated at these Congresses. Electricity in all its branches is cosmopolitan. As your Chairman implied, it has no geographical limitations. It knows no nation. It has but one language; and the object of our meeting here is to try to make that language a little more perfect. Its growth and history have been guided by the principle of continuity, and by the principle of evolution, and we are here to show how the modern electrician has planted the ideas of Franklin and Henry and Faraday and Maxwell and others on the history of the present, while we are still working hard to cultivate those seeds planted at our feet by such men as Helmholtz.
>
> But there is one other function that a Congress fulfils, and one which I trust we will do our best to fulfil, and that is to secure amongst ourselves that alone which makes life pleasant and happy—feelings of friendship and of amity. In my small career I have found that the friendships made abroad at these Congresses have been lasting, and can look around me here, and see several of those whom I have met at other Congresses, and whom I know that I shall be able to call my friends as long as we exist.
>
> One of the earliest lessons that I learned in this lesson-teaching country was this: Never prophesy unless you know. Now, I will venture to prophesy this: That when in future ages men shall look back to the annals of history to discover those epoch-marking events that have made history, there will be no assemblage of electricians that will be more indelibly engraved on the marbles of time than this great Electrical Congress of 1893, held in Chicago.

Chairman Gray introduced Vice-President Prof. E. Mascart, of France, who delivered a brief address in his native tongue, thanking the Congress for the honor conferred upon him, and prophesying the greatest good to come from the deliberations of the distinguished scientists there assembled.

Dr. Mendenhall then presented the programme of exercises to be observed by the Congress, after which an adjournment was taken to Tuesday morning.

After adjournment the Chamber of Delegates met to complete their organization, which will meet in secret session, and report the results of their conference at the general meeting on Friday.

TUESDAY'S SESSIONS.

Section A.

Section A, which included the department of Pure Theory, was called to order at 10 o'clock A. M. by Prof. H. A. Rowland of Johns Hopkins University, and the following officers were nominated and unanimously elected:

Chairman, Prof. H. A. Rowland of Johns Hopkins; vice-chairman, Prof. Galileo Ferraris of Italy; secretary, Prof. A. L. Kimball of Amherst College; sectional committee, Prof. A. G. Webster of Clarke University, Alexander Macfarlane of the University of Texas, Charles P. Steinmetz of Yonkers, N. Y.

A permanent organization being effected, Chairman Rowland said:

> We meet here for a discussion of pure science and all will take part in the proceedings. I will ask Prof. Ferraris to say a few words in regard to Italy.

Prof. Ferraris came to the platform, and on being introduced by Chairman Rowland was received with hearty applause. He addressed the section as follows:

> This is my first visit to America. I came here in order to see the New World, where scientific ideas find great applications which result in splendid advancement. I came to take part in the sessions of the Congress which occupy themselves with pure science. It is apparently a contradiction, but it is not a contradiction in fact. The science of electricity is the science which better than any other has demonstrated the mutual relation of pure science and practice, and especially here in America it is difficult—it is impossible—to divide science from practice. It is not only in theory but in the great practice which has been developed here and in their love for science that the great American people exhibit the wonderful results achieved by them in technical science and material wealth.
>
> You see the difficulty with which I express myself in a tongue which is not native to me, but I promise you that I will contribute to the full extent of my power to the objects of the Congress. I thank you for your kindness.

The reading of papers being in order, Chairman Rowland called on Prof. Macfarlane to present the subject, "On the Analytical Treatment of Alternating Currents." Prof. Macfarlane was ready to proceed, but in the absence of a blackboard for diagrams was unable to properly present his paper.

The same objection lying to the presentation of the other papers on the programme, on motion an adjournment was had until 10 o'clock A. M., August 23d.

Section B.

In Section B Prof. Charles R. Cross presided, and on motion appointed a committee consisting of Prof. S. P. Thompson, of London; Dr. Louis Duncan, of Baltimore, and Prof. Hasson, of Chicago, to nominate officers for the section.

Prof. S. P. Thompson made the following report:

"We have the honor to bring in the following report for permanent organization. We propose to continue in the chair Prof. Cross. We propose as secretary of the section the name of Lieut. Reber. We propose as the third member of the executive committee Prof. Dolbear."

After this ticket was elected, Prof. Preece proceeded to the reading of his paper, which after some discussion was followed by Prof. S. P. Thompson's paper on "Ocean Telephony." At the conclusion of this paper the meeting adjourned.

Section C.

The meeting was called to order at 10 o'clock by Prof. Edwin J. Houston, the temporary chairman, and the following officers were elected:

Prof. Edwin J. Houston, permanent chairman; George P. Lowe, of San Francisco, vice-chairman; Prof. E. P. Roberts, of Cleveland, secretary; George W. Blodgett of Boston, Dr. F. A. C. Perrine and Townsend Wolcott, sectional committee of three.

In assuming the position of permanent chairman, Prof. Houston made a short address, and called upon several members of the section who responded briefly.

The regular business of this section commenced with the reading of Mr. Shulze-Berge's paper on "Rotary Mercurial Air Pumps," which was followed by a discussion and adjournment.

WEDNESDAY'S SESSIONS.

Section A.

Section A of the Congress was opened Wednesday morning by Prof. H. A. Rowland, and the first paper read was "The Analytical Treatment of Alternating Currents," by Prof. A. Macfarlane.

The discussion was opened by Prof. Davis, who was followed by Dr. Frederick Bedell and Prof. Rowland. After this Mr. Charles P. Steinmetz was called upon for his paper on "Complex Quantities and their Application in Electrical Engineering." This was followed by the paper of Dr. Albert C. Crehore, entitled "General Discussion of Current Flow in Two Mutually Related Circuits Containing Capacity." At the conclusion of this paper Section A adjourned for the day.

Section B.

Section B was called to order by Chairman Cross, and after the reading and approval of the minutes of the previous meeting the chairman called for the discussion on the paper by Prof. Thompson, on "Ocean Telephony," which had been read the day before. At the conclusion of this discussion the paper by Dr. Lindeck on "Materials for Standard Resistance and their Construction" was read. The discussion of this paper was by Mr. Weston, Prof. Thomson and Dr. Lindeck. Afterwards Mr. Kennelly was called upon for his paper, entitled "Some Measurement of the Temperature Variation in the Electrical Resistance of a Sample of Copper," the discussion of which was postponed to the following day.

Section C.

Section C was called to order by Prof. Houston, and Prof. D. C. Jackson read the paper on "Underground Electric Construction in the United States." The chairman then called upon Mr. M. D. Law to open the debate on Prof. Jackson's paper. Mr. T. G. Lockwood, Mr. Abbott, Mr. Farnum, Mr. Heavysides, Mr. DeCamp and Mr. Blodgett also took part in the discussion. The chairman next introduced Mr. F. Sahulka, whose paper was on "Various Uses of the Electrostatic Voltmeter."

There being no discussion of Mr. Sahulka's paper, the chairman next introduced Prof. L. B. Marks, who read the paper on "the New Incandescent Arc Light." Prof. Nichols, of Cornell University, was called upon to open a discussion of this paper and was followed by Prof. Thomson, Mr. Low, Prof. Marks and others. At the close of this discussion the meeting adjourned until the following morning.

THURSDAY'S SESSIONS.

Section A.

Owing to Prof. Rowland's absence on Thursday morning, Section A was called to order by Secretary Kimball, and Dr. Henry T. Eddy, president of the Rose Polytechnic Institute, was elected temporary chairman of Section A. The first paper of the morning, entitled "Explanation of the Ferranti Phenomenon," was read by its author, Dr. J. Sahulka. At the close of the paper, a recess was taken until 12 o'clock, and owing to the failure to secure a quorum, the section was not called to order again that day.

Section B.

Section B was called to order by Chairman Cross, and after a few remarks by Professor Thomas relative to the discussion of the previous paper, the discussion was continued by Mr. Carl Hering and Professor Patterson.

The next paper on the programme was read by Professor Carhart on a "Pair of Electrostatic Voltmeters," which was discussed by Professor Webster, the chairman and others. The next paper was by Professor A. G. Webster, "On a Method of Governing Electric Motor for Chronographic Purposes," on which there was no discussion. The secretary then read a paper by Professor J. A. Ewing, F.R.S., entitled "Iron for Transformers from a Magnetic Point of View," and a recess was then taken until 12 o'clock, at which time Professor Jamieson presented a paper on "London Electrical Engineering Laboratories," which after a short discussion was followed by Dr. Frederick Bedell on "Transformer Diagrams Experimentally Determined." Mr. Kennelly also read a paper entitled "On an Improved Instrument for Measuring Magnetic Reluctance," at the conclusion of which the session adjourned.

Section C.

Section C was called to order by Professor Houston, who introduced Professor F. B. Crocker; the latter spoke extemporaneously on the subject of "Direct Current Dynamos of Very High Potential." After a short discussion the Chairman called upon Professor Thomson to close the discussion for the time being, and upon Dr. Louis Duncan to open the discussion on "Multiphase Motors." The two subjects being connected with the question of long distance transmission of power, the discussion of both was held jointly. The subject was considered at great length, and occupied the greater part of the morning. The last paper on the programme for this session was by Dr. C. Pollack on the "Conversion of Alternating into Continuous Currents.". Adjournment was then taken.

FRIDAY'S SESSIONS.

Section A.

Section A was called to order by the secretary at 10 o'clock.

The secretary stated that in the absence of the chairman a motion would be received for the election of a temporary chairman, whereupon a delegate nominated Prof. Macfarlane.

Prof. Macfarlane was unanimously elected to the Chair, and on taking his seat called for the reading of the first paper, on "Measuring the Power of Polyphase Currents," by A. Blondel.

The secretary stated that Mr. Blondel was absent, but had left his paper here, and as it was in French it would be better perhaps to have it read by title and appear in the transactions.

The paper was read by title and passed.

The chairman then announced that the next paper on the programme was "Extended Use of the Name Resistance in Alternate Currents," by Prof. W. E. Ayrton.

The secretary stated that as Prof. Ayrton was obliged to be present at the other section, he suggested that the paper be read by title only, which was done.

The session then adjourned.

Section B.

This session, which was devoted entirely to the subject of arc lights, was opened with Prof. Ayrton's paper on the "Variation of the Potential Difference of the Electric Arc with Current, Size of Carbons and Distance Apart." In it he gave the results of an elaborate set of tests with arc lamps. In the discussion Prof. Elihu Thomson gave some interesting experiences with the phenomena of hissing and Dr. Silvanus P. Thompson showed the curve of potentials in relation to the length of the arc.

Mr. Violle read his paper in French; the subject was "Light and Heat of the Arc." His conclusions are that the temperature of the arc is the same as that of the crater, that both are independent of the current, and have a constant value of about 3,500 degrees C. In the discussion, Prof. Elihu Thomson gave some results of experiments with the arc, showing how sapphires may be welded, iridium volatilized, and carbon made plastic.

The next paper, that of Dr. S. P. Thompson, on the "Swinburne-Thompson Unit of Light," was read by title at the suggestion of the author. Prof. B. F. Thomas's paper, on the "Periodic Variation of the Candle Power of Alternating Arc Lights," followed.

Prof. Carhart read his paper on the "Maximum Efficiency of Arc Lamps with Constant Number of Watts" in abstract only.

The meeting closed with the reading by title of two papers in French by M. Blondel, one on new researches with the alternating current arc, another on the constant current arc and its employment as a standard of light, and the last by Prof. Rowland on the "Source and Effects of Harmonics."

Section C.

Section C was called to order by the permanent chairman, Prof. Edwin J. Houston, at 10 o'clock.

On motion of Lieut. Hasson, it was

Resolved, That the secretary of this section be instructed to draw up a letter of thanks to Lieut. Spencer, of the General Electric Company, in acknowledgment of courtesies extended by him to members of the Congress.

Dr. Pollak made a few supplemental remarks to the paper read by him before the section on the preceding day.

The chairman then announced that before passing to the discussion continued from the preceding day, Mr. Freke desired to make a few remarks on Dr. Pollak's paper.

The section then took up the discussion of the various systems for long distance transmission.

The Chairman read by title the name of a paper which was passed on by the proper committee, "A Note on the Variation of the Capacity of Insulated Wires with Temperature," by Prof. Herman T. Hering.

On motion it was

Resolved, That a vote of thanks be tendered to our chairman for the impartial and good-natured way in which he has performed his duties as chairman.

This resolution being carried unanimously, the meeting adjourned.

General Meeting—Hall of Columbus.

Prof. Elisha Gray presiding.

The Chairman—If you will please come to order we will now have the pleasure of listening to the report of the Chamber of Delegates.

Dr. Nichols—Mr. President, Ladies and Gentlemen of the International Electrical Congress and Chamber of Delegates: As you know, in accordance with the provisions laid down in this programme the Chamber of Delegates has considered the questions laid before it and has reached certain decisions. It is my duty as secretary to report to you to-day.

The first question which came before the Chamber of Delegates was the Adoption of Values for Electrical Units.

The following resolutions upon this point were passed by the Chamber of Delegates:

Resolved, That the several Governments represented by the delegates of this International Congress of Electricians be, and are hereby, recommended to formally adopt as legal units of electrical measurements the following: As a Unit of Resistance the International ohm, which is based upon the ohm equal to 10.9 units of resistance of the C. G. S. system of electro-magnetic units, and is represented by the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice, 14.4521 grammes in mass, of a constant cross sectional area and of the length of 106.3 centimeters.

As a unit of Current the International ampere, which is one-tenth of the unit of current of the C. G. S. system of electro-magnetic units, and which is represented sufficiently well for practical use by the unvarying current which when passed through a solution of nitrate of silver in water and in accordance with accompanying specifications deposits silver at the rate of 0.001118 of a gramme per second.

As a unit of Electromotive Force the International volt, which is the electromotive force that steadily applied to a conductor whose resistance is one international ohm will produce a current of one international ampere, and which is represented sufficiently well for practical use by $\frac{1000}{1434}$ of the electromotive force between the electrodes of the voltaic cell known as Clark's cell at a temperature of 15 degs. C. and prepared in a manner specified.

As a unit of Quantity the International coulomb, which is a quantity of electricity transferred by a current of one International ampere in one second.

As a unit of Capacity, a conductor which is charged to a potential of one International volt by one International coulomb of electricity.

As a unit of Work, a joule, which is 10.7 units of work in the C. G. S. system and which is represented sufficiently well for practical use by the energy expended in one second by an International ohm.

As a unit of Power, the International watt, which is equal to 10.7 units of power in the C. G. S. system, and which is represented sufficiently well for practical use by the work done at the rate of one joule per second.

As the unit of Induction, the henry, which is the induction in the circuit when the electromotive force induced in this circuit is one International volt while the inducing current varies at the rate of one ampere per second.

The committee appointed to consider the standard of light, beg to present the following report: They have had much discussion upon the various forms suggested for practical standards, and in particular upon two forms of lamps known and represented as the Amyl-Acetate lamp of Von Hefner Alteneck and the Pentane lamp of Vernon Harcourt. The only practical lamp actually presented to the committee is the new Von Hefner lamp, which, although it has been laboriously tested at the Riechs-Anstalt and reported accurate to within two per cent., has not received any extended trials in other lands. That thereafter it was reported that the Pentane lamp in its recent improved form was preferred in England for the photometer to gas lights. There is the objection to the Pentane lamp that the composition of the commercial Pentane is not sufficiently well defined and to the Amyl-Acetate lamp that its color is too red in hue; finally, the objection to all open flame lamps is that they are too liable to be influenced by the changes in the pressure and temperature and moisture of the air. It is admitted on the other hand that no electric lamp suitable for use as a convenient practical standard has yet been realized. Under these circumstances there was a sharp division in the committee between those who advocated the Von Hefner lamp as an independent standard and those who desired to the maintain *statu quo* until further researches should have been made in various countries.

It was proposed by Drs. Budde and Lumner that the Hefner lamp, constructed exactly according to the specifications of Mr. Von Hefner Alteneck, be introduced as a provisional, practical standard of light, and that the problem of determining its value in terms of an absolute unity be left to subsequent investigation. On vote this was lost by two votes for and four votes against. The following motion, proposed by Messrs. Palez and Thomson and amended by Drs. Budde and Lumner, was then carried unanimously:

Resolved, That this committee while recognizing the great progress realized in the standard lamp of Von Hefner Alteneck and from important researches made at the Riechs-Anstalt, and also recognizing that other standards have been proposed and are now being tried, and that there are serious objections to every kind of standards in which an open flame is employed; it is, therefore, unable to recommend the adoption at the present time of either the Von Hefner lamp or the Pentane lamp, but recommends that all nations be invited to make researches in common on well defined practical standards and on a convenient realization of the absolute unit.

Signed
J. VIOLLE,
EDW. L. NICHOLS,
A. PALEZ,
SILVANUS P. THOMPSON.

Mr. Preece—The announcement I have to make is a simple one. As president of the Institution of Electrical Engineers in England it is my wish to invite the members of this institution of Electrical Engineers in America to meet me at the Victoria House, in the grounds of the World's Fair, especially as they have done me the great honor to make me an honorary member. There are only two honorary members, and I am one of their body. I have experienced this great difficulty that the addresses of the members of the American Institute or the members of the Congress have not been very carefully kept, therefore I have to invite all the members of this Congress, whether they are the members of the Institute of Electrical Engineers or not, to allow me to have the pleasure of receiving them tomorrow afternoon between the hours of 5 and 7 o'clock in my present British home, Victoria House, World's Fair grounds.

It was moved and seconded that the names of the various parties who had extended courtesies be tendered a vote of thanks.

Dr. von Helmholtz spoke as follows: Ladies and gentlemen : We have performed a work which I hope will have some good fruits for all future time in creating a congruity of the electrical associations of all nations so that scientific and industrial men can understand each other in the simplest and best way. Now, it was rather a hard piece of work in these hot days, these continual meetings of the delegates and members of the Congress, and he who has had the greatest part of these exertions and work on this occasion is our venerable president, Elisha Gray, and therefore I want you to extend to him your thankfulness for this work he has done.

L. Mascart seconded the motion.

Mr. Preece—It is my duty, ladies and gentlemen, to put this proposition to the meeting : it is that a vote of thanks be extended to this fine old man, according to the papers, who, by the way, is a younger man than myself; it is my duty to put this proposition before you. Those in favor of this proposition will kindly say aye. I see there is no use to ask for the contrary vote.

Prof. Gray responded as follows : Gentlemen, I cannot tell you how grateful this is to me. I worked for the last two years in organizing this Congress under many difficulties, and these difficulties have continued right up to the present moment. These steam engines outside don't even give us a chance to express ourselves. Now, before we leave, I want to thank the members of this Congress for the part they have taken, and I want to thank you for the good part you have taken in the difficulties under which you have had to labor and I have had to labor. I think upon the whole the Congress has been very successful, and I trust that you will go away feeling this is true, and that you will think of us kindly. And you, gentlemen, who come from foreign shores, when you go home and look back don't think of only the smoke and noise and high buildings, but think of us over here as having warm hearts. I wish you well and pray that you will have smooth sailing and a warm, hearty welcome to your home and dear ones.

Now, gentlemen, this closes the work of the International Electrical Congress at Chicago in 1893.

I now declare the same adjourned.

The Social Side.

Among the entertainments which occurred during the meeting of the Electrical Congress was the banquet on Thursday evening, August 24, of the American Electricians, in honor of the Foreign Official Delegates to the Congress. The banquet was given in the Grand Pacific Hotel and was well attended, the large dining-room being well filled. Prof. Gray presided, and after the solemn duties of the feast had been fulfilled and the cigars lighted, made a happy address which scored frequent applause. Two toasts were then proposed, one of which was responded to by Dr. von Helmholtz, and the other, in three languages, by Mr. Preece, of England, Prof. Mascart, of France, and Prof. Ferarris, of Italy.

The party was a jovial one and numerous speeches were made during the evening. Prof. Ayrton spoke of the hospitality with which he and his associates from abroad had been received, and Prof. S. P. Thompson jokingly attempted to claim all our distinguished scientific men as his countrymen, and pointed to the fact that even Franklin was an Englishman when he flew his kite. The speeches which followed were all in the happiest strain and the occasion was thoroughly enjoyed by all.

On Friday evening the Congress met at the Agricultural Assembly Rooms at the World's Fair grounds to listen to an experimental lecture by Mr. Nikola Tesla, who explained a new electric generator with a reciprocating armature of very high speed. Several of the machines were shown in operation, and diagrams showing their construction were displayed. Mr. Tesla said that although the machines were only at an early stage of advancement, yet he considered them capable of important development for the reason that their speed could be kept absolutely constant under any condition of load or with any variation in the pressure of the compressed air with which they are driven.

On Saturday afternoon the members of the Congress received special invitation to visit several of the exhibits at the World's Fair. These included the Bell Telephone Company, the Western Electric Company, Prof. Gray's Telautograph, the General Electric Company, the Westinghouse Company, the Ferris Wheel, Libby Glass Works and Scenic Theatre.

At 10 o'clock Prof. Barrett, of the Department of Electricity, tendered a collation to the members of the Congress, which was largely attended and thoroughly enjoyed. A number of speeches were made, and at 12 o'clock the company broke up, thus closing a most pleasant and eventful week.

Wednesday's Trip to the Fair.

The members of the Congress, after the session Wednesday forenoon adjourned, took the whaleback steamer Christopher Columbus to the World's Fair grounds. On their arrival on the Casino pier the members were invited to take a ride on the moving sidewalk, the operation of which aroused considerable interest in the party. After the ride the party was taken over to the exhibit of the Krupp Company, where the members were received by Carl Richter, the German Commissioner, and Mr. Lauter, the representative of the Krupp Company. On invitation of Lieutenant Spencer, a visit was made to the Intramural power-house, and the party was given a ride on the Intramural Railroad to the north end of the grounds where they viewed the parade of the West Point cadets. In the evening, through the courtesy of the Electric Launch Company, the entire party were taken around the lagoons in the electric launches. The members were then taken over to the Ferris Wheel and were introduced to Mr. Ferris, after which a trip was made around the wheel. The surprise of the day was the invitation to the German Village to lunch. On the arrival of the members it was discovered that Mr. W. R. Brixey, of Day's Kerite Wire Company, was the host. After the lunch speeches were made by a number of the guests and the party separated for the day.

THE line of telegraph in Cashmir, between Srinagar and Gilgit, reaches an altitude of 12,000 feet at the summit of the passage of Tragbal. It is probably the most elevated telegraph line in the world.

A Tide-Water Register.

Novel Service at Rouen, France.

A Town-Clock Which Tells the Mariner When He May Sail.

The city of Rouen, France, whose inhabitants are largely sea-going folks, has lately installed an electrical tide-water register, which conveys to every part of the city exact information as to the height of the tides.

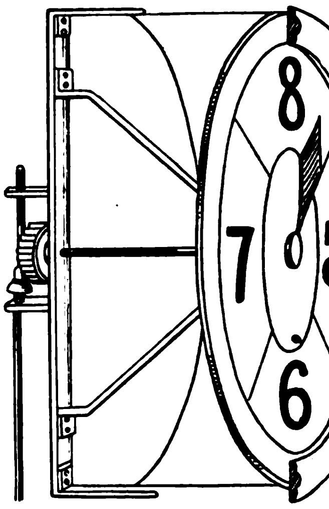


FIG. 1.

The system is very similar in its arrangements to our electric time service.

The Chamber of Commerce, in addition to the series of dials which are distributed to subscribers throughout the city, has erected a central tower with four illuminated dials which can be read from a considerable distance. One of these dials is shown in the illustration (Fig. 1.)

The carrying out of the plan is simplicity itself, the novelty consisting in its conception.

A large iron tube is placed at tide-water, as shown in Fig. 2, containing movable floats, the position of which is registered by electrical mechanism and is simultaneously duplicated on any number of service dials.

While the movement of the tides is calculated in advance, the information is not readily obtainable in smaller towns, and there are many American seaport towns where such a service would be of great value to the inhabitants.

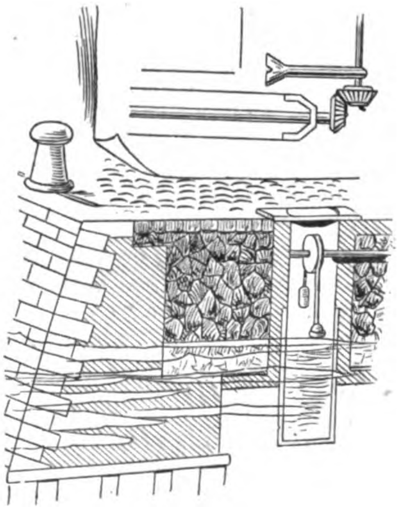


FIG. 2.

Electric Heating.

Probably the most attractive exhibit at the Rhode Island State Fair this year will be an elaborate display of electrical cooking apparatus in practical use. The exhibit will be in charge of graduates from a cooking school.

Mr. H. W. Axford, the incubator man, says he obtains better results by the use of electricity for heating than by any other process yet tried.

Ocean Telephony.

BY SILVANUS P. THOMPSON, D.SC., F.R.S.[*]

The retardation ot signalling, which is found in submarine cables, is due to the capacity of the cable, and this capacity is distributed fairly uniformly along the cable. Owing to this circumstance, all attempts made hitherto to annul or compensate its operation by means of devices situated at the *ends* of the cable, have met with very limited success. Whereas, the ordinary speed of signalling through an Atlantic cable is about eight words or so per minute, it would be quite possible to send 400 words per minute through a line of the same resistance, but destitute of capacity.

The only effective way to annul the retarding effects of a *distributed* capacity is to apply a *distributed* remedy; that is to say, compensating devices *distributively* along the length of the cable, either at intervals or continuously.

It is well known that the effects of electromagnetic induction are, in a sense, reciprocal to those of capacity. If electrostatic capacity can be used to correct the effects of electromagnetic induction, conversely it will be possible to use electromagnetic induction to correct the retarding effects of electrostatic capacity.

There are two main modes of action of electromagnetic induction, namely, *mutual induction*, from wire to wire (with or without an iron core intervening, and sometimes called electrodynamic induction), and *self-induction* when the current in a wire reacts inductively on itself. Both are known to be due to the setting-up, by currents, of magnetic fields in their neighborhood.

There are a very large number of ways in which, theoretically, the end may be obtained of compensating the effect of the distributed capacity by means of distributive electromagnetic induction. It will suffice here to consider two simple cases, and for the sake of simplicity it will by supposed that each is applied to the case of a cable containing two insulated wires for the outgoing and returning currents. Such a cable may be represented in Fig. 1, where AA is the outgoing wire or " line," and BB the incoming wire or return. In the subsequent figures the sheathing will not be specifically indicated.

In the case of self-induction devices used distributively a series of self-induction coils of sufficiently high resistance and sufficiently great inductivity are placed across at intervals from the A conductor to the B conductor. In order the better to follow the action it will be convenient to represent the distributed capacity in Fig. 2. Here the two conductors A_1 A_2, B_1 B_2, are drawn as though each in itself was devoid of capacity, but that a capacity was given to them in a distributive way by arranging a number of condensers along at intervals, each condenser having one coating joined to the A line, and the other coating joined to the B line.

Suppose the signalling to take place from the left-hand end, and that a wave of current is being thrown into the circuit at A_1 by a transmitting apparatus joined to A_1 B_1. Were there no capacity or inductivity in the line A_1 A_2, the waves would travel simply along without retardation. But the presence of capacity changes all this. When the potential at A_1 is rising the potential at some point along the line *a* would not rise simultaneously, because of the capacity in the intervening part of the conductor. The potential at *a* cannot rise to its proper value until the condenser between A_1 and *a* has received its charge. Similarly, the potential at *c* does not rise as soon as at *a*, because of the action of the capacity between *c* and *a*. Again, when the potential at A_1 is falling, it will not also fall at *a* or at *c* simultaneously, because the condensers in between tend to keep up the potential and take time to empty themselves. Whenever the potential at any part of the line is rising, some of the current tends to flow into the condenser at that part, with the result that the rise of potential in that part is delayed, while the current beyond that part is for the moment smaller than the current that is coming up to the part. Further, when the potential at any part is falling there is a tendency for current to flow out of the condenser at that part, and thereby keep up the potential a little later; so that at that moment the current flowing away from the part in question is greater that that flowing towards the part. If nothing is done to compensate this action, the effect would be that virtually all the wave thrown into the cable at A_1 would be taken up in playing into and out of the successive condensers, and so only an insignificant and much-retarded fraction of it would reach the end A_2.

Now, suppose that self-induction coils are placed across the cable at the proper intervals, as in Fig. 3. The operation of these coils in compensating the retarding effect of capacity is as follows: When the potential at *a* rises, current begins to flow through the self-inductive coil *a b*, and this current tends, by the well-known inertia like action of self-induction, to go on after the applied electromotive force producing it has begun to diminish, or has even stopped or reversed. Hence, the current in the self-induction coil *a b* will attain its maximum value at a time after the potential at *a* has begun to fall. It will, by that very circumstance, as a consequence of the electromagnetic momentum, tend to make the potential at *a* fall *sooner* than it otherwise would do. Hence the respective actions of the self-induction coil and of the condenser are of opposite kinds. One tends to cause the changes of potential in the line to occur *later* than they should occur; the other tends to cause the changes of potential to occur sooner than they otherwise would occur. Hence their action tends to compensate one another if applied at the same place. But the capacity of a line or cable is not at one place; it is distributed all along it. Therefore, it is essential that the compensating devices should also be placed all along it, at sufficiently frequent intervals. It is well-known that Varley employed an inductive shunt *at each end* of a cable; but this is not capable of compensating the capacity, except within, at most, a few score miles of the ends. The coil *a b* (Fig. 3) may be looked upon as compensating the capacity on both sides of it to a certain distance; the coil *c d* as compensating the capacity on both sides of it; and so forth. If all these compensators are properly ranged along the cable, then the total retarding effect of the distributed capacity will be practically annulled. The currents that run in and out of the transmitting end will be greater in quantity than those that are delivered in and out at the distant end; the difference being of course accounted for by the currents that flow across through the compensating coils. It will be seen that by the use of these devices a certain fraction of the currents that are sent in at the transmitting end is, so to speak, used up on the way to pass through the compensating coils, and by their action prevents the retardation of the rest of the currents that are flowing down the line. To put the matter tersely, the compensators act as leaks across from the A line to the B line, which by their inductive action sweep out the accumulating charges that would otherwise retard the signals. Some calculations on the magnitude of the currents that must thus flow across in the compensating coils have been made by the author, and some others for him by Dr. Sumpner. From these it appears that taking as a working basis the actual facts about cables as they are, as assuming a twin wire cable having a capacity of $\frac{1}{8}$ microfarad, and a resistance of 10 ohms, for a mile length, also assuming that compensating coils are placed across at every 10 miles, if such coils have a coefficient of self-induction of 100 henrys and a resistance of 3,000 ohms each (its time-constant being then about $\frac{3}{100}$ths of a second), the rise and fall of current in each section will, with currents of the ordinary telephonic periodicity, be practically instantaneous in each section during the very small fraction of a second that the impulse lasts; and the value of the current from section to section will be practically determined solely by the shunting action of the successive compensators. Now, as telephonic currents may be shunted down to an extraordinary degree of tenuity, and yet be perceptible, it is evident that there are great possibilities opened out by this method of using the shunted portions of the current to neutralize the retardation.

FIG. 1

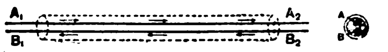


FIG. 2

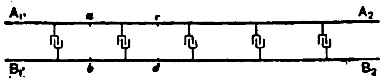


FIG. 3

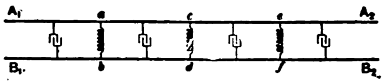


FIG. 4

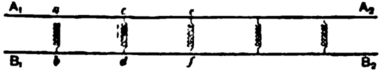


FIG. 5

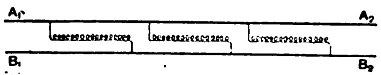
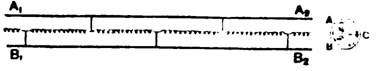


FIG. 6



The cable so constructed of two wires with compensating devices shunted across at intervals of 10, 20, or it may be 500 miles apart, will be represented diagrammatically by Fig. 4. The practical problem then remains how to provide compensators having a sufficiently great time-constant without their constituting unwieldy enlargements of the cable. This is a very simple matter of construction. The author has tried several species of devices, some of them resembling elongated " hedgehog " transformers made very long and thin, and wound with one coil only of fine wire; others consisting of " shell " transformers elongated into a very long, narrow loop; others again consisting of simple iron wire, straight or looped, or of wire over-wound with a layer of iron wire. The self-induction, for example, of a one millimetre iron wire, over-wound with a layer of iron wire three millimetres deep, is roughly about 0.1 henry per kilometre; and its resistance is 144 ohms. One point in favor of the use of loaded straight wires as self induction devices is the circumstance that the compensator need not join two adjacent points in the two conductors within the cable, but may lie across as in Fig. 5. This construction, which is specially suitable for cables of moderate length, resolves itself into a three-wire cable, of which one wire is loaded in some way to give it self-induction and resistance, and is connected at intervals alternately to the other two, as in Fig. 6.

As stated above, however, not only by self-induction but by mutual induction, the retarding effects of capacity may be neutralized.

With the use of mutual-induction devices distributively, the cable is considered in sections, each of which is in inductive relation with those on each side of it; and again there are many possible varieties included. One example is as follows:—Let the two conductors along the cable be each divided into a number of equal lengths, and let the parts be joined together by mutual-induction coils, that is to say, by induction coils with two windings each. Though the exigencies of cable-laying will necessitate some very different shape of coil or device as an organ of mutual induction, we may assume these induction coils to be of the familiar form of an iron core surrounded by the two windings. The cable so made of sections will be indicated by Fig. 7.

In this figure it is indicated that the coils are so connected that in the A line when the current is increasing and flowing toward *a*, the inductive action will be causing a current in the next section, which will be at the same instant increasing, flowing, so far as the A line is concerned, in the opposite sense, so that while the potential of the point *a* is rising that of the point *m* is falling. The consequence will be that the currents required to sweep out any accumulated charges due to capacity will not have to travel (as in ordinary cables) all the way from the ends of the cable, but need only travel short distances, never more than the length of half a section. Hence, if a cable 2,000 miles long is cut up into 25 sections of 80 miles each, there should be no more retardation than on an ordinary cable 40 miles in length. It is not needful that both the lines should actually be divided: a virtual division into sections is effected in Fig. 8, where the B line is actually continuous. In this figure *p p* is the primary, and *s s* the secondary (or *vice versa*) of the mutual induction coil. Or the arrangement may be alternated, as in Fig. 9.

Or again, if three conductors are employed—of which one may be the sheathing—the sectioning and use of mutual-induction may be accomplished as shown in Fig. 10.

Here, again, as remarked above, the kind of induction coil which naturally suggests itself as suitable for the purpose in question is something of elongated shape, such as a very elongated loop " shell " transformer, or the " cable " transformer which was suggested for electric lighting purposes by Messrs. Siemens & Halske some years ago. Or, as the author suggested in 1891, by using a mutual induction between the wires of the cables themselves by merely enwrapping them, as they lie side by side, with iron. So that the cable once more becomes an arrangement of three parallel wires, of which two are specially brought into mutual inductive relations to one another, and are joined up at intervals, as indicated in Fig. 11.

Lastly, it is, as is well known, possible to have mutual induction between two wires that do not form part of closed circuits, as in the phonopore of Mr. Langdon Davies.

With the facts already known that the Varley shunt does indeed operate at the ends of a cable to compensate in some measure the effects of capacity near those ends, and that on long land-lines the speed of signalling can be increased by inserting a translator in the middle, or even by a mere leak at some intermediate point, it is remarkable that no one should have suggested hitherto the very simple solutions now proposed. Perhaps the reason is to be found in the intense horror with which all good telegraph engineers regard the idea of having a fault on their line. Deliberately to insert, as the author proposes, a series of faults, as shunts across the cable from the going wire to the return wire, will, to many of them, appear sheer madness. The shunts are not mere faults, however. They are bridges possessing considerable resistance, and, what is more to the point, considerable self-induction. They are not leakages, through the insulation to the sheath, of an unknown amount, and one liable to increase by corrosion ; they are as fixed and determinate as the resistance of the cable itself.

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[*] Abstract of paper read at the International Electrical Congress, Chicago.

Many experiments have been made in the author's laboratory with arrangements of apparatus set up to imitate by condensers and resistances the retarding properties of actual cables. An example will suffice. A section of artificial cable was made up of a resistance of 7,000 ohms, and a capacity across between line and earth of 10 microfarads. Through this cable not a sound could be transmitted telephonically to a double-pole Bell receiver at the distant end, either with a Blake transmitter (with induction coil) or with a Hunnings transmitter without induction coil. When, however, a single compensating self-induction coil, having a resistance of only 312 ohms, and a time constant of about 0·005 second, was bridged across at an intermediate point, telephonic transmission became at once possible, save for very shrill sounds.

One curious result came out in one of the series of experiments, namely, that those telephonic transmitters which have induction coils in them (the ordinary mutual-induction coils with thick and thin winding), are almost useless for the purpose of cable transmission. Apparently the fine-wire winding has too great a self-induction in series in the circuit to be suitable for this purpose. At any rate, better results were obtained from transmitters of other types. Quite recently the author has got better results from a transmitter in which the ordinary two-wire mutual induction coil was replaced by a single self-induction coil on a plan suggested by him in 1884. It is obvious that in any plan which contemplates the counter-balancing of retardation by shunting (through self-induction coils) a notable fraction of the current may necessitate a new type of transmitter capable of sending telephonic currents of much greater amperage than those ordinarily used in overland telephony.

There exists also much evidence to show that mutual induction by devices properly distributed along a twin-wire cable will also be effective in neutralizing the retardation due to distributed capacity. It is an old and well-established rule that the retardation in a cable is proportional to the square of its length. If one could cut a 2,000 mile cable into two cables of 1,000 miles each, and simply translate or relay the current from one into the other, the retardation of the whole ought to be reduced very materially, perhaps not to one-quarter, but at least to one-half. Only here, again, it is evident that some of the electric energy supplied at one end must be used up in the act of working the translator or relay, however it is constructed, even if it be only a simple mutual induction coil. Therefore, if a cable is cut up into numerous sections, each connected by mutual induction with the next, a considerable fraction of the energy put in at one end may never reach the other, being spent on the road in overcoming the retardations that will otherwise arise. Mutual induction, as is well known, tends always to wipe out the self-induction of both the circuits thus brought together ; but with the most perfect conditions of magnetic circuit, the utmost that the mutual induction can effect is to neutralize the self-induction only of those coils which are acting as mutual inductors. It cannot neutralize the self-induction in parts of the circuit beyond. Hence, for the particular purpose in question—namely, that of enabling the circuit to transmit telephonic signals—the induction devices must not be simple ordinary coils inserted haphazard at intervals ; they must be specially designed and inserted with perfect regularity. And the cable itself must be freed as far as possible from self-induction. *Never, for such a purpose, must a cable be constructed, as Atlantic cables have hitherto been, of a single conductor* (of stranded copper) *surrounded by an iron sheathing* that comes in between the outgoing and the returning parts of the circuit, thus adding an enormous impedance. Happily, in all twin cables where outgoing and returning conductors lie side by side within the sheath, the iron of the sheath, enclosing both, increases the mutual induction between them. In such constructions as Fig. 6 the iron used to increase the self-induction of the wires that act as compensators will of itself increase the mutual induction between the twin conductors if they are properly disposed. The experience gained with alternate-current working is absolutely conclusive as to the efficient action that may be expected in special constructions for future ocean telephony.

FIG. 7

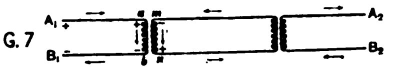


FIG. 8

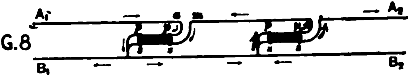


FIG. 9

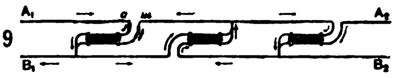


FIG. 10

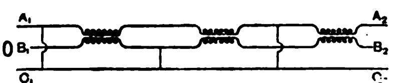
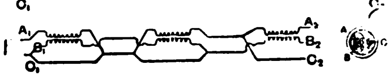


FIG. 11



Ocean telephony is possible. The means for attaining it are within our grasp. Compensated cables of the new type are entirely practicable. It may be needful to begin with some shorter line than an Atlantic cable, in order to gain experience. But an Atlantic cable constructed on the new plan will not cost much more, when laid, than one of the old type ; and whether or not it is successful in conveying telephonic speech, it will certainly transmit telegraphic messages at a greatly accelerated speed of signalling. If one Atlantic cable can be constructed to do the work now requiring eight cables, that cable will be constructed. Acceleration of the ocean telegraphic service is in itself a desirable step in advance ; but the advance will not be complete until telephonic speech is transmitted also from shore to shore.

A New Incandescent Arc Light.

BY L. B. MARKS, M.E.*

The *incandescent arc* to be treated of in this paper differs radically from previous forms. In it the electrodes are not in contact, while the current is indirectly used in maintaining all the products of disintegration of the carbon in a state of incandescence or opalescence.

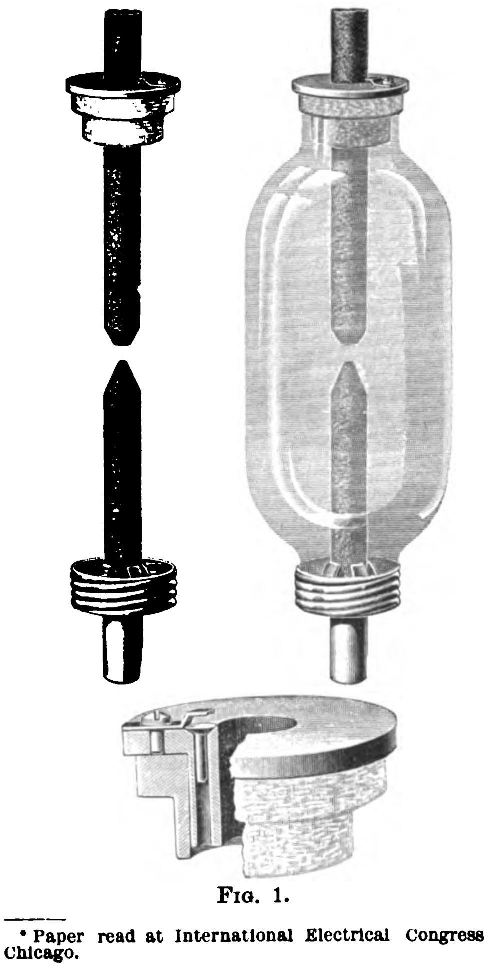


FIG. 1.

Plate A shows the main features of the appurtenance. It will be seen that the arc is enclosed in a small envelope, which is made of highly refractory glass. The envelope is closed at the bottom and provided on top with a metal plug having an opening in it just large enough to admit of the feed of the upper electrode. A fire-proof plug of asbestos-pulp insulates the metal from the glass. A valve, shown in the plate, allows the egress of gas but prevents ingress of the air. With this construction the operation of the lamp will be as follows:

Upon the closure of the circuit, and the springing of the arc, the air in the enclosing envelope is robbed of its oxygen, the latter uniting with the carbon of the electrodes to form C O and C O_2 gases.

The gases are brought to an exceedingly high temperature, at which they maintain the carbon-vapor issuing from the arc. This vapor is deposited in the form of a thin coating on the internal surface of the glass chamber.

The expansive force of the gases may become sufficiently great, if no means of egress be provided, to rupture the envelope; hence, a small safety valve is provided for their outflow. The only possibility of ingress of air is through the narrow space between the positive carbon and the plug; experience has shown that after temperature has been raised beyond a certain point the amount of air that enters in this way is inappreciable : in any event, the oxygen is immediately converted by combination.

It is important that the enclosing glass envelope be as small as possible, for the conservation of the radiant energy, and hence the efficiency, will depend largely upon the size of the chamber. The heat which in the ordinary arc-light is dissipated in the air is here conserved and raises the temperature of the enclosed gases and vapor of carbon. The proper conditions being fulfilled, the lamp maintains its maximum efficiency shortly after the current has been passed through it, and glows like the incandescent with the brilliancy of the arc-light. The arc proper is scarcely visible, but the entire contents of the chamber seem to be luminous, giving the appearance of a solid cylinder of light.

The pressure, as well as the temperature of the enclosed gases has a very important bearing on the performance of the lamp, and affects to a marked degree the character of the carbon deposit on the glass chamber. At this date no definite figures can be given, but it appears that a high tension is absolutely required to give good results.

The structure and constituency of the electrode are also pre-eminently important. Absolute purity of the carbons is imperative.

Investigators in this field have apparently found it impossible to obtain all the requisite conditions. Beardslee[1] mentions a type of lamp similar to the one under discussion, but whether the size or character of the arc-enclosing chamber, the nature or management of the gases, or the quality of the electrodes, or other features, made his arrangement impracticable, is not recorded. Suffice it to say, the comparatively poor grade of arc-light carbon manufactured ten years ago would alone explain his failure.

EFFICIENCY MEASUREMENTS.

Measurements of the efficiency and candle power of the light were made in the laboratory of Cornell University. The method employed in making the efficiency tests was that used by Nakano,[2] in determining the efficiency of the arc lamp, and subsequently by the writer in an investigation on arc light carbons[3]. The ratio of luminous to total radiation of the lamp was taken at different angles below and above the horizontal. The values obtained are given in Table I, where L equals luminous radiation, T equals total radiation, and $\frac{L}{T}$ equals radiant efficiency.

(*Concluded on Page* 82.)

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* Paper read at International Electrical Congress at Chicago.

[1] G. W. Beardslee; U. S. Patent, 265, 737, Oct. 10, 1882.

[2] H. Nakano: Efficiency of the Arc Lamp. Trans. Amer. Inst. Elec. Eng. Vol. VI, page 208, 1889.

[3] L. B. Marks: Life and Efficiency of Arc Light Carbons. Trans. Amer. Inst. Elec. Eng. Vol. VII, page 185. 1890.

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The International Electrical Congress. The International Electrical Congress, which completed its work with the general meeting held last Friday afternoon, has proved by general consent to be the most important Congress of electricians which has yet been held, and its work, especially that of the Chamber of Delegates, in regard to the names and values of electrical units, cannot fail to be of the greatest value in securing an identical nomenclature for the science of electricity among all the nations represented at this Congress.

Some points, such as the standard unit of light, upon which an agreement was to be desired, still remain open questions. This, however, was due to the lack of sufficiently exact knowledge on these points rather than to any difference of opinion among the delegates, and in view of this the conservative course was adopted of awaiting further developments in these directions.

The papers read were of invariably special interest and treated of many subjects which are being brought prominently before the electrical profession at present for solution, and lively interest was displayed in the discussions of these subjects.

It has been remarked that a great advance has been made in the achievements of each successive International Congress which has been held over those of the previous one, and in this respect the present Congress was no exception to the rule.

The organizing of this Congress, which has been in the hands of several committees, has involved careful and laborious work on the part of many of the members to whose efforts the Congress is largely indebted for its successful results, and especial credit is due to Mr. Carl Hering and Mr. Kennelly for the efforts they have made in this direction.

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The Foreign Delegates. One of the most noticeable features of the Congress was the number of distinguished men of science from all over the world which composed the Chamber of Delegates, and it is not going too far to say that only an event like the World's Fair could make such a meeting possible.

Aside from the scientific interest which attaches to this Congress the social advantages accruing from the meeting of the leading men of all countries in the electrical science will long be felt by the members, and the friendships thus formed will be of the greatest mutual advantage.

The courtesies exchanged between the foreign and home delegates were noticeable. In the Chamber of Delegates the motion to adopt the name of Henry for the unit of Induction was made by Prof. Mascart, in deference to the wishes of the American electricians, notwithstanding a French Congress had already adopted another name for the same unit, and at several informal social meetings our foreign guests took occasion to warmly acknowledge the hospitality which had been extended to them during their visit to Chicago.

The circumstances surrounding this occasion and the distinguished character of its members will make this Congress a feature in the history of electricity whose prominence is unlikely to be eclipsed for many years.

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Long Distance Transmission. One of the most interesting discussions of the Congress took place in Section C on the subject of long distance power transmission by electricity. The discussion was divided between the system of high tension direct currents and multiphase currents, the latter claiming a greater part of the attention.

Prof. Crocker, who has given considerable attention to direct current machines of as high as five thousand or ten thousand volts, explained some of the difficulties in the construction of such machines, and the precautions which are necessary in the methods and the extent of the insulation of the parts.

The polyyhase systems were then taken up, and in the course of this discussion Prof. Forbes explained considerable of the work which is being done at Niagara and the types of machinery which are to be adopted. In the present light he considered the multiphase system to be the most practical factor in power transmission for general distribution. The dynamos for this plant will be of special design as a vertical shaft is required.

A number of different schemes for transmission were considered during the meeting, and the prevailing opinion seemed to favor some form of multiphase currents, although the relative value of two-phase or three-phase currents was in dispute.

The best number of periods per second is an important point which was also considered briefly, the general opinion being that a very low frequency was not compatible with a general system for both arc and incandescent lighting.

Some descriptions of work in this direction were given by a number of foreign engineers, which proved of great interest and will be given in a future issue of ELECTRICITY.

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General Electric. It has not been officially announced, but it is a fact nevertheless, that the most important action taken by the General Electric Directors last week was the appointment of a Committee on Reorganization.

We are not able to predict, at present, whether the proposed organization will tend to strengthen or to weaken the position of the company.

It is also a fact, though not yet announced, that all the district offices of the company, except Chicago, are to be dispensed with.

Mr. H. McK. Twombly, who has been for some weeks *de facto* president and general manager, is taking hold with vigor. His most radical moves so far are not open to public criticism. But that he should consider for one moment, however, the placing of a man like Mr. O. T. Crosby in a position where business experience counts for everything and a technical training for little, shows how easy it is for a good business man, which Mr. Twombly doubtless is, to make serious blunders in conducting an electrical enterprise. Mr. Crosby is a valuable man, but his place is in the workshop, and not in a business office.

We suspect that Mr. Twombly is already convinced of this. He cannot have failed to take notice that since the ill-advised shaking up in the Railway Department the best contract—that at Baltimore for fifty car equipments and three 500 K.W. generators—has been secured by the Westinghouse Company.

Discussion of Mr. Crosby's *business* qualifications excites merriment among his best friends. Any reorganization which places good men in improper places is just as bad judgment from a business standpoint as placing improper men in good places.

Other acts of Mr. Twombly, however, show a better insight into human nature, notably the decapitation of Mr. John I. Beggs, and the semi-official announcement that Mr. E. I. Garfield is also about to walk the plank.

The company received last week $800,000 in cash from the new syndicate, and this is to be followed by four more similar payments. It should also have received $500,000 from the Electrical Corporation.

The directors were in almost continuous session all of last week, beginning on Monday by hearing reports from all the district managers. On Thursday night they did not adjourn until near daylight.

The outcome of the reorganization is yet in doubt, but it will take place in a very short time.

The bitter attack in a Boston paper, written by Mr. Coffin's broker friend, was inspired beyond question. It may have had the desired effect of convincing the New York directors that Mr. Coffin would be a dangerous man to turn loose under present conditions.

The only reorganization which will merit the respect and confidence of the trade at large will be the placing of a man of experience and honesty, a man with thousands of friends and few enemies—such a man, for instance, as Mr. E. H. Johnson—in control of the business affairs of the company. Mr. Twombly should confine his attention to the finances, a subject of which he has knowledge.

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It is at least two months since we have seen any newspaper mention of the Boston Comet, or the Young Napoleon of Electrics.

……o……

The Truth is Coming Out. Last week we had occasion to refer to an attack on General Electric published in a Boston paper. It was in reality an attack on the New York members of the Board of Directors and upon the former Edison management. We expressed the opinion that the matter was instigated by a high official of the company. Subsequent events have confirmed our view, and no denial from him would change our opinion. A pointer on this theory is the following reference to the article from the Boston *News Bureau*, which never prints a General Electric item that is not authorized by the Press Agent.

"Most of this the Boston *News Bureau* has reason to believe is not true. *It is, however, true that the Edison Company was not found after the consolidation to be financially so sound as the Thomson-Houston, and that the New Yorkers have been the main sellers of the stock.*"

If Mr. Coffin is to live comfortably among his old friends and neighbors, it must be proved that he was not personally guilty of humbugging New England investors, and that he was a helpless agent in the hands of the wicked Board of Directors.

By these contemptible methods it is, we believe, sought to prove Mr. Coffin an injured man.

It may work in the rural districts, but not in communities like Boston and New York, where men's wits are sharpened by communion with their fellows.

We think this is about the last we shall ever hear of The Fallen Watchtower, The Shattered Comet, The Young Napoleon of Electrics.

……o……

We have had occasion from time to time to chide the *Electrical World* for its utter lack of moral courage in discussing the affairs of the General Electric Company when that company seemed likely to ride rough-shod over the country, crushing out of existence scores of worthy companies and individual concerns. We still believe that our criticisms, however severe, were fully merited. If the *Electrical World* had done its full duty the Trust scheme would have flattened out months ago, instead of dying by degrees; the trade at large would have had ample opportunity to recover, and the present unfavorable conditions would not have been so serious in their effects.

But while we have emphasized the shortcomings of the oldest of our contemporaries we are not blind to its many good qualities, nor to its meritorious achievements. The issue of the *Electrical World* for August 26 was a credit, not only to its publishers, but to the trade it represents, and we felicitate its distinguished editor, Mr. Nelson Warhorse Perry.

……o……

The announcement of a receivership for the firm of Wallace & Sons will cause genuine grief throughout the trade. The firm's establishment at Ansonia has been for three decades closely connected with the electrical manufacturing business. Twenty years ago it was the common meeting place of many of the pioneers in the art, the scene of many interesting and valuable experiments, and in fact, the very centre of interest. It is indissolubly linked in memory with the early work of William Wallace, Farmer and Maxim, and was unquestionably the source whence Edison and Brush imbibed many of their ideas for subsequent inventions.

It is a pleasure to record the statement of the officers that the company is solvent, will pay its debts in full, and soon be running again. The reputation of these gentlemen leaves no room to doubt the correctness of their statements.

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As was generally expected, the troubles of Wallace & Sons forced the Ansonia Electric Company to seek the protection of the courts temporarily. The statement of the latter company is not yet to hand, but there is no doubt the assets are abundant to protect all creditors. We know that we speak for the trade at large in expressing the hope and the belief that the company will emerge from its difficulties as strong as ever.

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There is business to be picked up by a careful reading of Electricity's "General News" columns every week.

……o……

Mr. Nelson W. Perry, editor of the *Electrical World*, has resigned his position. Mr. Perry's work this summer has been of great value not alone to his paper but to the public. He possesses in a marked degree the genuine newspaper instinct and a wide fund of general information, both grounded upon a solid technical training. Mr. Perry cannot well be spared from electrical journalism.

……o……

A welcome addition to our exchange table is the *Engineering Review*, of London. Vol. I, No. 1, is just at hand, bearing the name of Mr. J. Stephen Jeans as editor. A couple of pages are very properly given up in this number to congratulatory letters from friends of the editor, among whom are H. Bessemer, Andrew Carnegie, W. S. Caine, W. H. Preece and W. T. Stead. The *Engineering Review* will be to engineering what the *Review of Reviews* is to current miscellaneous literature, and a good deal more. It ought to have as many subscribers in America as in England.

……o……

Notwithstanding the circumstance that the Edison General Company was in need of cash at the time of the consolidation, the facts remain that the Edison business was the foundation for the superstructure; that it was Edison assets which saved the Trust from wreck three months ago, and that the Edison business has been the only real profit earner in the combination.

……o……

For the deluded public who lost their money in General Electric there is cold comfort in the accusations of the Boston and New York factions that each was swindled by the other. Electricity hopes that both factions have suffered in pocket, as they have in reputation.

Eugene Phillips's Clambake.

Invitations are out for the fifteenth annual clambake tendered to the fraternity by the American Electrical Works of Providence, R. I., on Saturday next. The festivities of the day will be a very oasis in the desert of dulness and stagnation, and no doubt will be largely attended.

A Modern Cincinnatus.

The following extract from a private letter received from an old newspaper man, Mr. G. W. Pearce, is interesting. The articles referred to are those recently printed in a Boston daily in regard to General Electric affairs:

"Boston, August 23d, 1893.

"B. E. Greene, Esq.:

"*My Dear Sir:* . . . They were written by a State Street broker, who is laboring under the delusion that Mr. Coffin is the innocent victim of the wiles of 'wicked partner' J. Pierpont Morgan. I have not heard anything funnier since I interviewed Rube Burrowes, the Alabama train robber, at Flamington Junction during the yellow fever epidemic at Jacksonville. Rube found out that I was connected with a daily paper having a large circulation, and he requested me to inform my readers that he was not at all the bad man that he was painted, and that if he did steal from rich Yankees on the trains, he never failed to give liberally to the poor Confederate cripples in his county. So it seems by the statements *made by Mr. Coffin's friends* that the worthy ex-shoe man left his bench as Cincinnatus left the plow, to take up arms for his countrymen, and battle against the wicked schemes of Wall Street. Of course everybody in newspaperdom and in financial circles here knew that Coffin would make a silly fiasco of the Electric Trust, which was in the beginning and is now the most asinine organization of dotard speculators that the history of industrial enterprise records in pages blotched with the life blood of trustful investors."

Common Sense from Canada.

(The Canadian Electrician and Mining Review.)

We gather from recent personal interviews with persons interested in electrical matters in the United States, that the line of action taken by the General Electric Company towards manufacturers of incandescent electric lamps is regarded as a huge mistake. Most of the lamp manufacturers stood prepared to pay the General Electric Company a fair royalty on the production of their factories if a liberal disposition had been shown towards them. The attempt to crush them out of existence has aroused the determination that by some means they will survive. The minds of inventors have been stimulated to produce lamps which could not be proved to infringe the Edison patents, and in many instances they have succeeded. This fact, as well as the decision in the case of the Columbian Lamp Company, and the brief period constituting the future life of the Edison patents, has resulted in the entire failure of the coercive policy of the General Electric Company, which is likely to find little comfort in the reflection that its treasury is minus many thousands of dollars which, had its method been more conciliatory, it might have enjoyed possession of.

Receiver for Wallace & Sons.

Abundantly Solvent, but Unable to Get Cash.

Wallace & Sons, manufacturers of brass and copper goods at Ansonia, Conn., with offices at No. 29 Chambers street, New York, have been forced to suspend on account of inability to make collections. Thomas Wallace, treasurer of the concern, and Robert M. Thompson, president of the Orford Copper Company, have been appointed receivers, on the application of John B. Wallace, secretary, and Uri T. Hungerford, manager of the New York office.

The liabilities are placed at $875,000, of which $450,000 is on open accounts and $425,000 on notes. The nominal assets are put down at $2,000,000, of which the plant and machinery are valued at $1,000,000; book accounts, $600,000, which are supposed to be good, and merchandise $400.000.

Following the suspension of Wallace & Sons, the Ansonia Electric Company made application for a receivership, which was granted on Saturday last.

The Franklin-Oil City Electric Road.

The Oil City *Blizzard*, which is published six miles away from the county seat, heads a notice of the Franklin and Oil City Electric Railroad: "All Aboard for Franklin, for Business, Base Ball, Politics, Court or the County Jail."

A New Incandescent Arc Light.

Table I.—Efficiency Measurements.

Mean Current = 9 Amp. Mean P. D. = 55 Volts.

Angle.	0°	−10°	−20°	−40°	−50°	60°	+10°	+20°	+30°
L	7	12.3	17.	22.	20.5	13.5	8.5	7.	7.
T	155.	175.	120.	195.	180.	155.	135.	135.	135.
$\frac{L}{T}$	.045	.07	.094	.113	.114	.087	.063	.052	.052

Fig. 1 represents the curves platted from these

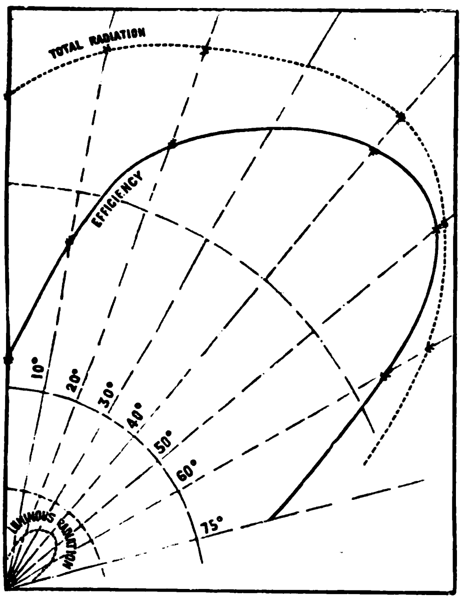

FIG. 2.

values, the dotted line curves showing the distribution of luminous and total radiation respectively, and the full line curve the measure of the efficiency below the horizontal.

The value of the mean hemi-spherical efficiency is obtained by integrating the curve, and is found to be 8.4 per cent. The mean efficiency of the ordinary arc is about 10 per cent.[1] The mean efficiency of the incandescent lamp, according to Merritt[2] is rather below than above 5 per cent. The value obtained in the test of this new light therefore lies between those of the two present forms of electrical illumination, approaching, however, more nearly that of the arc.

While it is true that the average efficiency of the electric arc in open air nets about 10 per cent., it is questionable whether in commercial practice in this country this value is often reached. The writer has made tests of a standard brand of arc light carbon where the efficiency was only $7\frac{3}{4}$ per cent.[3]

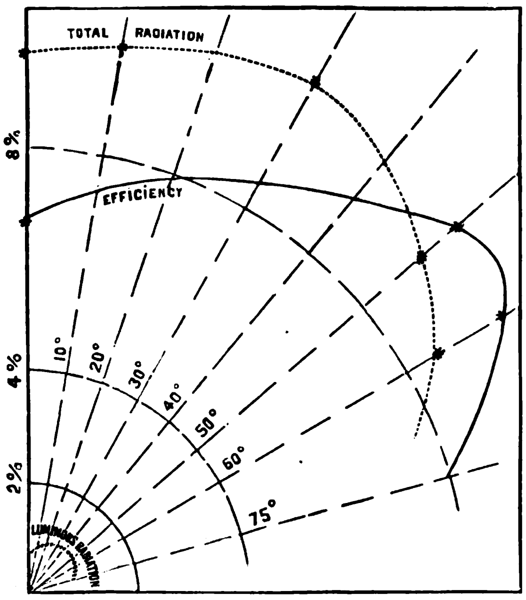

FIG. 3.

Glancing at Fig. 1, we note that while the form of the efficiency curve differs entirely from that of the incandescent lamp, it is not unlike that of the arc. The distribution of light-giving energy is, however, more uniform than in the arc, a fact which is more prominently brought out in comparing the candle power curves of the two. While the approximate law, *Hemi-spherical efficiency*, $= \frac{1}{4}$ *horizontal*, $+ \frac{3}{4}$ *maximum*, holds for the ordinary arc, the mean of several tests indicate that —

Hemi-spherical efficiency $= \frac{1}{2}$ *horizontal* $+ \frac{1}{2}$ *maximum*, fairly represents the conditions manifested by the *incandescent arc*, curves, Figs. 1 and 2.

Tests were made to determine the effect of initially coating the internal surface of the cylinder with various ingredients other than carbon. No marked difference in the efficiency was discovered. Fig. 2, platted from values in Table 2, represents a curve taken in this way. The mean hemi-spherical efficiency was 8.02 per cent.

Table II.—Efficiency Measurements.

Mean Current = 9 Amp. Mean P. D. = 55 Volts.

Angle.	−0°	−10°	−30°	−50°	−60°	+20°	+40°
L	10.5	12.0	14 0	15.5	14.0	10.5	8.50
T	155.	160.	170.	150.	140.	155.	150.
$\frac{L}{T}$	.168	.075	.082	.103	.100	.168	.067

CANDLE POWER MEASUREMENTS.

Table 3 gives the candle power measurements from which the curve, Fig. 3, was platted. Distances measured along the radii give the candle powers for the various angles throughout the "zone of useful illumination."

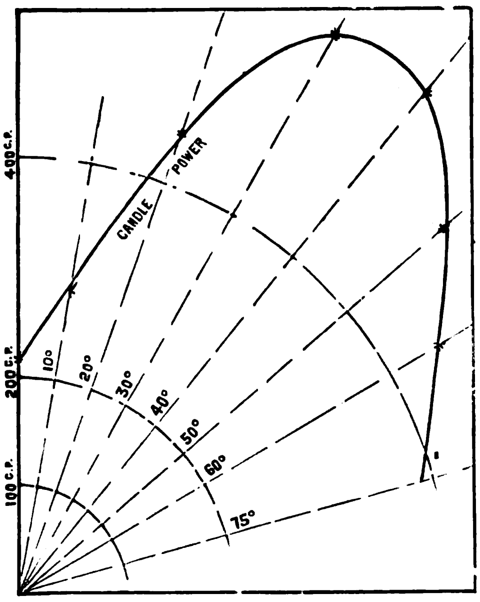

FIG. 4.

Table III.—Candle Power Measurements.

Mean Current = 8 Amp. Mean P. D. = 68 Volts.

Angle	0°	−10°	−20°	−30°	−40°	−50°	−60°	+20°
Candle Power.	218	283	455	590	595	515	450	170

(To be continued.)

A Curiosity.

A correspondent of the London *Electrical Review* tells of a 200 C. P. Swan lamp made of green glass for a ship's side light, which has been destroyed by the focussing of heat rays upon it by the reflector placed behind it. The heat has been so intense that the glass was softened, and the vacuum drew it in like the "kick" of a bottle, until the glass was perforated and the carbon consumed. He has another lamp drawn in also, but not perforated, the filament remaining intact. Both were softened on the side next the reflector, so that it is evident that the filament did not touch the glass, but that the mischief was done by the concentration of heat in the focus of the mirror. The green is very dark in the glass, and absorbs a lot of heat.

Performance of Street Railway Power Plants.

(Concluded.)

BY WM. A. PIKE AND T. W. HUGO.*

TEST NO. 3—THIRTY-FIRST STREET STATION, MINNEAPOLIS, OCTOBER 21 AND 26, 1892.

The plant at Thirty-first street consists of ten (10) 16 inches by 27 inches by 16 inches Westinghouse compound engines, nine of which are belted directly to Thomson-Houston generators ; the other is belted to an exciter and to an arc-light machine.

Five of the engines only were in service at the time of the test, and were connected to the main steam-drum in the boiler room by long 8-inch pipes with a number of ells and valves in each.

There are seven (7) Stirling boilers of 287 nominal horse power each. These are connected by 8-inch pipes to the main steam-drum above referred to.

During the first test, boiler No. 7 was disconnected from the steam-drum and used for furnishing steam for pumps, atomizers, etc., and enough of the other boilers were used to furnish steam to the engines.

During the variable load or service test, boiler No. 7 was not used, and the other boilers in service furnished all steam used for engines, pumps and atomizers ; all connections to boilers except those in use were blanked off or known to be tight.

The same apparatus for weighing water, oil, etc., and for determining other data, was used as in the tests of the other plants, except that iron tanks were used for weighing the water and the same precautions taken to insure that the results would be reliable.

Rheostat for Obtaining a Steady Load.

In order to obtain a steady load on these engines, it was first proposed to pass the current through a water rheostat composed of wrought iron rods ¼ inch in diameter, in a tank through which water was kept circulating. It was found, however, that after a short time scale, similar to that deposited in boilers, would collect on the rods and that then they would burn out. To obviate this difficulty, an open-air rheostat was extemporized by Messrs. Cooper and Morell, of the Street Railway Company. This rheostat consisted of 1,200 feet of ½ inch iron rods, clamped together and arranged in two sets of 600 feet each in parallel. This combination was supported on bearers placed across a repair pit in the car house. By this means it was found practicable to obtain a very steady load of any amount required, the only trouble being that in some cases the joints were imperfect, due to the haste in which the rods were put together.

Later tests, with a more carefully constructed rheostat, have given entire satisfaction. In this way a steady load can be obtained much more easily than by means of a friction or Prony brake, wherever engines are used for running generators.

STEADY LOAD TEST, OCTOBER 21, 1892.

It was intended to make a continuous run of eight or ten hours under a steady load, obtained by passing the current from the generators through the water rheostat above referred to. On account, however, of scale forming on the wires the rheostat burned out after a short time, and it became necessary to improvise a new rheostat, as also referred to above. This mishap reduced materially the length of the test under steady load, but the records were so carefully taken that each ten minutes gave results complete in themselves, so that the final results, as given below, are considered to be as accurate as if the actual running time were longer.

Summary of Results.

Duration of test	4 h. 25 m.
Average horse-power	783.3 H. P.
Average steam pressure at boilers	131.5 lbs.
Average steam pressure at engines	118.5 lbs.
Average moisture in steam	4 p. c,
Total water per hour, as evaporated	19,549.5 lbs.
Net dry steam per hour, as evaporated	18,798 lbs.
Average steam per horse-power per hour under above conditions	23.51 lbs.
Probable average steam per hour, if full boiler pressure had been had at engines (loss estimated at 4 p. c.)	22.47 lbs.
Average temperature of feed water	57.44 deg.
Total water furnished main boilers	83,063 lbs.
Amount of water collected from drips and loop.	1,760 lbs.
Net dry steam from main boilers	79,759.7 lbs.
Total water furnished for pumps, atomizers, etc.	14,540 lbs.
Percentage of steam required for pumps, atomizing oil, etc., as compared with steam used in engines, reduced to same pressure	15.9 p. c.

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[1] H. Nakano ; l, c.

[2] E. G. Merritt : *Amer. Journal of Science*, Vol. XXXVII, page 167.

[3] Trans. Amer. Inst. Elec. Eng., Vol. VII, Nos. 6 and 7, page 202.

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* Abstract of paper read at the Chicago Meeting of the American Society of Mechanical Engineers.

TEST NO. 3—A TEST TO DETERMINE COST OF ATOMIZING OIL.

To settle this question, a run of three and one-half (3½) hours was made October 24, 1892, during which the auxiliary boiler was used to furnish steam for atomizing the fuel oil only, and the amount of steam used for this purpose and also the amount evaporated for the use of the engines determined.

Results.

Total water from boilers used for service	53,734 lbs.
Total water from boilers used only for atomizing oil	8,330.5 lbs.
Average steam pressure in service boilers	132.7 lbs.
Average steam pressure in atomizer boiler	131.8 lbs.
Ratio of water used for atomizing to total water for all purposes	13.4 p. c.

TEST NO. 2*b*—TEST OF PLANT IN ACTUAL SERVICE, OCTOBER 26, 1892—LENGTH OF TEST, 20 HOURS 40 MINUTES.

Total water used in boilers	354,705.4 lbs.
Moisture in steam	4.05 p.c.
Total dry steam	330.517.2 lbs.
Average pressure in boilers	134.4 deg.
Average temperature of feed water	54.4 deg.
Average horse-power	522.5
Maximum horse-power	901.25
Minimum horse-power	77.49
Average dry steam per horse-power per hour	29.2
Average electric horse-power	434.2
Average loss in horse-power between engines and line (by difference)	88.3
Percentage of loss between engines and line	16.9 p. c.
Friction of engine alone in horse-power as determined by friction cards	14.27 h.p.
Percentage as compared with maximum horse-power of any one engine	3 7-10 p. c.
Equivalent water, from and at 212 deg., per pound fuel oil	14.48 lbs.
Equivalent evaporation per pound standard coal	9.87 lbs.
Cost of fuel oil for whole test	$99.07
Total car mileage	6,296.4
Cost for fuel oil per car mile	$.01573

Summary of Result, all Tests—Comparative Cost per Horse-Power per Hour.

From tests made at the Thirty-first Street Station, under the title of "Test No. 3," it is determined that the cost of running the necessary pumps and atomizing the fuel oil is, in percentage of the whole power	15 9-10 p.c.
Cost, in percentage of the whole power, of atomizers	13 4-10 p.c.
Cost, in percentag of the whole power, of pumps.	2 2-10 p.c.
Cost of fuel oil for main engines, "Test No. 1," using steam of 1⅛ per cent. saturation, with fuel oil costing $0.0226 per gallon, weighing 6 3-10 lbs. per gallon, per day, including atomizers	$157.85
Cost of running necessary pumps	3.95
Cost of running condenser engines	6.87
Total cost of power, "Test No. 1," per day	$168.67
Cost of labor, per day	51.50
Cost of lubricating oil and waste, per day	14.71
Total cost per day	$234.88
Cost, as above, per hour	10.92
Cost, as above, per horse-power per hour	$0.00881
Cost, as above, per electric horse-power per hour	0.01004
Cost, as above, per car mile	0.01346
Cost of fuel oil for main engines, "Test No. 2," using steam of 2 4-10 per cent. saturation, with fuel oil costing $0.0226 per gallon, weighing 6 3-10 lbs. per gallon ; per day, not including atomizers	$92.21
Cost of steam for atomizers	12.35
Cost of running necessary pumps	2.30
Cost of running necessary condenser engine	5.75
Total cost of power, "Test No. 2"	$112.61
Cost of labor, per day	23.83
Cost of lubricating oil and waste per day	7.82
Total cost per day	$144.26
Cost, as above, per hour	$6.76
Cost, as above, per horse-power per hour	0.00895
Cost, as above, per electric horse-power per hour	0.01083
Cost, as above, per car mile	0.01464

NOTE.—The slight difference between the cost per horse-power given here, and that from the other test, comes from assuming the cost of atomizing oil, running pumps, condenser engines, etc.—as given by percentages. The results are within less than one per cent. of each other, showing the cost of atomizing, etc.—as obtained directly and by the above percentages—to agree remarkably well.

Cost of fuel for main engines, "Test No. 3," using steam of 4 5-100 per cent. saturation, with fuel oil costing $0.0226 per gallon, 6 3-10 lbs. per gallon, per day, including steam used for atomizers, and necessary pumps	$99.04
Cost of labor, per day	16.83
Cost of lubricating oil and waste, per day	4.02
Total cost per day	$119.89
Cost, as above, per hour	$5.80
Cost, as above, per horse-power per hour	0.01110
Cost, as above, per electric horse-power per hour	0.01336
Cost, as above, per car mile	0.01904

It must be noted here in comparing the cost of power during "Test No. 3" with that of "Test No. 1" and "Test No. 2," that less than half of the power of the plant was used from which the data was obtained for "Test No. 3," and, consequently, the item of labor is somewhat high in proportion to the horse-power developed, for with double the horse-power the labor item would not be materially increased.

Comparison of Cost per Car Mile—Subdivided Power vs. Concentrated Power.

In making this comparison, the results as obtained from the above tests at Thirty-first Street are compared with those obtained from the test of the triple expansion engines at Power House No. 1.

In order that the results may be properly compared, the following assumptions are supposed to apply to both plants, though they were different when the tests were made :

Cost of fuel oil per gallon	$.0257
Evaporation, from and at 212 deg., per pound of oil	14.48 lbs.
Total car mileage to be provided for	17,118
Average horse-power for 21 h. 30 m. for above mileage, Power House No. 1	1,203.5
Average horse-power for 21 h. 30 m. for above mileage, Thirty-first Street Power House	1,173.0

NOTE.—This difference comes from the difference in friction at the two stations. At No. 1 it is estimated at 20 per cent., and at Thirty-first Street at 17 per cent.

The following figures, which are as close as could be obtained from the auditor's office, are the basis of the "fixed charges," which go to moke up total cost, and will serve as basis of comparison.

Value of real-estate and buildings, assumed to be the same for both plants for comparison.	$35,000.00
Value of engines, Power House No. 1	60,000.00
Value of boilers, Power House No. 1	25,000.00
Value of line shafting, Power House No. 1	15.500.00
Value of belting, Power House No. 1	5,000.00
Total	$105,500.00
Value of engines at Thirty-first Street	$35,000.00
Value of boilers at Thirty-first Street	25.000.00
Value of belting at Thirty-first Street	1.500.00
Total	$61,500.00
Rate of interest on investment	6 p. c.
Rate of depreciation on machinery, boilers, etc.	10 p. c.

Cost of Labor, Power House No. 1.

10 men at $55.00 per month	$550.00
4 men at $65.00 per month	260.00
1 man at $75.00 per month	75.00
1 man at $80.00 per month	80.00
1 man at $100.00 per month	100.00
Total	$1,065.00

Or $35.50 per day.

Cost of Labor, Thirty-First Street.

6 men at $55.00	$330.00
1 man at $75.00	75.00
1 man at $100.00	100.00
Total	$505.00

Or $16.83 per day.

Cost of superintendence reckoned at $2.75 per day per station.

Cost of Lubricating Oil and Waste, Power-House No. 1.

Cylinder oil, 126 gallons per month, at 50 cents	$63.00
Engine oil, 94½ gallons per month, at 25 cents	23 62
500 lbs waste at 10 cents	50.00
Total	$136.62

Or $4.55 per day.

Cost of Lubricating Oil and Waste at Thirty-first Street, if all Engines Were in Use.

Cylinder oil, 63 gallons	$31.50
Engine oil, 60 gallons	12.00
Crank-case oil, 378 gallons	56.70
Waste, 200 lbs	20.00
Total	$120.20

Or $4.00 per day.

Total Cost per Day of 21 *Hours* 30 *Minutes, at Power House No.* 1*—Car Mileage,* 17,118.

Fuel oil for 1,203 H. P. at rate of 25.4 lbs. water per horse-power per hour from and at 212 degs., and 14.48 lbs. water from and at 212 degs. per lb. oil	7,258 gals.
Cost at $0.0257 per gallon	$186.53
Interest on machinery	17.58
Interest on real-estate and buildings	5.59
Depreciation of machinery	29.30
Lubricating oil and waste	4.55
Labor	35.50
Superintendence	2.75
Cost per car mile, Power House No. 1, for fuel oil, labor, lubricating oil, waste and superintendence	$.013333
Cost per car mile for interest and depreciation.	.003065

Total Cost per Car Mile, Power-House No. 1, $0.16398.

NOTE.—This includes, as it should, 4 5 lbs. per horse-power per hour for condenser engines, pumps, atomizing oil, etc.

Total Cost per Day of 21 *Hours* 30 *Minutes, at Thirty-first Street, if Car Mileage Were* 17,118.

Fuel-oil for 1,173 H.P., at rate of 33 28 lbs. water per horse-power per hour	9,200 gals.
Cost at $0.0257 per gallon	$236.55
Interest on machinery	10.11
Interest on real-estate	5.59
Depreciation of machinery	16.88
Lubricating oil and waste	4.02
Labor	16.83
Superintendence	2.75
Cost per car mile, Thirty-first Street Station, for fuel, oil, labor, lubricating oil and waste, and superintendence	$0 01513
Cost per car mile for interest and depreciation.	0.00190
Total cost per car mile, Thirty-first Street	0.01703
Percentage in favor of concentrated power	3 2-10 p. c.

In this comparison of concentrated and subdivided power it has been our object to put both plants on the same basis as far as it is proper, and to make the result depend on the real difference between the two. For these reasons the Thirty-first Street plant has been treated as if it were covering the same mileage as the No. 1 plant, and that it required the same horse-power on the line to do it.

The result, as given above, shows very little difference in cost per car mile, and if the pressure at the engines were 140 lbs., as required by the contract for the engines, we estimate that at least 6 per cent. would be saved in steam, and, therefore, in fuel oil, which would bring the total cost per car mile down to $.01615 for the Westinghouse plant as compared with $.016398 for the No. 1 plant, or 1½ per cent. less.

In considering the relative adaptability of the two systems to street railway work it should be remembered that the subdivided system allows of the shutting down of one or more engines when not needed, as during the slack time in the forenoon, middle afternoon and evening. This would be felt in economy more when the plant was in full operation than under present conditions.

Another matter which cannot help affecting economy is the very rapid regulation of the smaller engines, thus adapting themselves more readily to variations in load than is possible with the engines of the Corliss type. In a regulation test, October 26, 1892, it was found that the governors on the Westinghouse engines were able to change from a very heavy load to a mere friction load within four revolutions, or one second of time.

(*Concluded.*)

World's Fair Notes.

Brush Electric Company's Exhibit.

The exhibit of the Brush Electric Company, which occupies a space near the southwest corner of the Electricity Building of the World's Fair, is one of the most comprehensive displays of electrical machinery to be found on the grounds. Included with the Brush exhibit is the Short and the Sperry Electric Railway Companies display of street railway apparatus. The space occupied by the machinery amounts to nearly 9,000 square feet, a portion of which is devoted to a small office that forms a very conspicuous object in this part of the building. It is of Greek architectural design and is used as an office and reception room by the representatives of the company.

As an exhibit the Brush Company have arranged a number of dynamos representing the various sizes and designs near the outer line of their space, the centre of which is occupied by racks of arc lamps and switchboards. A very interesting part of the exhibit is a collection of all machines which were built by the company in the first years of its existence and sold to various customers. Most of these machines have certificates attached, showing the date of sale and length of time in actual service. The illustration shown in the frontispiece is that part of the exhibit occupied by the switchboard which is used to distribute the currents to the various machines.

A New Arc Light Machine.

Said to Have 14 per cent. Greater Efficiency than Present Types.

The Westinghouse Electric and Manufacturing Company has perfected an arc-light dynamo which, it is claimed, is a great advance over anything heretofore made. It is a direct current machine, and is controlled automatically. It will be made in sizes up to 80 lights each, and is said to have shown an efficiency of 94 per cent. on actual tests.

On the Transmission of Electric Signals Through Space.

BY W. H. PREECE, F.R.S.[*]

In the year 1842, Henry showed how the disruptive discharge of a Leyden jar in an upper chamber of his house magnetized needles in a cellar 30 feet below.

The introduction of that beautifully sensitive instrument, the telephone, in 1877 made us acquainted with disturbances and influences between neighboring wires at a distance which surprised every one. Morse signals, cross talk, strange noises, impaired the efficiency of telephone working.

In 1884, telegrams sent to Bradford (England) in Morse characters from the General Post Office, London, through a gutta-percha covered copper wire in an underground iron pipe, buried in the street, were read upon an open telephone circuit consisting of an iron wire carried on poles on the housetops 80 feet away.

In 1885, Mr. Edison showed how it was possible to communicate with a moving train by utilizing the electrostatic influence between a circuit erected upon the poles on the side of a railway and a telephone circuit carried by the train.

In the same year, I made many experiments to determine whether the effects observed in England were due to electro-magnetic induction, and were quite independent of the earth; and also to find out how far the distance between the wires could be extended before this influence ceased to be evident.

With our ordinary telegraph working currents the region of disturbance reached a distance of 3,000 feet, while the effects were detected on parallel lines of telegraph 10¼ miles apart, between Durham and Darlington. Even between the East and the West coasts at the border, a distance of 40 miles, currents produced at Newcastle on the Jedburgh line were distinctly heard at Gretna on a parallel line. These later results, in the North of England, were vitiated by the presence of a large network of railway and other telegraphs between the two places, and as they may not have been due solely to direct electromagnetic induction through space, but to electrostatic effects between neighboring wires as well, I took a district in the West of England, between Gloucester and Bristol, along the banks of the River Severn, where for a length of 14 miles, and at an average distance apart of 4.5 miles, no intermediate disturbing conductors existed between the pole lines. The Valley of the Mersey, and several other localities in England where no disturbing elements existed, were similarly investigated.

It is necessary at the outset to point out that if we have two parallel conductors separated from each other by a finite space, and each forming part of a separate and distinct circuit, either wholly metallic or partly completed by the earth, and called respectively the *primary* and the *secondary* circuit, we may obtain currents in the secondary circuit either by conduction or by induction, and we may classify them into those due to—

1. Earth currents.
2. Electrostatic induction.
3. Electro-magnetic induction.

It is very important to eliminate (1), which is a case of conduction, from (2) and (3), which are cases of induction.

1. EARTH CURRENTS.

When a linear conductor dips at each end into the earth, with which it makes a good connection, and voltage is impressed upon it by any means, the resulting return current would probably flow through the earth in a straight line between these two points if the conduction of the earth were perfect; but as the earth, *per se*, is a very poor conductor indeed (and probably is a conductor only because it is moist), lines of currents flow spread about symmetrically in a way that recalls the figure of a magnetic field. These diffused return earth conduction currents are evident at great distances.

These lines of current-flow are very easily traceable by means of exploring earth plates or rods. The primary current is best produced by alternating currents of such a frequency as to excite a distinct musical note on a telephone, and if these currents rise and fall periodically and automatically they produce an unmistakable wail. If they are made and broken by a Morse key they can transmit readable signals. The secondary circuit, which contains the receiving telephone, is completed in the case of the earth by driving two rods into the ground, or, in the case of water, by plates dipping into the water at a distance of from five to ten yards apart.

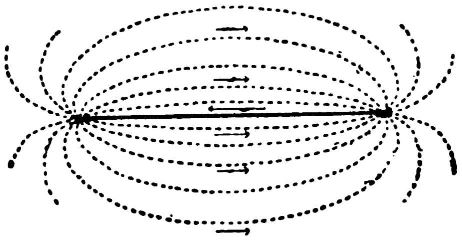

FIG. 1.

In this way the town moor near Newcastle, the sands and the land about Lavernock and Penarth, on the coast of South Wales, the water of the Bristol Channel, the towns of Liverpool and Leeds, and London itself, have been thoroughly explored; and it has been proved that the distance to which these lines of flow can be detected depends upon the intensity of the primary current flowing, on the area of the surfaces in contact with the earth, on the resistance of the portion of the earth utilized, and on the dryness of the season. In London the currents working the City and South London Electric Railway affect recording galvanometers at Greenwich, 4½ miles away, and a diagram of the train service on the railway can be recorded in any part of the metropolitan area.

FIG. 2.

The distance in sea water is not so extensive, for the latter is a better conductor than earth; still, with primary currents of 15 amperes, effects have been traced to one-third of a mile.

In all cases where disturbances have been created by electric tramways they have been shown to be greater in summer than in winter.

FIG. 3.

It is very necessary to be able to distinguish or separate these earth currents from currents due to induction, for they are very apt to give false effects and to lead to erroneous conclusions. This is easily done, if the instrument be sensitive enough, by making the primary current continuous when the earth current also becomes continuous, while induction currents are momentary and are observed only during the rapid rise or fall of the inducing cause.

ELECTROSTATIC INDUCTION.

When a body, A (Fig. 2), is electrified by any means and isolated in a dielectric, it establishes an electric field about it. Lines of electric force are projected from it in every direction; and if in the direction of any of these lines of force there is placed another similar body, B, it is also electrified by induction. If B be placed in connection with earth, or with a condenser, or with any large body, then the charge of the same sign as A is conveyed away, and B (Fig. 3) remains electrified in the opposite sense to A, and to the same amount A and B are seats of electric force. They form a stress, and are the ends of a line of force. The dielectric between them is displaced or polarized electrically. It is in a state of strain and remains so as long as A remains charged, but if A be discharged, or have its charge reversed or varied, then similar changes occur in B and through the dielectric separating them.

If A (Fig. 4) be a flat disc electrified positively and be placed inside a ring, B, then the ring becomes the termination of lines of electric force, and the sum of their terminal negative charges is equal to the whole positive charge of A. A may, in each of the above cases, be the section of a continuous wire or conductor forming part of a complete circuit. The charge on A may be due to the electric force of a primary current, while in the secondary conductor, B, the displaced charge in flowing to earth establishes a momentary current whose direction and duration depend on the current of A and on its rate of variation.

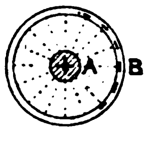

FIG. 4.

The strained state of the dielectric and the charges on A and B remain quiescent as long as the current flows steadily; but if the primary current ceases or falls, then we have the secondary currents in each conductor, as shown by the arrows, and flowing until equilibrium is restored.

The secondary currents, due to discharge, flow in opposite directions at each end, and there is always some intermediate zero point.

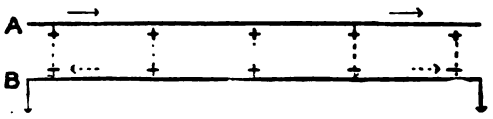

FIG. 5. DURING CHARGE.

It is thus easy in long circuits by observing their direction to differentiate currents of induction due to electric displacement from those due to electro-magnetic disturbance.

The dielectric plays just as important a part in the electrical operations that occur as do the conductors. Its molecular disturbance cannot be neglected. It is subject to strain and variations of displacement in one direction, while it is permeated by a wave of energy in another direction, viz., in the direction of the primary current. In fact, it is a question much discussed at the present day whether the prime action in all current effects is not this wave or flux of energy passing longitudinally through the dielectric in the direction of its length, and that nothing whatever passes through the conductors, which are mere passive agents in the matter, wasting energy but not transmitting it.

There are two views of the formation and support of a current. The one following Faraday regards it as the continuous discharge of the continuous charged molecules of the conductor, the action originating in and being propagated uniformly throughout the conductor. The dielectric plays only a secondary part. The other, derived from Maxwell by Poynting, regards a current as the consequence of the propagation of a wave of electrical energy through the dielectric in the direction of the line and which reaches the wire from the exterior. The conductor plays a secondary part; it simply dissipates the energy conveyed by the dielectric. The current is set up on the surface, and it penetrates the interior comparatively slowly, while its distribution in any given sectional area of the conductor is not uniform.

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[*] Paper read at the International Electrical Congress, Chicago.

The truth lies probably in a combination of each view. The dielectric is as much an essential agent in the action as the conductor, and in each plane perpendicular to the current the charge and discharge of contiguous molecules, the formation of an electric field, the formation of a magnetic field, the flow of energy across this plane and parallel to the conductor, its dissipation as heat in the conductor, are all simultaneous and self-dependent, and equally concerned in the final result.

In a complete metallic loop, like a telephone circuit, the energy is propagated in the dielectric between the wires; it is dissipated in the wires; there are longitudinal waves propagated through the dielectric parallel to the wires, and there are other circular electro-magnetic waves emanating from each conductor as a centre and flowing as a resultant in planes perpendicular to the wires. Thus there are lines of electric force, lines of magnetic force, and lines of energy-flow. The first determine displacement, and are controlled by electrostatic capacity; the second determine electro-magnetic disturbance, and are controlled by inductance; the third determine transformation of energy, and are controlled by resistance. Time enters into the consideration of the longitudinal flow of the energy through the system, of the electro-magnetic disturbance through the dielectric at right angles to this flow, of the rise and fall of the current at each point of the circuit, of the character of the current at each point of the circuit, of the character of the current, whether continuous or alternating, and, if alternating, of the frequency of the complete alternations.

The effects of electrostatic induction do not play an important part in the inquiry immediately before us, but they are of great consequence in considering questions of speed of signalling in submarine cables and clearness of speech in long distance telephony.

(To be continued.)

New Beacon Lamp at 44 Broad.

The General Electric Company is magnanimously doing a fine piece of gratuitous advertising for the new incandescent lamp that has recently been put on the market by The Beacon Vacuum Pump and Electrical Company. As if conscious that other processes than those of actions at law must be followed to secure the supremacy of the Edison lamp, the officials of the General Electric Company have adopted this method of comparing their own with other lamps' and a number of "New Beacon" lamps have been placed on service in the chief offices of the General Electric Company at 44 Broad street.

We believe that not so much to enjoy the superior brilliancy of this new lamp as for comparison with Edison lamps were these "New Beacons" installed. Be that as it may, amusement has been caused by this unwonted action on the part of the Trust, as it displays unmistakably the serious straits to which that gigantic concern has been reduced for an argument against the new Beacon lamp. Were it possible to suppose for a moment that, in attempting such a comparison or contrast, the General Electric Company would act in a fair and unbiassed manner—a thing that has never yet been known to be done under any circumstances since the Trust was organized, the makers of the "New Beacon" would have no fear of the results; and even with sinister efforts being made to discredit the new lamp, nothing but benefit can accrue to the manufacturers for the publicity thus given their new lamp. The Beacon Vacuum Pump and Electrical Company is feeling grateful almost beyond expression for the splendid advertising its new lamp is receiving from its quondam opponent, the General Electric Company.

Charcot and His Fruitful Labors.

The death, at Morvan, France, of Jean Martin Charcot, which has lately been announced, recalls the significance of his labors in the new field of electro-therapeutics, and the extent to which the world is indebted to the French physician and scientist for his earnest recognition and upholding of the value of electricity in medicine. It is unquestionably much to these labors, and to the enthusiasm and conscientious work of those who took their inspiration from them, that the marvellous possibilities that are now opening out in the most merciful and efficacious method of alleviating and curing disease that the world has known are due.

Dr. W. J. Morton, who is deservedly recognized as the leader of electro-therapeutic development in this country, was for some time a student with Charcot, and on being asked by a representative of ELECTRICITY for some details of the character and work of his illustrious master, he said:

"In the death of Charcot the medical profession of the world has met with an irreparable loss. His was a unique, one might say an isolated character, in the sense that he combined both the true scientific spirit of hard work ever conducted on a pathological basis, i. e., upon postmortem findings, together with the happiest facility for culling, systematizing and popularizing the results of his labors. In this sense, I may truly say, he was most remarkable, and ranks with such men as Virchow and Pasteur. Enthusiastic by temperament, he never allowed his enthusiasm to get the better of his reason. Keen to detect isolated and hitherto unobserved medical anomalies, he never rode a hobby, but viewed his single facts in a grand correlation with all knowledge. His character was so broad and generous that he gathered about him special workers in all directions of medicine, stimulated them individually to special research, imbued them with his own confidence and methods of labor, and finally, so to speak, aided their combined labors so that the entire medical world got the crystallized benefit of their aggregate toil. By these methods he created what can only be regarded as a school of medicine, for the results of his work are as peculiar y stamped with the impress of his character as they are everlasting. His published works constitute a small library in themselves, and cover a very wide range of subjects.

JEAN MARTIN CHARCOT.

"The time that I spent at the Salpétrière in Paris. listening to Professor Charcot's lectures, I now look back to as the most instructive and delightful experience that has occurred to me in a medical life. I returned to America full of these new ideas, as well as of a vast amount of clinical and pathological instruction in the class of nervous diseases. I gave many demonstrations to physicians, illustrating the Charcot methods, hypotheses and facts of mesmerism, and introduced into this country the use of statical electricity."

Dr. Morton was here asked what were likely to be the developments in this country in the near future on the foundations thus laid by Charcot. He replied: "Well, we shall soon see some wonderful developments, although our progress has been comparatively slow. Like all pioneers, I found the conservatism of set barriers difficult to move. To push these ideas was like sticking a lance into the mud; the hole was no sooner made than it filled up again. To-day I have the inestimable privilege that all may have who in the beginning, knowing they are right, persist, of seeing both hypnotism and static electricity fully and cordially recognized. You ask me regarding Charcot's relations to the advancement of electro-therapeutics. I can only say that his mind was singularly alert to therapeutic measures, medicinal, mechanical and electrical. His great desire was to cure diseases. You know it has been said of many very scientific physicians that their interest in a case was confined to a diagnosis and a postmortem. It was, however, not so with Charcot; he took not only scientific but also a humane and practical interest in suffering humanity. So far as electricity goes, the world owes to him the introduction of static electricity into general practice. His experiments, to me, formed a nucleus about which has accumulated ideas of practice not yet fully fledged, and yet which I believe must, in time, in the hands of an advancingly educated profession, grow into a system and method of treatment of a large class of diseases, especially chronic diseases, superior to any we now possess. Static electricity is essentially high frequency, high potential current. For me such currents have ever possessed a fascination. They represent not the old-fashioned chemical decomposition of the continuous current, but represent energy acting intermittently. It is this sort of energy, whether in its electric forms or manifestations or in other forms of vibration, that is charged with an influence over the constituent parts of our human bodies which is mechanical rather than medicinal. In medicine, thus far, I have only heard or read in books of the conductive circuit or the inductive circuit, both of which may be measured in terms of Ohm's Law; but I intend to call attention, in future, in a more extended manner to the action upon human tissues due to the electric stresses, strains and displacements of known conductive tissues; namely, of dielectrics. This involves the construction of the electrostatic field. This is a field established between two charged bodies—every surge or wave in one or the other of these charged bodies produces an equal surge or wave in the intervening electrostatic field, and every dielectric or known conductor within this field is displaced, disturbed or strained synchronously with the initial disturbance. Now this initial disturbance may be in the shape of a spark drawn from the patient sitting on an insulated platform; may be set up by the discharge rods, with the patient in the same position; may be obtained from the electrostatic qualities of induction coils, with condensers in circuit, or in many ways where the electrostatic qualities of electricity are called into play intermittingly. This is a widely different effect from anything to be obtained by current strength in amperes, by magnetic lines of force, from electro and permanent magnets, or from the magnetic field of coils. Each nerve fibre of the human body, together with its connecting cell, constitutes an individual entity. Its sheath and structural framework is dielectric. Each cell, each muscle fibre, each gland cell, is more or less of the same homogeneous type. Conceive of the vast electrical shimmer or thrill to which such tissues are subjected from the electrostatic surges, and you may conceive, as I do, of a system of electro-therapeutics till now unknown and undescribed.

"In one sense, Charcot builded better than he knew when experimentally he had the courage to revivify statical electricity, for in doing so he has furnished others of us a hint to pursue the high frequency, high potential currents to further and legitimate limits. I believe, as I have just pointed out to you, that they will in the end, prove to be of incalculable value to mankind."

Personal.

Mr. W. H. Hall is to have charge of the electrical department which has been added to the course at the Baltimore Polytechnic Institute, formerly the Baltimore Manual Training School.

Mr. W. Oswald, general manager of the Southern Electrical Manufacturing and Supply Company of New Orleans, passed through New York last week on his return from a four months' trip abroad.

Mr. H. M. Littell, president of the Crescent City and New Orleans and Lake Electric Railway lines of New Orleans, is a visitor in New York.

Electricity in Mining.*

BY F. O. BLACKWELL.

It is roughly estimated that some three hundred companies in the United States engaged in mining and the kindred arts now employ electricity in their operations. As all these plants have been installed within the last few years, it is evident that mining engineers have been quick to appreciate the great advantage of the use of electricity and adopt it for their many requirements. In underground workings the chance of accident resulting in loss of life and destruction of property is, at the best, great. Humanity and economy both demand that any means that will secure greater safety should be eagerly grasped. It is an established fact that to add to the comfort and facilitate the work of the miner is to diminish financial risk and increase profits.

Electricity tried under the arduous conditions of mining service has been shown to be peculiarly efficient, safe and reliable. It presents a system of the greatest simplicity, completeness and flexibility, permitting power from one source to be distributed in units of any desired size and for any purpose to the places where it can be employed to the greatest advantage, thereby securing the minimum consumption of power and expenditure of labor. With electricity there is neither friction, heat nor condensation. There is no leakage nor loss of power when not in use, which especially recommends it for intermittent work. It is not affected by heat or cold, and does not vitiate the air, as is the case with steam and compressed air. The rapid deterioration of timbering, a source of great expense in all mines, due to bad air and heat, is to a great extent obviated. It has been urged against electricity that it increased the risk of fire. As a matter of fact it greatly decreases it, as the statistics of insurance companies testify. With proper safety devices and a system of concentric wiring it is practically impossible to start a fire from the current. To the engineer accustomed to speed indicators, pressure gauges and indicator cards, electrical methods of measurement seem particularly simple. The work being done by motor or generator at any instant can be read directly from a scale and, if desired, automatically recorded. If necessary motors can be controlled from a distance without difficulty.

The prime source of power is first to be considered. By conversion into electrical energy, water power, even at a considerable distance from the mine or mill, can be made valuable for all purposes, and steam power can be so located as to secure fuel and water cheaply. In addition to this, one large engine costs less, is more evenly loaded, requires less attendance, and is necessarily more efficient than a number of small ones. The introduction of electricity has in this way made important reductions in the cost of power, and there are cases in which it would be impossible to run without its help. An example is furnished by the Virginius Mine at Ouray, Col.; 300 horse power is carried at 800 volts from a water power four miles distant. The cost of coal at the mine was formerly $18 per ton, which would amount, for the present plant, to about $80,000 per year, equaling the total cost of the electric plant. The item of fuel was a complete saving, the expense of operating the steam and electric plant being about the same in other respects. Several mines in Colorado are operated by electricity that could not be by steam on account of their situation on the face of precipitous cliffs, up which the transportation of water and fuel would be nearly impossible. The character of the country over which the power had to be carried for the Virginius plant is exceedingly rough. A portion is at an elevation of 12,700 feet above sea level and well above the snow line.

ELECTRIC POWER TRANSMISSION AND DISTRIBUTION.

The cost of copper with any fixed loss, power and distance varies inversely as the square of the voltage. It is, therefore, evident that as high a voltage as possible should be used if economy of copper alone is to be considered. When the power is carried over long distances the cost of copper is the largest item of expense. For general distribution, especially underground convenience of insulation and handling are of more importance and call for a low potential. Nearly all the plants now in operation are supplied with current at 220 or 500 volts. There are a number, however, in which voltages of 1,000 and over are in use; notably at the Poorman, Comstock, and Calumet and Hecla mines. When bare wires are used, as for haulage, we are limited to a potential of 500 volts. Direct current generators are confined, by difficulties of construction, to potentials of less than 1,500 volts. The distance over which direct current can be economically carried at this potential is about four miles. Above this point alternating currents are used.

Alternating currents are particularly desirable on account of the ease with which the electrical pressure can be changed. By means of transformers without moving parts the high potential used for transmission is converted into low pressure for distribution. Alternating generators are wound for as high as 5,000 volts, but it will probably be found better to limit them to 2,500 volts. This potential permits of economical transmission to a distance of seven or eight miles. Above that distance step-up and step-down transformers are used. At present we do not care to go above 10,000 volts, which places the limit of about twenty-five miles to practical work. Alternating current motors possess nearly the same properties as those built for direct current. They have the advantage of being commutatorless, but can not be so heavily overloaded as a series wound direct current motor. They are, therefore, not as suitable for railway or hoisting service. Direct current can, however, be readily obtained from alternating by means of a rotary transformer which is a combined alternating motor and direct current generator. Motors have been designed to meet all the special requirements of mining work, and I will give a short description of some of the more recent applications.

ELECTRIC DRILLING.

Although it has been a matter of great difficulty to make an electric percussion drill which would stand the continual abuse and hard usage to which air drills are subjected, they are at present in constant and successful operation. By care in designing the coils so as to make them fire-proof and rigid they have been made to stand the strain. The drill consists of an outer iron pipe casing inside of and attached to which are two coils and the ratchet mechanism. The plunger, equipped with the ordinary chuck and rifle nut, is in the centre of the coils. The coils are supplied with current alternately and draw the plunger up and down at a speed fixed by the generator which supplies the current.

Electric diamond drills are in use for drilling solid holes and for removing cores for prospecting purposes. For prospecting both above and under ground the electric drill is particularly available, as it is extremely light and compact, and temporary wires can be run to places where it would be difficult to carry steam pipes or boilers.

ELECTRIC COAL CUTTING.

Electric coal cutters are now largely in use in the bituminous mines. In the machine most employed the coal is undercut by means of bits set in a rotary bar on the end of a sliding frame which is fed into the face of the seam. Other cutters are constructed with a sprocket chain to the links of which are affixed cutting tools. Machines of this kind can be fed either in or along the face of the coal for long wall or room working. In both of these the electric motor is built into and forms part of the frame, adding but little to its weight. In exceedingly hard or pyritiferous coals, which can not be cut with a continuously moving cutter, an electric pick machine is advantageously used. This also has the advantage of giving a kerving wider at the front than at the back of the cut, which allows the coal to fall outward and more lump coal to be gained. The motor draws a projectile back against a spring and releasing it lets the pick fly against the face of the coal at the rate of 150 blows a minute. Electric drills for putting in holes, for blowing down coal after it has been undercut or from the solid, as is done in anthracite, are also used. Mounted on a column a machine of this kind is free to drill in any direction from horizontal to vertical. A drill of this type, of 100 pounds' weight, will easily drill a $1\frac{1}{2}$-inch hole at the rate of six feet per minute in hard or soft coal.

VENTILATING.

It is often desirable in order to obtain the best results from fans and blowers to locate them at the most distant points from the surface. This is done more easily by electricity than by any other power, and the blowers can be readily advanced as the workings are pushed deeper. The electric motor is especially suitable for high-speed blowers, which are efficient and occupy but small space. Much saving in piping can also be effected by using higher velocities and forcing air out from the inside rather than sucking it from the surface. Fans can be controlled by a shutter on the outlet pipe or the speed of the motor may be varied.

ELECTRIC LIGHTING.

It has been found that much more work can be gotten from men by giving them better illumination. By avoiding the use of oil lamps and candles the air is left purer, and both time and power saved by doing work underground which would otherwise have to be done on the surface. Electric lighting also reduces the risk of accident by calling attention to conditions which would otherwise pass unnoticed. In gaseous mines, where many explosions have resulted from the reckless use of miners' lamps, electric lighting is invaluable.

METALLURGY.

It is impossible to go fully into the electro-metallurgical and electro chemical processes now in use. The refining of black and blister copper has reached large proportions, fully one-third of the copper refined in this country being electrically treated, and considerable quantities being shipped abroad. By this process gold and silver are obtained from the matte, the recovery of which would be impracticable by any other method. Gold, silver and lead are also beginning to be refined electrolytically. Aluminum and silicon are gotten almost exclusively by electric smelting and reducing. Caustic soda, sodium, chloride of lime and vermilion are commercially obtained by electrolysis.

I have not, within the scope of this paper, been able to deal with all the many and constantly increasing applications of electricity, but enough has been said to make evident its far-reaching importance to the mining industry.

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* Abstract of paper read before the International Engineering Congress at Chicago.

Current Items.

A movement is on foot in Cincinnati to organize a society to be called the Cincinnati Electrical Society. City Electrician Cabot, Thomas Creighead, of the Creighead Engineering Company, and Thomas F. Cohesey, of the Commercial Telegraph Company, are pushing the project. The object of the organization will be advanced discussion of the science of electricity in all its branches.

Professor Weston, in answer to the question how the trouble arising from the action of electric currents on water pipes can be prevented, is reported to have said: "In one way only, if a single trolley line continues to be used with the earth in circuit, and that is by insulating the pipes in some moisture proof material. With a double trolley road, that is with two wires above the car and two trolleys, there would be none of this trouble."

To obviate the blinding effect of the direct rays of searchlights on the pilots of vessels passing through the Suez Canal, the canal authorities have issued an order making it obligatory after October 1 next, on all vessels passing through the canal by night, to employ an apparatus for dividing the light of the projector into two divergent rays. Approaching vessels may, by this means, travel right up to each other without their respective helmsmen being blinded. The diverging apparatus which is to be used has been devised by one of the agents of the company.

Canadian Electrical Association.

The Third Convention of the Canadian Electrical Association will be held at Toronto, September 12, 13 and 14. The following papers will be read:

"Some of the Causes of Interruption to Telegraph Circuits," Mr. Fred. C. Robertson, Toronto.

"Water Wheels," Mr. A. C. McCallum, of Peterboro.

"The History of the Telephone in Canada," Mr. L. B. McFarlane, of Montreal.

"Electrical Education," Mr. E. B. Merrill, Toronto.

"Direct Connected Dynamos and Steam Engines," Mr. John Langton, Toronto.

"Electric Street Railways," Mr. E. Carl Breithaupt, of Berlin.

On Thursday, the 14th, the delegates will enjoy a special excursion to Niagara, and will take a ride on the new electric road.

General News.

What is Going on in the Electrical World.

Muskegon, Mich.—The Shaw Electric Crane Company will hereafter manufacture the dynamos to sell with its cranes.

Asbury Park, N. J.—The new Asbury Park and Belmar electric railway has been completed as far south as Shark River.

Plainfield, N. J.—The Plainfield Electric Street Railway Company is now planning to extend its line to Netherwood.

Hagerstown, Md.—The Schuyler Electric Light Company has added a 75 H. P. engine to its plant, and will extend its service.

Belmar, N. J.—The electric light system on Ocean avenue has been completed, and arc lights now illuminate the thoroughfare.

Seattle.—An ordinance has been introduced providing for the construction of a subway and the placing of all wires underground.

Hastings, Neb.—Owing to difficulties with the local lighting company, the town is considering the feasibility of putting in a plant of its own.

Brooklyn, N. Y.—Experiments are being made on the Atlantic Avenue line with a view to having the entire system equipped with air brakes.

Toledo, O.—The city council is still wrestling with the municipal plant problem, and has received many tenders for supplying the needed apparatus.

Franklin, Pa.—The boiler in the electric light station exploded on the 21st, killing one man, and wrecking the entire building and machinery; loss $25,000.

Mauch Chunk, Pa.—The electric railway system is completed, the poles and wires are up, and ready for business, connecting the three sections of the town.

Elwood, Ind.—The Elwood Electric Street Railway Company is contemplating an extension of its lines to Alexandria via Orestes. The distance is ten miles.

Franklinville, N. Y.—The electric lights were turned on here on Friday night for the first time. Everything worked smoothly, far beyond the expectation of the company.

Cincinnati.—Messrs. A. J. Baker, D. J. Hauss, Oliver Kinsey, W. H. Jones and E. A. Sarran have been appointed a committee on by-laws for the proposed electrical exchange.

Paw Paw, Mich.—The town has sold $15,000 of electric light bonds to an Adrian bank and will build its own plant. Water power has already been purchased for that purpose.

Providence, R. I.—Arbitrators have agreed upon 38½ cents per night for each arc light for street purposes furnished for this city by the Narragansett Electric Light Company.

Indianapolis, Ind.—The Citizens' Street Railway Company announces that it will put in service on the week of the National G. A. R Encampment twenty-five new motor cars.

North Attleboro, Mass.—The Attleboro Electric Light and Power Company will build a plant here. The building is to be 55 x 77. The plans were drawn by Loring & Phipps of Boston.

Auburn, N. Y.—The common council has appropriated $25,000 to be paid to the Auburn Electric Light Company for lighting the city for one year—the full amount of the company's offer.

Rochester.—The Glen Haven narrow gauge steam road, running to the lake, has so far proved a failure, owing to the heavy grades, and the company will be compelled to adopt the trolley.

Mobile, Ala.—The Mobile Street Railway Company has formally opened its electric line, the cars are painted in white and gold, and are very striking. Mr. Raphael Semmes is the general manager.

Wilmington, Del.—The projectors of the New Castle and Wilmington Electric Railway will begin its construction at an early day. Application has been made to the New Castle council for permission to lay tracks in the streets.

Yarmouth, Me.—The lighting plant, which has been in process of construction for three months, has been completed, and the town is lighted by electricity for the first time. Messrs. Loring & Gould did the construction work.

Saline, Mich.—A franchise is to be had by any company that will construct an electric railroad from Adrian to Ann Arbor and take in intermediate towns. The franchise is for 30 years and stipulates that a power-house shall be built at Saline.

St. Joseph, Mo.—The city electrician will hereafter be compelled to fill an exhaustive monthly report covering every pound of material used and every dollar spent on the light plant, so that it can be quickly told just what the operating expenses are.

Longmont, Colo.—The Colorado Electric Light Association at its annual meeting at Colorado Springs elected J. J. Elliott, of Idaho Springs, president; M. T. Moreland, of Golden, vice-president, and C. M. McCamer, of Longmont, secretary and treasurer.

Niagara Falls.—The Cataract Construction Company has begun work on an underground conduit for conveying electric cables from the wheel-pit to the site of the proposed plant of the Pittsburg Reduction Company, the construction of which is to be begun soon.

Kingston, N. Y.—The Colonial City Electric Railway Company, which has asked for a franchise, has offered to give its note for $10,000 as a guarantee that the road shall be completed within a year. Messrs. Wendell Goodwin and Frederick Swift are the leading men interested in the company.

Noblesville, Ind.—The scheme for connecting a dozen Indiana towns with Indianapolis and Chicago by an electric line has collapsed, and the two promoters, E. J. Pennington and N. D. Pontious have fled, after obtaining perhaps $5,000.

Dubuque, Ia.—There is a little war between the Dubuque Light and Traction Company and the Star Electric Company, and the employees of the former company are threatened with arrest for cutting down the poles which either has the right to use.

New York.—The Broadway Cable Company has made application for permission to lay signal wires in its conduits to be used for signalling the power houses in case of accidents. The Third Avenue Railroad Company made a similar application a year ago which has not been granted.

Detroit.—The Public Lighting Commission has awarded the contract for the electric light conduit system to Liphardt & Winterhalter, the lowest bidders, and work will soon be commenced. The St. Clair Tunnel Company is considering the advisability of adopting electricity as a motive power in the tunnel.

Portland, Me.—At the recent annual meeting of the Bradbury-Stone Electric Storage Company it was decided to purchase the property and rights of the sub-companies at Kittery, Me., East St. Louis, Ill., and Sioux City, Iowa.—The Bath electric line has been formally opened, and cars are now running regularly.

Boone, Ia.—After a year and a half without electric lights of any kind, Boone is now rejoicing over the completion of the best built electric plant in the State, operating both arc and incandescent lights. The company has a power-house amply large, and expects to supply the power for five miles of electric road which it will soon build.

Annapolis.—Foundations have been laid at the Naval Academy for the new power-house. When it is completed eight boilers will be put in, and three boilers will supply steam-power now utilized at the Academy in heating the public and private buildings. These dynamos will be placed in the building to supply light and power through the grounds.

Binghamton, N. Y.—The trustees of the State Hospital have decided to advertise for bids on the following proposals: "First, to furnish a complete electric lighting plant on the river bank; second, to equip a complete plant on the asylum grounds; third to supply the necessary power from the city's plant, and fourth for wiring the State Hospital buildings for electric lighting purposes."

Removal.

The offices of the Star Electric Lamp Company and the Sunbeam Electric Lamp Company have been removed from the Chamber of Commerce Building, Chicago, to No. 102 Michigan avenue.

Boston Notes.

Captain W. Brophy, the well-known electrical and insurance expert of this city, has raised a small cyclone about his distinguished personality by reason of an utterance of his made on Wednesday last at a meeting of the National Association of Fire Engineers in Milwaukee, when, in reference to the recent serious conflagrations in Boston he assigned the cause of them to over-insurance. Insurance men, property owners and some of the morning papers warmly resent such an insinuation. Be that as it may, Captain Brophy was never yet known to deliver an opinion upon anything with which he was not familiar and capable of substantiating, and if Captain Brophy has been correctly reported, we don't doubt but he could prove his statement if necessary.

To check, if possible, the growing public distrust in the General Electric Company, some one, presumably in the employ of the Trust, industriously causes to appear about every third day in the Boston and Lynn papers, in both of which cities there are thousands of stockholders, reports stating that there is not the slightest ground for alarm in what is being done by the directors. The company is declared most emphatically to be as sound as ever, and that all statements to the contrary are baseless. It is admitted that a large part of the working force has been laid off and the rest is working short time, but this has been done as a simple matter of economy in view of the general financial and commercial depression that prevails. These frequent assertions about the company's financial strength and stability, however, don't appear to answer the purpose they were intended to serve, for they simply keep men's tongues wagging, their shoulders shrugging and their eyes casting furtive glances down the legal and financial columns of the daily papers, as if they were expecting to hear something drop.

The Safety Electric Light Company, whose office is at 620 Atlantic avenue, Boston, making a specialty of lighting railway cars by means of current generated in a primary battery of its own exclusive type, is running a car between Boston and Chicago over the Fitchburg Railway. Besides lighting the car, a number of ventilating fans are operated by the same current, and the entire system is reported as being a success.

Notwithstanding the very general depression now prevailing, there are several electrical factories in Boston which are not only running full time but even increasing their staff. This is indeed subject for congratulation, and during the present week there have not been lacking indications that a somewhat easier feeling prevails both in financial and business circles; and the opinion is growing that the bottom has been reached.

The Island of Malta Wants a Lighting Plant.

From the United States *Consular Reports* for August we learn that the establishment of an electric lighting plant for the cities of Valletta and Floriana, on the Island of Malta, is under consideration.

Mr. W. H. Preece, who is now in this country, first called the attention of the Governor to the matter and drew the specifications. American manufacturers will do well to look into the matter. The Colonial Government will guarantee payment. Mr. John Worthington is the U. S. Consul at Malta, and will supply further information.

A large contract for a plant on the Island of Manilla has recently been secured by American concerns. The New York Insulated Wire Company sold the wire, the Brush Company the dynamos, and the Ball Engine Company the engines.

Portable Electro-Hydrogen Lighter.

A very ingenious piece of apparatus is the electro-hydrogen lighter described and illustrated below. The operation of the device will be readily understood by reference to the accompanying illustrations in connection with the general description given herewith.

The object of this electric lighter is to provide a small temporary light for cigar lighting and for other igniting purposes, domestic use, etc., and the device is made in a compact and very neat form, convenient for easy handling.

Fig. 1 gives a general external view of the lighter, from which it will be seen that the apparatus is ornamental in design as well as useful. It is a radical departure from other electric gas lighters in its construction. The outside jar is really a battery cell, which contains dilute sulphuric acid (one part of sulphuric acid to six parts of water and two ounces of bichromate of potash) as shown in the cross-sectional view in Fig. 2. The carbon electrode of the battery is shown at *E*, Fig. 2, and the zinc at *J*. The zinc is attached at the end of the gas tube *G*, the whole being placed within a gas tight vessel with its opening at the lower end and placed in the liquid after the manner of a porous cup. The tube *G* terminates at its upper end in a gas tip, and at *H* is a small hole which allows the accumulated gas within the inverted cup to escape into the upper part of the tube.

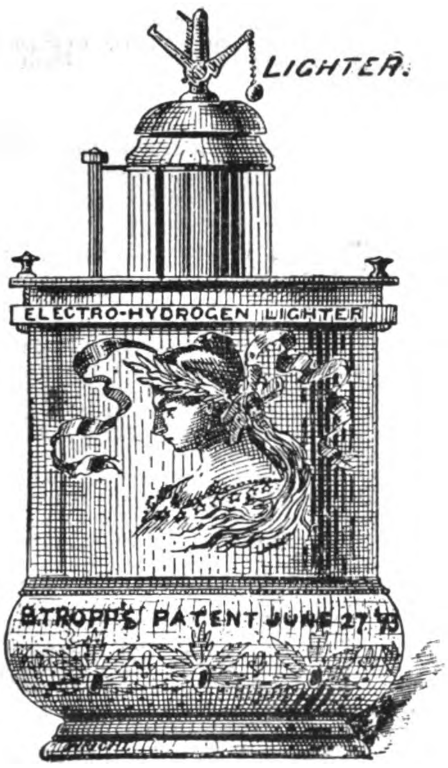

FIG. 1.

On the outside of the jar, on top, but suitably enclosed, is a spark coil, *F* (Fig. 2), one terminal of which is connected to the carbon electrode in the battery; the other terminal is connected with the contact pin *L*, which is insulated from the gas tube, to which it is attached at *M*. The lever *P*, being in metallic contact with the gas tube, causes an electric spark to be generated when it is pressed down by the finger plate *P*, and contact is made with the contact pin *L*, and by the same movement the gas cock is opened, allowing the gas to issue from the small hole *K*, at the top of the tube.

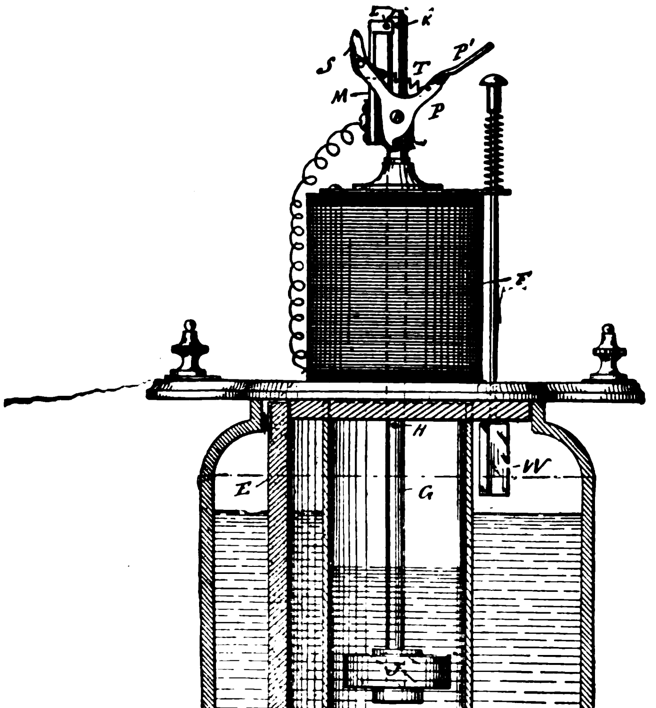

FIG. 2.

This device is very useful and ornamental in the household, smoking room, cigar stores, offices, steamers, yachts, smoking cars, and in all places where a temporary light is required.

This invention has recently been patented by Mr. B. Tropp, 101 East 90th street, New York City.

The "New Beacon" Goes in Spite of Hard Times.

The Beacon Vacuum Pump and Electrical Company, which last week made formal announcement that the "New Beacon" was ready for shipment in any quantities, have no reason to cry "Hard Times." Orders have come in in flattering numbers, and from all parts of the country. The "New Beacon" is a sure winner.

George Cutter.

George Cutter is pleased with his growing sales of Simplex wires, having just furnished another large batch for the Ferris Wheel.

A New Carbon Company.

After many months of preparation and experimenting, the Boulton Carbon Manufacturing Company of North Tonawanda, N. Y., is ready for business. The officers of the company are Wm. H. Boulton, late of Cleveland, president: Geo. P. Smith, secretary; J. H. Schmeck, treasurer.

The company occupies three buildings, one 50 by 120 feet, and two 40 by 150 feet each. The product at present is 18,000 per day, and thirty hands are employed. The output will soon be increased to 60,000 per day.

The Bryant Specialties.

The Bryant Electric Company of Bridgeport, Conn., believes in perpetual push, whether general business is bad or good. By this the company shows wisdom, and will maintain its position at the front. The new catalogue of the Bryant Company shows that their line of specialties has been increased by nearly a score. They are all necessities, and the high-standard of excellence which has always distinguished "Bryant" goods will be maintained.

Micanite is in the Swim.

The Mica Insulator Company has just issued a 4-page circular containing, besides a description of the specialties they manufacture, a number of very strong testimonials on Micanite from the leading manufacturers of electrical machinery.

Micanite is fast being recognized as a first-class insulator in every respect. This company has pased the experimental stage, and is sending out an insulator made of pure sheet mica that cannot be equalled by anything now on the market. They will be most happy to refer any one to the different companies who have adopted Micanite as an insulator.

Hart Switches.

The Hart & Hegeman Manufacturing Company, of Hartford, Conn., send out a neatly printed catalogue of Hart Switches, for which the following points of merit are enumerated:

The Hart Snap Switches are mounted on porcelain only.

The movement is rotary in one direction by quarter turns, keeping the contacts bright and free from dust, and giving the maximum length of "Break."

"Make" and "Break" are instantaneous, the switch-plates remaining stationary and locked until the handle has been given a quarter turn and the actuating spring has its maximum tension.

The actuating spring is of the best steel wire, and as it is not in circuit its temper cannot be affected by the current.

The current passes from one contact to the opposite contact, through solid metal and not through pivoted joints.

The "Break" is double in all sizes, and in the double-pole switches the circuit is broken at four points.

The insulation used is of the best quality obtainable.

The workmanship and carrying capacity of every switch is guaranteed.

All switch covers are finished in polished nickel unless otherwise ordered.

Further information will be furnished upon application to the company.

INCORPORATIONS.

Atwood Electric Head Light Company, St. Louis, Mo.—to manufacture electric lamps, etc. Capital stock, $125,000. Promoters: L. C. Atwood, E. B. Roth, M. Keber, all of St. Louis, Mo.

The Youngstown Park and Falls Street Railway Company, Youngstown, Ohio—to operate street railway, steam, electric, horse or other motive power to be used, etc. Capital stock, $50,000. Promoters: H. G. Hamilton, M. T. Evans, J. H. McEwen, Geo. A. Baker, Jas. Hiney.

Iowa Electric and Construction Company, Des Moines, Iowa—to do a general electrical and supply and construction business. Capital stock, $100,000. Promoters: A. T. Hess, J. A. Innes, Josiah Stedman, E. C. Spinney, E. G. Pratt, Wm. Bowen, Des Moines, Iowa.

The Mildwood Electric Light, Heat and Power Company of Kings County, Flatbush, N. Y.—to furnish electricity for lighting, heating and power purposes in the town of Flatbush. Capital stock, $50,000. Directors: William Matthews, of Brooklyn; A. J. Ditmas, John Z. Lott, John D. Prince, Jr., of Flatbush, and others.

The Electric Service Company, a new telegraph company, which will build and operate lines in New Jersey only. Capital stock, $50,000, one-third paid in. The incorporators are Winfield Thomson, Charles N. Cadding and George W. Peck, all of Westfield, N. J.

The Altmeyer Electric Light, Heat and Power Company, McKeesport, Pa. Capital stock, $30,000. Directors: George Altmeyer, George J. F. Falkenstine, John Oliver, Jacob P. Hill, F. W. Patterson, Theodore Tonnele, Peter Milmoe, Frank Becker, John F. Davitt, William J. Kirk and Frank J. Chester.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED AUG. 1, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

502,297. Electric Locomotive. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Electric Car Company of America, same place. Filed Nov. 30, 1886.

502,530. Electric-Railway Trolley Base. Otto Rau, Jersey City, N. J., assignor of one-half to Robert S. Dobbie, New York, N. Y. Filed Oct. 31, 1891.

502,538. Converter System for Electric Railways. Georg W. von Siemens, Berlin, Germany, assignor to Siemens & Halske, same place. Filed Mar. 29, 1893. Patented in Austria-Hungary Aug. 7, 1886, Nos. 31,923 and 2,522, and Nos. 570,681 and 2,394, and in England Aug. 26, 1886, No. 10,926.

502,539. Electric Railway System. Georg W. von Siemens, Berlin, Germany, assignor to Siemens & Halske, same place. Filed March 29, 1893. Patented in Austria-Hungary Aug. 7, 1886, Nos. 31,923 and 2,522 and Nos. 570,681 and 2,394, and in England Aug. 26, 1886, No. 10,926.

502,553. Trolley-Head. Robert S. Dobbie, Jersey City, N. J., assignor of one-half to Otto Rau, Milwaukee, Wis. Filed Oct. 31, 1891.

502,629. Trolley-Guard. George Moore, Boston, Mass. Filed Aug. 22, 1892.

ELECTRIC LIGHTS AND APPLIANCES.

502,278. Carbon-Holder for Arc Lamps. Sigmund Bergmann, New York, N. Y. Filed Oct. 22, 1892.

502,322. Electric Incandescent Lamp. Paul Scharf, Vienna, Austria-Hungary. Filed April 17, 1893.

502,340. Rheostat. James J. Wood, Fort Wayne, Ind. Filed July 15, 1892,

502,444. Electric Regulator. Daniel M. Moore, New York, N. Y. Filed Nov. 8, 1892.

502,458. Lamp-Guard. Emil Gahlau, Detroit, Mich. Filed Nov. 18, 1892.

502,465. Means for Protecting the Carbon-Holders of Electric-Arc Lamps. Jacob F. Mehren, Chicago, Ill. Filed Oct. 6, 1892.

502,471. Electric-Arc Lamp. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed March 4, 1891.

502,518. Automatic Cut-Out. Carl Hoffman, Berlin, Germany, assignor to Siemens & Halske, same place. Filed April 11, 1893.

502,519. Two-Pole Switch. Carl Hoffman, Berlin, Germany, assignor to Siemens & Halske, same place. Filed April 11, 1893.

502,535. Circuit-Controlling Mechanism for Arc Lamps. Charles E. Scribner, Chicago., Ill., assignor to the Western Electric Company, same place. Filed July 26, 1890.

502,655 Socket for Incandescent Electric Lamps. Waldo C. Bryant, Bridgeport, Conn., assignor to the Bryant Electric Company, same place. Filed May 6, 1893.

502,682. Distribution of Alternating Electric Currents. Wilhelm von Siemens, Berlin, Germany, assignor to Siemens & Halske, same place. Filed July 16, 1892. Patented in Austria-Hungary Dec. 28, 1885, Nos. 768 and 36.918 and 17,243 and 20.890; in England Dec. 30, 1885, No. 16,088; in Belgium July 15, 1886, No 73, 585, in France Oct. 20, 1886, No. 176,794; in Italy Dec. 30, 1886, Nos. 20.191 and 381: in Germany Jan. 14, 1887, No. 38,880: in Sweden April 15, 1887, No. 814, and in Norway June 30, 1887, No. 51.

502,687. Arc-Lamp Frame. August Weber, Schenectady, N. Y. Filed Sept. 8, 1892.

DYNAMOS, MOTORS, ETC.

502,377. Electric Motor or Dynamo. Samuel Paugh, Indianapolis, Ind. Filed Oct. 11, 1892.

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502,398. Portable Telephone. Brown S. Flanders, Boston, Mass. Filed Jan. 31, 1891.

502,466. Telephone Circuit and Apparatus. James L. McQuarrie, Boston, Mass., assignor to the American Bell Telephone Company, same place. Filed May 25, 1893.

502,472. Electric Annunciator. Theodore Spencer, Cambridge, assignor to the American Bell Telephone Company, Boston, Mass. Filed Feb. 7, 1893.

502,660. Electric Switchboard-Signal. Francis W. Dunbar, New York, N. Y., assignor to the American Telephone and Telegraph Company, of New York. Filed May 15, 1893.

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502,272. System of Electric Distribution. Edward M. Bentley, Boston, Mass., assignor to the General Electric Company, same place. Filed May 8, 1893.

502.287. Electrical Cash Register, Recorder and Indicator. Leo Ehrlich, St Louis, Mo., assignor, by mesne assignments, to the National Cash Register Company, Dayton, Ohio. Filed Sept. 28, 1889.

502,300. Electric Pole Changer. Charles. E. Kells, Jr., New Orleans, La. Filed Feb. 23, 1893.

502,315. Electrical Indicator for Elevators. Eugene E. Peirce, Boston, Mass. Filed July 5, 1892.

502,325. Electric Jail. Charles H. Sparks, St. Louis, Mo., Filed March 28, 1892.

502,358. Electric Cable. Theodore Guilleaume, Cologne, Germany. Filed March 1, 1893.

502,381. Electric Synchronizer for Clocks. Henry Prentiss, Elizabeth, N. J. Filed May 19, 1892.

502,399. Electric Telemeter. Charles H. Haskins, New York, N. Y. Filed March 9, 1892.

502,405. Galvanic Battery. Edward H. Lyon, Brooklyn, N. Y. Filed Sept. 26, 1892.

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502,494. Electrical Heater. Charles E. Jones, Elgin, Ill. Filed Aug. 1, 1891.

502,624. Electric Water-Wheel Regulator. Eugene R. Holcomb, Portland, Ore. Filed Jan. 21, 1893.

502,626. Electric Signal Apparatus. Jacob W. Lattig, Easton, Pa. Filed June 14, 1893.

502,627. Railway-Track Electric Annunciator. Jacob W. Lattig, Easton, Pa. Filed June 14, 1893.

502,670. Magneto-Electric Machine. Frank X. Hofbauer, Newark, N. J. Filed Oct. 22, 1892.

502,677. Insulator. Louis McCarthy, Boston, Mass. Filed Sept. 23, 1892.

ELECTRICITY.

VOL. V. NEW YORK. SEPTEMBER 6, 1893. CHICAGO. No. 8

A Novel Method of Transforming Alternating Into Continuous Currents.

BY CH. POLLAK.[*]

It is well known that the use of accumulators in central stations has taken a great development in Europe during the last years. Indeed, nearly all the *central plants* in Germany, France and England generating *direct currents* are now provided in the central station itself, or in sub-stations, with storage batteries of comparatively large size working in parallel with the dynamos while the load is at its maximum and supplying the whole current needed in the time of low demand. The technical journals having given ample information about this subject, I desired to show you on this occasion the projections of several central stations which we built in Germany; unfortunately they were not ready at my departure, and as our mails are not yet run by electricity they arrived only yesterday. The photographs represent batteries of accumulators for 110 volts and our types of 600 and 1,200 amperhours in central stations built by Lhneckert & Company of Nuremberg, and by the Society of Electric Lighting in Frankfort-on-Main.

The alternating current light stations storage batteries have also proved of great usefulness for exciting the magnetic field of generators, the latter giving in these cases far better results as to production of constant tension and regular light than with excitation by means of direct current dynamos. But it has not been possible as yet to secure for alternating machinery a reserve to be disposed of at any time for the supply of current equal to the ever-ready storage battery in the direct system, nor to combine with an alternating system substations duly situated and possessing all the advantages of the direct system, including the supply of currrent for electro-chemical work and ordinary motors. (Another field for the employment of stationary accumulators has begun to open in electric railway plants.) The surplus current necessary in the moments of starting or for overcoming steep grades is now in many cases supplied by storage batteries placed either in the generating station or near the points of increased demand for current. Owing to the lack of appropriate alternate current motors this sort of current has not yet got any significance for electric railways, though it might give many advantages, especially on as long lines as are now built anywhere, by applying high tension primaries and line transformers. If there were a simple means for directly feeding from transformer substations on the line the usual continuous current motors and charging auxiliary storage batteries, with or without capacity, a great saving in conducting material and a remarkable increase in safety and simplicity of working would be the result.

All these considerations have led me to the construction of an apparatus for directly transforming alternating into direct currents that requires little cost, little space and little attendance, and gives high economical results. I call this transformation *direct* in contradistinction to the well-known method of using a dynamotor consisting of an alternate current motor and a direct current generator on the same axis.

An ordinary commutator held in motion synchronous with an alternating current generator gives birth to a pulsating current of the same direction whose tension varies between zero and a certain maximum given by the generator; it will therefore not be able to drive direct current motors or produce electrolytical effects; to fulfil these purposes, the tension of the pulsating current is to remain above a certain minimum determined by the counter-electromotive force to be overcome in the performance of an electrical work. Herefrom I have drawn the following principles for the construction of the commutator.

The typical commutator of this kind consists of two ranges of insulated strips alternately connected with the generator. The width of the insulation between the strips is in a definite proportion to the width of the strips, which proportion is made adjustable so that the brushes of the commutator will take off only that part of the current whose tension has the proper value.

If now, for instance, an accumulator battery is to be charged, I will first adjust the proportion between the width of the strips and of their intervals in such a way that the tension of the pulsating current to be taken off by the brushes and led to the battery may not drop beneath the amount of the counter-electromotive force of the accumulators and the latter be avoided from discharging in the generator circuit. Herefrom I will finish the adjustment of the commutator by a definite displacement of the brushes in order to produce the interruptions of the pulsatory current in those moments when its tension is equal to the counter-electromotive force of the battery in charge, and so does away with sparking.

In my first apparatus for laboratory purposes, the commutator fixed on the prolonged axis of a small synchronous alternating current motor consisted of two sliding rings insulated from each other, and which the alternating current is led to by brushes, and two ranges of strips with converging edges alternately connected to the sliding rings. The brushes sliding on the surface of the strips can be displaced in the ordinary way round the axis and parallel to it. The combination of these two movements allows to fix the necessary minimum tension of the pulsatory current as well as the sparkless taking off of this current in those moments when its tension is equal to the counter-electromotive force, and consequently its intensity zero.

Later on I left the pointed strips in the apparatus for practical use. The edges of the strips are made parallel to the axis, and the two ranges of strips fit to be displaced against each other by turning them separately round the axis; besides there are take-off brushes in double number whose distance can also be varied. By combining these two movements I may succeed without any difficulty in quickly attempting the appropriate position as to tension and sparkless working. In this shape the device is cheap, occupies but a small space, without foundations, and requires little attendance in comparison with a transformer dynamo of the same output. As to attendance in charging accumulators, for instance, the adjustment will have to be changed successively at the beginning of a charge during about a quarter of an hour, according to the then rapid increase of the tension; then nearly no attention has to be given the commutator, the tension rising at a very low rate until the end of the charge with approach and the voltage rise faster necessitating new adjustment of the intervals and brushes. The whole attendance therefore is very simple and takes little time and effort. To reduce the attendance I shall provide the new machines with automatic brush regulators. The first apparatus was built for 80 amperes and has proved to perform the transformation with nearly no loss at all. The measurements have been executed in the following manner: The alternating current was passed through a down-step transformer, and the secondary first through a fluid resistance and then through the commutator and battery to be charged. In both cases the number of watts in the primary and secondary circuits of the transformer were measured by means of a wattmeter. The output in the first case was 82,770; in the second 82,670. The motor having only to overcome the friction of the brushes requires only from 80 to 100 watts with full load, or less than 190 of the whole energy passing through the commutator.

(The small efficiency of only 82 per cent. of the transformers will be explained, as I had at my disposal only transformers of older style.)

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[*] Paper read at the International Electrical Congress, Chicago.

It might be said that a pulsatory current as produced by this commutation was perhaps not good for charging accumulators, but in my experience I did not find any difficulty with it. It may be true that grid or other oxide pasted plates will not stand it, owing to insufficient contact between grid and active mass; in every case the Planté type pure lead plates are preferable for the purpose. (The accumulators used in my experience were of my own system). They have pure lead plates or electrodes, produced by electrolytically depositing porous lead on laminated lead plates, provided with large conducting surface; this artificial increase of surface is effected by previously passing the lead bands through specially designed rollers that impart to them a great number of pins and ribs. When ready for use the plates are most solid and may be thrown or bent without harm, the porous lead adhering so fast to the core that no more exact limit is existing between them. Moreover the plates are arranged in the cells in such a way as to grant them free extension in either direction by suspending each plate separately on two glass tubes. The charging of these accumulators by means of the alternating current commutators, as described above, performs in quite like manner and in no more time than with the ordinary direct current. Indeed the bubbles of hydrogen and oxygen gas escaping at the end of the charge being usually small, with pure lead plates, seem to be of still less size when commutated current is employed, and give the fluid quite a milky appearance; herefrom it may be inferred that the destructive effects the bubbles sometimes produce upon the porous surface layers by mechanical action in cases of over-charging or excessive charging intensity are of lower influence on the durability of the plates than even the common direct current.

On the Transmission of Electric Signals Through Space.—II.

BY W. H. PREECE, F.R.S.[*]

3. ELECTRO-MAGNETIC INDUCTION.

Magnetic force is that which produces or tends to produce polarization in magnetizable matter, viz., iron, nickel and cobalt, and electro-magnetic disturbance in non-magnetizable matter and the ether. It excites lines of magnetic force and becomes a stress. An electric current in a conductor is a seat of magnetic force. It establishes in its neighborhood a magnetic field.

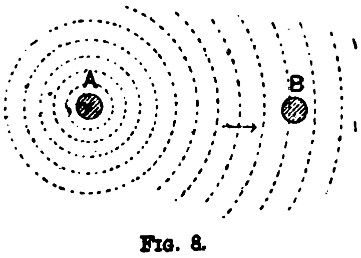

FIG. 8.

The lines of force [Fig. 8] in such a field are equivalent to circles in a plane perpendicular to the direction of the current, which, during the rise of the current in A flow outwards, and during the fall of the current flow inwards, like the waves on the surface of smooth water when a stone is dropped into it, but moving with the speed of light. Thus any other linear conductor B, placed in this field parallel to A, is cut at right angles to itself by these lines of force—in one direction as the current rises, and in the other direction as the current falls. The projection of lines of magnetic force through a linear conductor in a direction perpendicular to its length excites electric force in that conductor; and, if the conductor be continuous and form part of a circuit, it establishes voltage, and therefore a current in this secondary circuit. Now, the strength of this secondary current, depends on the strength of the primary current, on the rate at which it rises or falls on the resistance of the secondary circuit, on the distance which separates the two circuits, and on the length of the inductive system. The direction of the secondary current everywhere is reverse to that of the primary during its rise and in the same direction during its fall.

If the two circuits are separate and independent, this action between them is called mutual induction; but if B be a part of the same circuit, A, it is called self-induction. The amount of induction is dependent also on the magnetic conditions present in the conductors and in the space between them. This is measurable in its own unit [which it is proposed to call "henry"], is called *inductance*, and usually indicated by S or M, according as the question dealt with is self or mutual induction.

EXPERIMENTAL INVESTIGATION.

Since 1885 I have had a vast number of experiments made to thresh out the laws and conditions that determine the distance at which these magnetic disturbances can be usefully evident. The instrument used to receive these signals has been generally the telephone, but many absolute measurements have been made with a very sensitive reflecting galvanometer. The judgment required to determine the relative intensity of sound in a telephone is a very variable and uncertain agent, even though many observers be utilized and the same experimenters perform with the same apparatus. But this does not apply to the observation of the limiting audible intensity of signals. The point where sound ceases is obtained with concordant and satisfactory results when the mean judgment of several observers using the same telephone is made use of. I never use less than three observers, and sometimes have employed as many as seven. By this means we observe by what I call the average normal ear.

I. To prove that the effects were due to Electro-magnetic Induction.

Conductors of copper wire insulated with gutta-percha were formed into quarter-mile squares [Fig. 9] and laid on a level plain at a distance of a quarter of a mile apart.

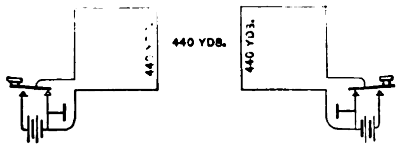

FIG. 9.

Arrangements were made for sending vibratory or alternating currents which could be broken into Morse signals by means of a telegraph key. Telephones were used as receivers, which transformed these signals into buzzing dots and dashes.

On closing the circuit in one square and sending signals, conversation could be readily held between the two operators by means of the Morse code. Now, obviously, earth conduction could play no part in this transmission of signals, for the squares were insulated throughout from the earth.

Next, in order to ascertain to what extent, if any, electrostatic effects were observable, one pole of the battery used was put to earth, and the further end of each square was disconnected [Fig. 10].

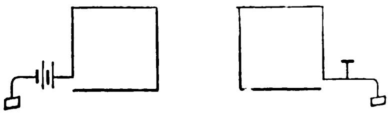

FIG. 10.

Now, by this arrangement, the mean electric force of one square was doubled, as compared with the former experiment, where the circuit was completed, but no effect was observed in the second square, either in the receiving telephone or with the reflecting galvanometer. The squares were even superposed at a distance of only 15 feet apart, the upper one being suspended on poles and the lower one lying on the ground, but without any result. Hence the effects observed in this experiment were clearly due to electro-magnetic induction.

II. To prove that the effects increased directly with the strength of the primary current used and diminished with the resistance of the secondary current.

a. Two quarter mile squares of insulated wire were opposed to one another, and the distances between the front faces varied from 8 yards to 192. Currents of one and two amperes respectively were sent into one square, and the induced effect in the second square with two amperes was invariably twice that with one ampere. The measurements were made with a reflecting galvanometer.

b. Open wires were placed parallel to one another, and a mile apart horizontally (Fig. 11). The primary circuit was two miles long. The other, the secondary circuit, was divided into two equal one-mile lengths. With a primary current of .22 ampere the vibrations were just audible in a telephone fixed to either of the single mile lengths of the secondary, the total resistance in the latter circuit being 85 ohms. With a similar current (.22 ampere) in the primary and the secondaries joined into a two-mile length, the same limit of audibility was reached when the resistance in the secondary was doubled, that is, it was raised to 170 ohms. Next, the current in the primary was doubled or increased to .44 ampere; and with a one-mile secondary the total resistance had to be doubled in order to reach the same limit. Finally, when the current in the primary was raised to .88 ampere—four times the original figure—then the same limit was reached when the resistance was quadrupled.

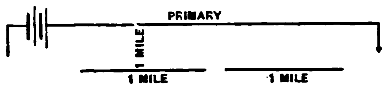

FIG. 11

III. To find how the effects varied with the length of the inductive system, and with the distance separating them.

The law for variation of length and distance is very complicated, and depends wholly on the form of the circuit and its various reactions. It may be briefly summarized as follows, but the experiments upon which these conclusions are drawn will be given as an appendix, together with the equations developed from them.

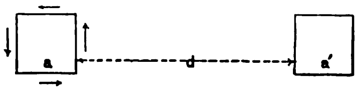

FIG. 12.

Let l = length and d = distance apart of two conductors assumed equal and similar, then

a. With two infinitely long straight wires, it varies inversely as d alone.

b. With one infinitely long straight wire and a wire of finite length, it varies as $\frac{l}{d}$.

c. With one infinitely long straight wire opposed to a rectangle, the law becomes

$$\frac{l}{\varphi}\left(\frac{l}{d}-\frac{l}{D}\right),$$

where D is the distance from the face to the back of the rectangle.

d. Where the rectangle is replaced by a square, the above formula becomes

$$\frac{l^2}{\varphi\, d\,(l+d)}$$

e. With a rectilinear wire of finite length l opposed to a square, the length of the former being equal to the face of the latter, it varies as

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[*] Paper read at the International Electrical Congress, Chicago.

$$\frac{l}{d},$$

f. With two squares of equal dimensions opposed to one another [Fig. 13], the effect varies, where l is great compared with d, as

$$\frac{l}{\sqrt{d}};$$

but when d exceeds half l, it varies as

$$\frac{l}{d}.$$

NOTE.—With cases *c*, *d*, *e* and *f*, if d became very great, the effect would diminish and ultimately disappear, owing to the opposing current in the back of the square having practically the same influence as that in the front. When d is very great the effects due to a and a_1 may be neglected.

g. With two rectilinear wires of equal length if the effect of the magnetic waves due to the return current through the earth be neglected, then when l is great compared with d it varies as

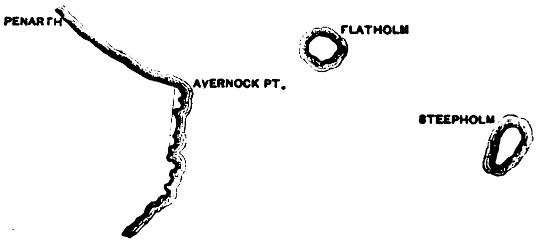

FIG. 13.

$$\frac{l}{d};$$

but when d is great compared with l, it varies as

$$\frac{l^2}{d^2};$$

The complete formula for the aerial portion of the circuit is as follows:

Let c_1 = current through primary.
q_2 = quantity induced in secondary.
r_2 = resistance of secondary.
l = length of either wire.
d = distance between wires.

Then M being a constant in C. G. S. units,

$$q_2 = \frac{c_1}{r_2} \frac{\sqrt{l^2 + d^2} - d}{d} \times \text{M}.$$

The complete formula must of course allow for the reverse effect of the return circuit through the earth. I hope later to obtain sufficient data on which to base such a formula.

The value of M, obtained from a series of experiments on two parallel squares of wire, 1,200 yards in length and 5 yards apart, was found to be .003.

h. The difference in water as compared with air is not very marked. In certain experiments on the Conway Estuary which were considered reliable, and which appear on Table I, it was about 6 per cent. more in the air than in water. The result was probably due to the magnetic waves being degraded into electrical currents in traversing the conducting sea water.

4. PRACTICAL EXPERIMENTS.

The Bristol Channel proved a very convenient locality to test the practicability of communicating across a distance of three and five miles without any intermediate conductors. Two islands, the Flat Holm and the Steep Holm, lie off Penarth and Lavernock Point, near Cardiff, the former having a lighthouse upon it. On the shore two copper wires, weighing 400 lbs. per mile, combined in one circuit, were suspended on poles for a distance of 1,267 yards, the circuit being completed by the earth. On the sands at low water mark, 600 yards from this primary circuit and parallel to it, two ordinary gutta-percha covered copper wires and one bare copper wire were laid down, their ends being buried in the ground by means of bars driven in the sand.

One of the gutta-percha wires was lashed to an iron wire to represent a cable. These wires were periodically covered by the tide, which rises here at spring to 33 feet. On the Flat Holm, 3.1 miles away, another gutta-percha covered copper wire was laid for a length of 600 yards.

There was also a small steam launch having on board several lengths of gutta-percha covered wire. One end of such a wire, half a mile long, was attached to a small buoy, which acted as a kind of float to the end, keeping the wire suspended near the surface of the water as it was paid out while the launch slowly steamed ahead against the tide. Such a wire was paid out and picked up in several positions between the primary circuit and the islands.

TRANSMISSION OF ELECTRIC SIGNALS.

The apparatus used on shore was a 2 H. P. portable Marshall's steam engine. working a Pike & Harris alternator, sending 192 complete alternations per second, with a voltage of 150, and of any desirable strength up to a maximum of 15 amperes. These alternating currents were broken up into Morse signals by a suitable key. The signals received on the secondary circuits were read on a pair of telephones—the same instruments being used for all the experiments.

The object of the experiments was not only to test the practicability of signalling between the shore and the lighthouse, but to differentiate the effects due to earth conduction from those due to electro-magnetic induction, and to determine the effects in water.

I have already alluded to the way in which the lines of current-flow were mapped out. It was possible to trace without any difficulty the region where they ceased to be perceptible as earth currents and where they commenced to be solely due to electro-magnetic waves. This was found by allowing the paid-out cables, suspended near the surface of the water, to sink. Near the shore no difference was perceptible whether the cable was near the surface or lying on the bottom, but a point was reached, just over a mile away, where all sounds ceased as the cable sank but were recovered again when the cable came to the surface.

The total absence of sound in the submerged cable rather surprised me, and it leads to the conclusion, either that the electro-magnetic waves of energy are dissipated in the sea water, which is a conductor, or else that they are reflected away from the surface of the water like rays of light.

Experiments on the Conway Estuary, showing the relative transparency of air and water of these electro-magnetic waves, tend to support the latter deduction, for if much waste of energy took place in the water the difference would be more marked; it was 6 per cent. only. As it is we have ample evidence that the electro-magnetic waves are transmitted to considerable distances through water, though how far remains to be found.

There was no difficulty in communicating between the shore and Flat Holm. Messages were read. Mr. Gavey, who was making the experiment on the island, wrote me: "There was then somewhat a lengthened pause, due to a slight derangement of the machinery on the mainland, but at 2 P. M. I heard clearly and distinctly the following, 'Here, Haskayne' (one of his assistants), 'with a message from Mr. Preece for Mr. Gavey.'" I was in London that day. "Then followed the announcement of the sad and sudden death of Mr. Graves, which cast a gloom over the success of the experiment. It seemed an extraordinary fact that the first readable message transmitted for such a distance by such means should announce the death of the head of the Technical Department."

The distance between the two places was 3.1 miles. The attempt to speak between Lavernock and Steep Holm was not so successful. The distance was 5.35 miles, but though signals were perceptible, conversation was impossible. There was distinct evidence of sound, but it was impossible to differentiate the sounds into Morse signals. We were just on the limit of audibility, and we were using our maximum available power. If either line had been longer, or the primary currents stronger, we should have spoken as was done at Flat Holm.

The fact indicated by the formula for parallel wires, that the limiting distance increases directly with the square of the length of the circuits, has a very important bearing on the practical results of these experiments, for it shows that if we can make the length of the two lines long enough it would be easy to communicate across a river or a channel. Of course, as previously pointed out, the formula does not take into account the effects of the reverse magnetic waves generated by the return current through the earth, and at present no data exist on which a satisfactory calculation can be based; but, for example, there is little doubt that two wires ten miles long could signal through a distance of ten miles with ease.

Although communication across space has thus been proved to be practical in certain conditions, those conditions do not exist in the cases of isolated lighthouses and lightships, cases which it was specially desired to provide for. The length of the secondary must be considerable and for good effects at least equal to the distance separating the two conductors. Moreover, the apparatus to be used on each circuit is cumbrous and costly, and it may be more economical to lay an ordinary submarine cable.

Still, communication is possible even between England and France, across the Channel, and it may happen that between islands where the channels are rough and rugged, the bottom rocky, and the tides fierce, the system may be financially practical. It is, however, in time of war that it may become useful. It is possible to communicate with a beleaguered city either from the sea or on the land, or between armies separated by rivers, or even by enemies.

A use to which these electro-magnetic disturbances can be applied is to indicate to ships their contiguity to lighthouses and land falls. Experiments are being made in this direction by Mr. Stevenson, of the Northern Lights Commission, on the coast of Scotland, but no results have yet been published. He proposes to submerge a cable on a given fathom line through which special automatic distinguishing signals are being sent, so that a ship approaching or crossing this line can pick up these signals on board and learn her true position.

I have also pointed out that as these waves are transmitted by the ether they are independent of day or night, of fog or snow or rain, and therefore, if by any means a lighthouse can flash its indicating signals by electro-magnetic disturbances through space, ships could find out their positions in spite of darkness and of weather. Fog would lose one of its terrors, and electricity become a great life-saving agency.

APPENDIX.

I. Experiments to determine the electro-magnetic induction, both in water and air, between a rectangle and a finite line of length equal to the face of the rectangle, June–July, 1893.

Currents were sent through the rectilinear circuit, A, by means of a suitable key, and the in-

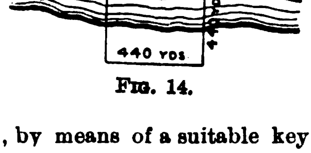

FIG. 14.

duced effect on the rectangle was observed on a carefully adjusted reflecting galvanometer.

EXPERIMENTS WITH CONDUCTORS COVERED WITH SEA WATER.

d yards.	Relative values of *d*.	Current through A (amps.)	Discharge deflection from B.	Equivalent in micro-coulombs.
100	1	2.00	16	.024
200	2	"	8	.012
300	3	"	5¼	.008
400	4	"	4	.006
800	8	"	2	.003

Remarks.—18 feet water over A.

EXPERIMENTS WITH CONDUCTORS IN AIR.

d yards.	Relative values of *d*.	Current through A (amps.)	Discharge deflection from B	Equivalent in micro-coulombs.
100	1	2.00	17	.026
200	2	"	8½	.013
300	3	"	5⅛	.008
400	4	"	4	.006
800	8	"	1⅛	.0028

Remarks.—Low water.

II. Experiments to determine the electro-magnetic induction between two rectangles of equal dimensions.

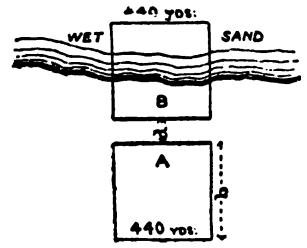

Fig. 15.

l.	*d*.	Relative values of *a*.	Current through A (amps.)	Discharge deflection from B.	Equivalent in micro-coulombs	Variation of deflection by formula $\frac{40}{d}$
yds. 440	yds. 8	1	2	40	.059	40.0
"	16	2	"	28 1-2	.042	28.3
"	24	3	"	23	.034	23.1
"	32	4	"	19 1-2	.029	20.0
"	64	8	"	11 1-2	.017	14.1
"	96	12	"	8	.012	11.5
"	192	24	"	4 1-2	.007	8

Remarks.—When current was reduced to 1 ampere the induced discharge was halved.

III. Experiment with a rectilinear wire four times the length of the face of the rectangle.

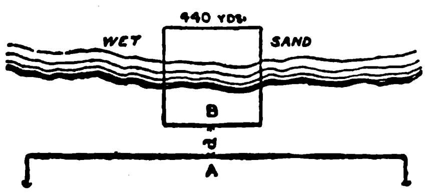

Fig. 16.

d.	Current through A [amps.]	Discharge deflection from B.	Equivalent in micro-coulombs.
192	2	20	.030

COMMUNICATIONS.

Prof. Stine was not Correctly Reported.

Armour Institute,
Chicago, August 28, 1893.

To the Editor of Electricity.

Dear Sir :—In the issue of Electricity for August 23, 1893, a kind reference was made to the equipment and future work of the Electrical Department of Armour Institute in Chicago. In the extract from an interview recently published in the *Inter-Ocean*, the writer was represented to have conceded that European electrical apparatus was generally superior to that made in this country. This was a mis-quotation on the part of the reporter ; my own opinion is in reality opposed to this statement.

The equipment of the Electrical Department of Armour Institute will not only be very extensive, but will be peculiar to the extent to which American apparatus will be employed. It is with much pride that we have noted the rapid advances made by several American makers of apparatus, and we believe that in no other institution will the equipment be so thoroughly American. While the greater portion of laboratory apparatus will be of American manufacture, European makers will also contribute. This broad policy must result in good, educationally, and further, having the same style of apparatus from both American and foreign manufacturers'comparative tests can be made with best results.

It is not long since that a writer for one of the leading electrical papers stated that a really first-class reflecting galvanometer cannot be obtained from an American maker. This, in my opinion, is a mistake, and I shall endeavor in the near future to give my reasons for this statement.

Reference was also made in the same mistaken vein to the Weston instruments. I am very glad to state that Mr. Weston is now making the standards for the calibrating department of Armour Institute, and the Weston ammeters, voltmeters and wattmeters will be used throughout wide ranges as working standards in the laboratory. When the contracts for these instruments are all filled Armour Institute will, without doubt, have a larger equipment of Weston instruments than any similar institution.

Yours truly,
W. M. Stine,
Director of the Electricity Department.

Goliath was only a Bluffer.

An appreciative constituent in the State of Michigan writes as follows :

"You must accept my compliments for the manner in which you attack the Trust (open and above board), which fully illustrates your principle of fair play to all and monopoly to none, and I am inclined to think that the Goliath has met his David."

Nails in this Coffin.

(*From the Wall Street Daily News.*)

We are told by a gentleman high in the councils of the Ceneral Electric Company, and enjoying intimate relations with Drexel, Morgan & Company, and by us considered a high authority on the subject, that it is useless to look for any rally or improvement in the price of General Electric stock as long as Mr. Coffin remains President of the company. Mr. J. Pierpont Morgan has never forgiven Mr. Coffin for having sold out on him about a year ago, and since then he [Mr. Morgan] has taken but a lukewarm interest in the company. Our informant states Mr. Morgan will take no steps to force Mr. Coffin out, but will let the price of the stock and the money necessities of the company do it for him.

The Ansonia Electric Company.

Mr. F. S. Terry, manager of the Ansonia Electric Company, has sent out the following statement to the customers of the house:

"Owing to complications resulting from the present business depression, the affairs of this company have been placed in the hands of Mr. James B. Waller, assignee, permission having been obtained from the Court to continue the business. All amounts due us will now be payable to him. Plans are already under way for a speedy settlement of our difficulties, but much will depend upon the promptness with which we are able to collect our accounts. We trust we are not mistaken in believing that we have the well wishes of our customers, and that they will assist us by making prompt remittances."

The Blue-Print Steal.

Trials of Mead, Clarke and Hamilton Begun at Pittsburgh.

The electric conspiracy case was called in the Criminal Court at Pittsburgh on Monday, Sept. 4th, before Judge Collier. The court-room was crowded with spectators. The defendants now on trial are : Morris W. Mead, William J. Clarke and Milton H. Hamilton. The selection of the jury consumed less than one hour, and the three defendants present entered a plea of not guilty. D. F. Patterson made the opening address for the prosecution.

A full report of the proceedings will appear in Electricity next week.

THEY ALSO STEAL SIGNS.

Suit for $10,000 Damages Brought by The Western Electric Co. against The General Electric Co. in Chicago.

Suit has been brought in the Superior Court of Cook County, Ill., for $10,000 damages, by the Western Electric Company against the General Electric Company, and criminal proceedings will be instituted against certain employees of the latter company if they can be found.

Part of the exhibit of the Western Electric Company has been thirty arc light poles of an improved pattern, upon which they had been granted the privilege by Prof. Barrett of placing two signs, one near the base and one at the extreme top, above the lamps.

Part of these poles supported arc lamps of the General Electric Company's make, and Lieut. E. J. Spencer, in charge of the latter's exhibit, insisted that the signs of the Western Electric Company should be removed from these poles. Prof. Barrett declined to grant this request.

In despair of accomplishing his object by lawful means, Lieut. Spencer, so it is claimed, conspired with a number of his employees to remove the signs by stealth, and some time during the night of July 17 the signs were stolen by these employees, the official guards having been duly bribed.

Suit is now brought, as above stated, to recover damages from the General Electric Company, as the guilty parties have removed themselves, for the time being at least, from the reach of criminal prosecution.

Death of R. D. Nuttall.

Robert D. Nuttall, the well-known manufacturer, and founder of the concern of R. D. Nuttall & Company, died on August 29, at his home in Allegheny, of pneumonia.

The Electro-Therapeutic Assoociation.

Programme of the Chicago Meeting.

The third annual session of the American Electro-Therapeutic Association, to be held in Chicago on September 12, 13 and 14, is expected to reveal a marked advance in the science. A leading topic to be discussed is "What are the Possibilities of Electricity in the Treatment of Fibroid Growths?" Among those who will take part are: Dr. J. H. Kellogg, of Battle Creek, Mich.; Dr. Georges Apostili, of Paris, France; Dr. Georges Gautier, of Paris, France; Dr. La Lorre, of Rome, Italy; Dr. Augustin H. Goelet, of New York; Dr. A. Lapthorn Smith, of Montreal, Canada: Dr. Franklin H. Martin, of Chicago, Ill.; Dr. G. Betton Massey, of Philadelphia, Pa.; Dr. Margaret A. Cleaves, of New York; Dr. George F. Hulbert, of St. Louis, Mo.; Dr. E. L. H. McGinnes, of New York.

"The Influence of Frequency of Interruptions and Character of Induced Current Waves upon Physiological Effect" will also be discussed by Prof. W. J. Morton, M.D., of New York; M. le Prof. d'Arsonval, of Paris; M. le Dr. Larat, of Paris; M. G. Weisse, of Paris; Prof. du Rois-Raymond, of Berlin; Mr. Newman Lawrence, of London, Eng.; Mr. Jno. J. Carty, of New York; Prof. G. M. Hammond, of New York; Dr. W. F. Hutchinson, of Providence, R. I., Prof. Elihu Thomson, of Boston, Mass., besides many of those taking part in the former discussion.

Most of these physicians will read papers.

On the Carrying Capacity of Electric Cables, Submerged, Buried or Suspended in Air.—II.

BY A. E. KENNELLY.[*]

From the measurements made on the samples of buried cable the mean thermal resistivity of the sandy soil in which they rested was almost 50 units, or fifteen times less than the mean resistivity of the insulator.

Formula (4) modified to include the resistance of the ground becomes

$$C = \sqrt{\left(\frac{\theta}{\rho\ (S + G)}\right)} \quad . \quad . \quad (9$$

and with the safety limit of 25° C. here recommended for Siemens cable, (5) becomes

$$C = \frac{5}{\sqrt{\rho\,(S + G)}} \quad . \quad . \quad (10)$$

As an example, suppose the cable previously considered to be buried at an axial depth of 2′ 6″ (76.2 cms.) in a soil of resistivity 50. Here the depth in radii is 148.2 and reference to the preceding curve shows that the ground resistance per centimetre is 0.9 *g*, or in this instance, 45 units. The thermal resistance of the insulator having been found to be 81.36, the total thermal resistance in the heat current path is 126.36. Substituting this in the formula (5) or (10),

$$C = \frac{5}{\sqrt{126.36 \times 0.000009417}} = 144.9 \text{ amperes},$$

the computed drop in temperature within the cable will be

$$\frac{24 \times 81.36}{126.36} = 16.1^\circ \text{ C},$$

and the temperature elevation of the sheath 8.9° C.

INFLUENCE OF EXTERNAL LAYERS OF HEMP OR COMPOUND.

If the cable instead of being simply sheathed in lead has also, as is usually the case, additional coverings of jute or compound, with or without intermediate metal bands or wires, additional

(*Continued on Page* 96.)

TABLE II.

P. C. of sheath elevation.	Horizontal distance from axis.		Per cent. of sheath elevation.	Horizontal distance from axis.		Per cent. of sheath elevation.	Horizontal distance from axis.		P. C. of sheath elevation.	Horizontal distance from axis.	
	Cms.	Cable diameter.		Cms.	Cable diameter.		Cms.	Cable diameter.		Cms.	Cable diameter.
95	3.15	0.63	70	7.40	1.8	45	28.28	5·6	20	91.8	18.4
90	3.92	0.784	65	11.71	2.3	40	35.38	7.1	15	121.5	24 3
85	4.88	0.976	60	14.58	2.9	35	44.38	8.9	10	169.1	33.8
80	6.07	1.21	55	18.16	3 6	30	56.0	11.2	5	269.6	53.9
75	7.55	1.5	50	22.65	4.5	25	71.2	14.2			

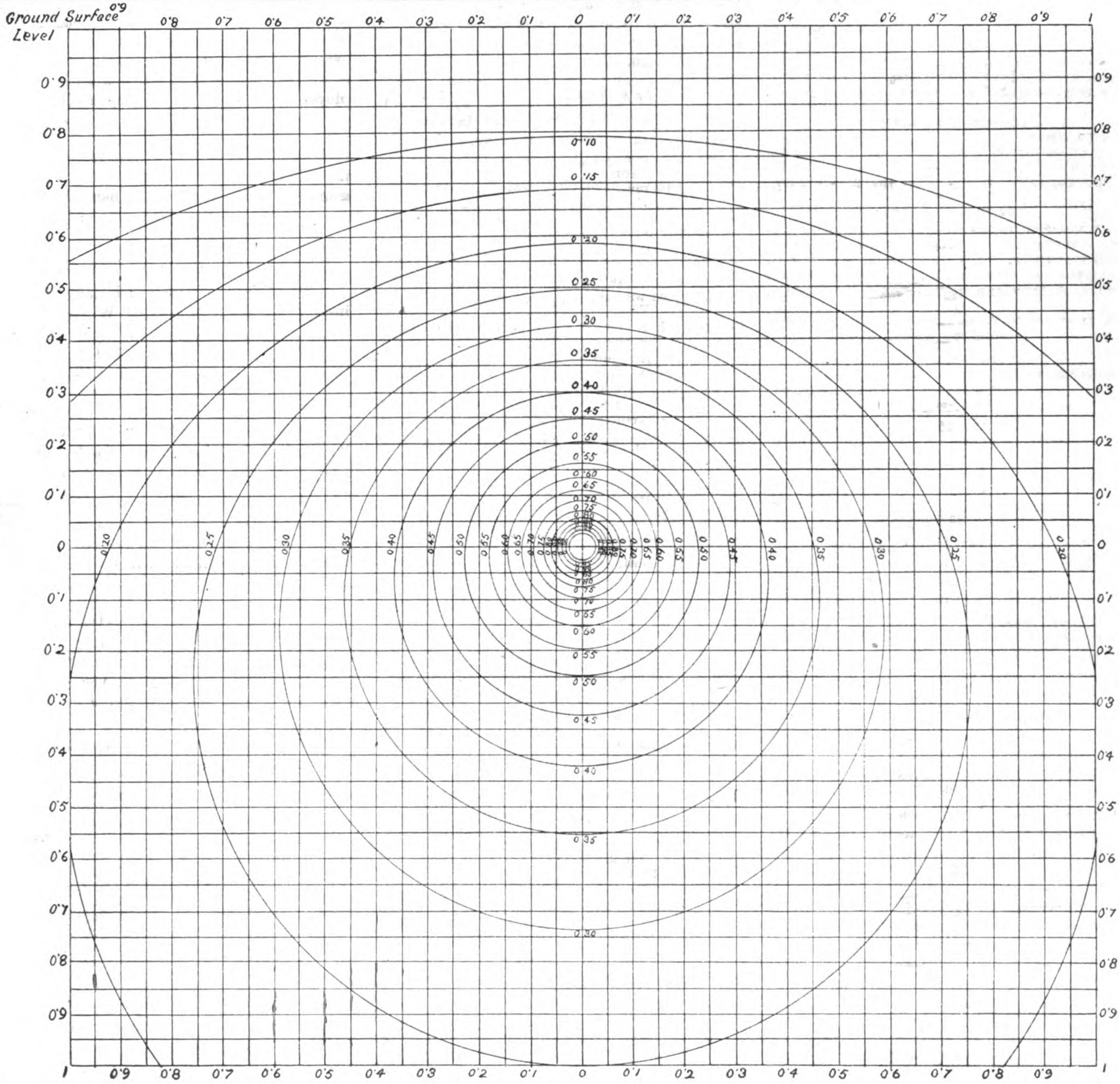

FIG. 2.

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[*] Read before the Association of Edison Illuminating Companies.

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Electrical Frauds Condemned. The criticisms offered by ELECTRICITY upon the exhibits of several medical quacks which disgrace the Electricity Building at the World's Fair received a notable endorsement from no less an authority than Prof. S. P. Thompson in the course of his remarks at the collation of the Electrical Congress held in that building.

After bestowing the most liberal praise upon the exhibition of electrical work both in the Fair and throughout this country, Prof. Thompson stated that in one respect England had gone ahead of America, viz., in properly branding that class of parasites who trade upon the credulity or gullibility of the public by selling electric belts and electric plasters to cure any and every disease. Prof. Thompson also recited the recent exposure of a similar fraud, by the *Electrical Review*, of London, an account of which was published in ELECTRICITY, and scored the American electrical journals for their failure to perform their obvious duty in enlightening the public as to the true status of these humbugs.

We have emphatically stated several times that a number of these electro-therapeutic exhibits are a disgrace to the electrical department, and this disgrace was made still deeper by the attempt on the part of Mr. Hornsby, of this department, to defend these humbugs in reply to Prof. Thompson's remarks. It is to be regretted that these impostors, whose exhibits have no business in company with those of the reputable concerns which surround them in Electricity Building, have secured such a hold on one of the officials of this department, whose office it is to maintain the character of the exhibition untarnished, that he should feel the necessity of defending a class of swindlers whose knavery is condemned by every reputable electrician and physician.

This action is the more surprising coming from a physician, as Mr. Hornsby in his remarks mentioned that he had followed the study of medicine both in this country and abroad. It would be of interest to know what medical colleges sanction the indiscriminate use of electric belts and plasters, as physicians are usually the least tolerant of any class of men in regard to quackery and humbugs in their profession.

It is not to be supposed that the men who sell electric plasters and belts indiscriminately for the cure of forty or fifty different diseases are susceptible to feelings of embarrassment or shame, otherwise their presence during such a denunciation might have been productive of salutary effects.

Next to the officials who have permitted this class of exhibits to degrade the character of the Fair, the electrical journals have been most culpable in the neglect of their duty. With the exception of ELECTRICITY there is not one of them which has not, by its conspicuous silence on this subject, giving tacit sanction to a number of swindles which it would not dare to openly defend or advertise ; and if an electrical paper owes any duty to the public which it pretends to serve, that duty should certainly be to expose those impositions parading under the guise of electrical science.

In this respect ELECTRICITY stands alone, and among its contemporaries not one appears to be free to criticise even the most barefaced swindle which seeks shelter under the name of the science which it espouses.

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Electrical Signalling Through Space. The paper of Mr. Preece on this subject read at the Chicago Electrical Congress presents a most instructive account of the experiments carried out in England, and points out pretty clearly the limitations which in practice attach to the plan of communicating intelligence by electricity without wires.

The experiments carried on under the direction of Mr. Preece across the British Channel were successful in the case of a distance of three miles, and less so in the attempt to cover five miles, but as the distance separating the parallel lines between which communication takes place is limited by the length of these lines, it is obvious that in practice this distance must be short, except in special cases. For this reason the system can be of no practical value in the case of lighthouses and ships, as the length of the lines carried on them is necessarily short. In the case of a vessel the maximum distance would therefore be the length of the ship, and this would be of no avail in case of danger.

Even in communicating across rivers, where the necessary length of line can be run on either bank, the system will generally be found of little value, as ordinarily a submerged cable furnishing direct communication will be found available and much more satisfactory.

The experiments are of scientific interest, however, from the fact that they showed that this phenomenon of transmission through space is due to electro-magnetic induction, and that there is actual transformation of the current into mechanical energy and back again into electrical energy, instead of simple conduction through the earth.

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Incandescent Arc Lamps. The problem of producing a practical arc lamp with an enclosing chamber like that of the incandescent lamp is one that has received the attention of a number of inventors for many years back, and although several lamps of this character have been devised and patented, all of them up to the present have contained features which prevented their practical adoption, either on account of their low efficiency, short life or danger of explosion.

The appearance of such a lamp is rather that of a luminous globe than the concentrated light of an arc, and for this reason its use would be found advantageous in many places where a steady diffused light is needed. The results given by Mr. Marks in his paper, printed elsewhere, show that most of the difficulties inherent in this problem have been overcome, and the tests of the lamp described give promise of the production of a commercial article.

The two most important requisites are carbons perfectly free from impurities, and a quality of glass capable of withstanding the severe heat to which it is subjected. In the old attempts to produce these lamps the best quality of carbon attainable contained marked traces of metallic and other impurities, so that the negative pole of the arc received a mass of plastic deposit which extended across the arc, making it in reality an incandescent lamp.

The valve for the egress of the CO_2 in the bulb of such a lamp is also a matter of special moment, as the pressure of the enclosed gas must be maintained below a certain amount to avoid explosion. It was found expedient by experimenters on many of the early lamps of this type to conduct their observations and experiments from an adjoining room to that containing the lamps owing to the certainty of eventual explosion. Mr. Marks states, however, that after perfecting the valve used on his lamp there has not been an explosion or any trouble caused by the gas for a number of months.

The coating of the globes with the carbon deposit is considered by Mr. Marks to be a practical advantage, as the light is more evenly distributed and the luminosity appears to be greater than with cleaned globes. With pure carbons this deposit has been found to be but slight.

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Western Electric vs. General Electric. It will surprise no one who has taken notice of the tactics pursued by Mr. E. J. Spencer, who is in charge of the General Electric Company's exhibit at the Fair, to learn that he has at last been caught in the commission of a crime.

The publicity given to this occurrence, some of the details of which are related elsewhere, should enable the trade to estimate Spencer correctly, and deprive him hereafter of the privilege of associating with gentlemen. He has proved himself a lawless fellow who is not to be further tolerated by law-abiding people.

Electricity has stated many times that employees of the General Electric Company are taught by the precept and example of the higher officials that roguery and rascality are virtues which will be rewarded, and it is not strange that Mr. Spencer has followed in the footsteps of his superiors.

Moreover, he went to the Fair in the first place with an exaggerated idea of his own importance, as also of that of his company. He seems still to believe that the General Electric Company owns the Fair, and that he is the chief executive officer, notwithstanding the many slaps in the face he has received in the past few months. Chicago is not so far from New York but that Spencer should have learned ere this that his company is dead, and that any further effort on his part to boom its apparatus at the Fair is useless.

Spencer's attempt to have the Westinghouse sign removed from the south wall of the building rendered him, it was supposed, sufficiently contemptible and ridiculous. He has now shown that he has no conception either of common fairness or of his own humiliating position.

He is an arrogant person, whose appointment to represent the General Electric Company at the Fair is added proof of the wretched management of that company.

Other manufacturers have made friendships at Chicago which will produce good business for them for many months to come; but Spencer and the General Electric Company have made nothing but enemies, of whom they had plenty before the Fair opened.

The Western Electric Company may be depended upon to carry its case through to the end.

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The General Electric Wreck. The immediate movements of the General Electric wreck are as difficult to predict as it would be to tell in which direction the derelict at sea, floating bottom upwards, at the mercy of wind and wave, would be next impelled.

It is doubtful if any member of the Board of Directors has any clearly defined plan beyond the active use of the headsman's axe, cutting off heads and expenses as rapidly as possible.

From the point of view of competing manufacturers, who care more about the sale of their own goods than about the success or failure of the sham Trust, the position of the latter to-day leaves nothing to be desired. It has fallen down before the race was half run, and it will be thoroughly distanced before it can get on its feet again, besides being bruised and knee-sprung.

It is superfluous to say again that the Trust scheme has been a failure. But it will never be superfluous to keep before the public with persistent iteration the fact that it has been worse than a failure. In its greedy attempt to control the business, the Trust for many months was strong enough to do almost irreparable injury to many single concerns and to the trade at large.

The electrical trade would have suffered little harm from the present wave of depression which is passing over the business world had it not been for the blighting effects of the Trust on the business eight months ago. And but for the existence of the inflated trusts, like General Electric, Whiskey and Cordage, there would have been no such tremendous shrinkage from fictitious values, and no such consequent loss of confidence in the financial world.

While Electricity has the ear of the electrical trade, these facts will not be allowed to become obliterated or befogged.

The power of the press, when grounded upon TRUTH and JUSTICE, is exemplified in the twelvemonth fight Electricity has made against the Electric Trust scheme. The organization of the company was a blunder, its policy has been a series of blunders. Whatever the future of the General Electric Company may be, that once imperious organization is to-day an absolute wreck, without business, without money, and without friends; with no organization and with no ability within its own ranks to perfect an organization--driven to the wall by the one trade paper which has dared to tell the truth for fifty-two consecutive weeks, Electricity.

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It is fortunate for the stockholders of the General Electric Company that it only did a trifle less than $14,000,000 of business for the first year. Losing about seventy-five cents for every dollar of business done, twenty millions of business would have wiped the stock completely out.

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Mr. B. E. Sunny, general manager of the Chicago office of the General Electric Company, was summoned to this city by telegraph last week, to explain how it came about that the final balance sheet of his office for the year showed a net loss of a quarter of a million dollars; also how it was that he sold to the Pueblo (Consolidated) Railroad Company $175,000 worth of apparatus, taking in payment therefor second mortgage bonds, there being already $225,000 first mortgage bonds on the property, the road now running behind at the rate of about $1,000 a month on operating expenses alone, saying nothing of defaulted interest on the first mortgage bonds. It is not known as yet whether Mr. Sunny convinced Mr. Twombly that this was or was not good business.

On a Method of Governing an Electric Motor for Chronographic Purposes.

BY DR. A. G. WEBSTER.*

The element of time is one of the important quantities upon which electrical measurements pend, and many of the most fundamental determinations, such as the absolute measurement of resistance, the determination of "V," the ratio of the two electrical units, measurement of capacities and of coefficients of inductions, involve a time-measurement as one of the principal data. The measurement suffers under the disadvantage that it cannot be preserved in a material standard, for while the meter and the kilogram are defined by prototypes deposited at Breteuil, the second cannot be so deposited nor directly copied. Nevertheless the instruments for the measurement of time have reached such precision in our astronomical clocks and chronometers that we have little to complain of.

In electrical measurements, however, the element of time generally enters as an angular velocity, and the difficulty enters not with the clock, but in the preservation of the angular velocity constant enough for accurate measurement. Of course a clock is but an instrument for preserving a constant angular velocity, and when the velocity is small nothing else is to be desired. In our electrical measurements, however, angular velocities are large, and clockwork is out of the question. Clocks and chronographs, escapements and governors, moreover, are at best delicate and expensive, so that no apology is required for an attempt to find something less so.

Next to a clock with a pendulum or balance wheel, a tuning fork is a good time-keeper, and has been adopted, or what amounts to the same thing, a reed has been used to govern a clock-train, in the Hipp chronoscope. The accuracy of the latter is, however, not all that could be desired. In electrical measurements the tuning fork has been of the greatest service, and is the instrument upon which the time measurement generally directly depends, the fork being used by the stroboscopic method to verify the constancy of the angular velocity.

The question of the maintenance of the constant velocity remains unanswered. It has often occurred to me to ask why the electric motor has not been applied in chronographic apparatus, and it seemed to me that this could often be done with material reduction of expense. In the course of some experiments last winter, when it was necessary to measure intervals of time of the order of a thousandth of a second with an accuracy of one part in ten thousandth if possible, so that an interval of ten millionth of a second must be distinguishable, and high velocities were necessary, clockwork is out of the question, and I determined to try the motor, and to attempt to give it a positive governor.

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* Paper read at the International Electrical Congress, Chicago.

The method adopted was of such simplicity that it must have occurred to all present, and was suggested by the method employed by Lord Rayleigh, and elaborated at the German Reichsanstalt, for comparing a tuning fork with a clock by means of Lacour's phonic wheel. The prevalence of the synchronous alternating current motor also suggested the practical means needed.

Upon the shaft of a small motor carrying a drum and disk for registration was directly attached the armature of a smaller motor arranged as an alternator, with separately excited field magnets. The current for the armature of the latter was made alternating by a commutator arrangement, composed of mercury cups and wires carried by the prongs of an electrically maintained tuning fork. The direct current motor was now run up to synchronism, in hope that the alternator would fall into step with the tuning fork, and be automatically governed. As it is obviously out of the question to pass more than a very small current through a mercury break, the question of phase is equally important with that of synchronism, and it was at first found impossible to make the governor work at all. It was soon found that an alternating current was not necessary, but that an intermittent current would serve as well, so one of the reversed currents was left out, and the complicated commutator on the tuning fork was reduced to a simple break.

In order to throw on the governing current at the right phase, a mirror was placed upon the end of a shaft, so that its normal was slightly inclined to the direction of the axis, so that a point of light would be seen as a continuous circle. A glow lamp reflected in a mirror, carried by the governor tuning fork with an interposed slit, was looked at in this mirror, and instead of a continuous circle of light there was then seen a number of bright arcs, which diminished as the speed of the motor was brought up to synchronism. When the number of arcs is reduced to two, synchronism is attained, if the arc stands still; in practice, however, by means of a fluid rheostat in the circuit of the field magnets of the driving motor the speed is made gradually to vary, so that the arcs revolve slowly, and when a part of the revolution is reached that a few trials show to denote the proper phase, the governing current is thrown on, and the apparatus runs controlled, and the arcs of light stand perfectly still. In order to give instant notice of a failure of the governor, a telephone was placed across the terminals of the armature, which spoke up in stentorian tones of beats on the least divergence from synchronism, so that the observer would be recalled even from the farthest part of the next room. An amperemeter also showed by the presence or absence of oscillations corresponding to the beats when the governor was acting properly. The motor which I used for driving was capable of giving out one third of a horse power, and the number of revolutions was thirty-two per second. The tuning fork was a large electro-magnetic fork by König, carrying a steel mirror and a sliding weight.

In order to make sure whether the frequency of the tuning-fork was influenced by the controlling current, a large free fork was set up near by and was frequently bowed and compared with the electro-magnetic fork by means of Lissajou's figures. No difference was ever detected whether the governing current was on or off, although a difference of one part in twenty thousand could have been detected.

The accuracy of governing by this method is of course only limited by the constancy of the frequency of the electro-magnetic fork. In my experiments this generally amounts to about one part in ten or fifteen thousand, but I have no doubt that by the exercise of proper precautions it could be made much greater. This method dispenses with the services of one observer, and gives a marked increase in the accuracy of the determination of angular velocity, one of the most troublesome measurements concerned in electrical measurements, so that I am left to hope that it may prove of practical utility in future determinations.

Current Items.

A boom in the electrical business in Southern cities threatened with yellow fever should be looked for at once, if the opinions of Mr. Park Woodward, of Atlanta, carry any weight. He says: "I can tell you why Atlanta can bid defiance to yellow fever and other plagues. It is because the earth is thoroughly charged with electricity from the street cars, telephones, telegraphs and city lights. All these combined keep the earth's surface like a huge electric battery. This kills any disease germ that may find their way into the city. You know it is a fact that the Western Union telegraph office has its ground wire across the Chattahoochee river, because the earth was too much charged with electricity to ground it in the city."

It is announced that the Illinois Central Railroad has discovered a new and valuable use for electricity. It is for nothing else than to kill weeds along the roadway. In order to comply with legal requirements in years past it has cost the company about $40 per mile to destroy the weeds. With the electric annihilator five miles of weeds can be killed in an hour at very small expense. The heavily charged brush runs along about eight inches above ground, and any weed with which it comes in contact, however big or strong, is struck dead, as it were, and becomes black as if smitten with frost.

On the Carrying Capacity of Electric Cables, Submerged, Buried or Suspended in Air.—II.

(Continued from Page 93.)

thermal resistance is again interposed by each layer of fibrous material, the thermal resistance of the metallic bands or wires being negligible in comparison. The thermal resistance of any cylindrical layer of resistivity δ_n and radii r_n and R_n is $S_n = \frac{\delta_n}{2\pi} \log_e \frac{R_n}{r_n}$ by formula (2), and since all these resistance are in series, the total thermal resistance per centimetre of cable length is $(S_1 + S_2 + S_3 + \ldots G)$ and this compound term should replace the symbol S in equation (4).

As the measurements referred to were all made on simple lead-covered cable, information is still missing as to the value of the resistivity for these layers.

In computing the tables given in Appendix III, these resistivities have been assumed as equal to that of the Siemens insulator next to the copper, i. e., $\delta = 750$.

INFLUENCE OF NEIGHBORING ACTIVE CABLES

If two or more active cables are buried in the same trench, they will exert a mutual thermal influence upon each other, and it becomes important to ascertain in what degree their proximity will influence their temperature elevation and safe carrying capacity.

As an illustration of the distribution of temperature communicated to the soil in the vicinity of an active cable, Fig. 2 represents the special case of a cable whose axis is buried forty radii below the ground surface. If the external diameter of the cable should be 5 cms. (1.97"), the depth will correspond to one metre (39.37"). Taking the temperature elevation at the external surface or sheath of the cable as standard, the circles indicate the sections of successive isothermal surfaces having 95, 90, 85 per cent.—10 per cent. of the sheath elevation, the ground surfaces being the postulated surface of zero elevation. It is evident that for a given distance from the cable the temperature elevation is highest immediately beneath, and lowest immediately above it. The following table, No. II, gives the horizontal distances at which these isotherms occur, measured from the cable axis, and this series is represented by the curve in Fig. 3.

These entries and diagrams by representing a dimensional system of common occurrence in practice may enable temperature elevations at different distances from an active cable determinable in some cases by direct inspection. The data, however, for constructing the diagram corresponding to Fig. 2, appropriate to any given case, are provided in Appendix II.

In this case, if the temperature elevation at the cable's sheathing should be 10° C., and a second cable should be placed in the same trench and parallel to the first at an interaxial distance of 22.7 cms., the table and curves show that the second cable would have its temperature raised by 50 per cent. of that at the sheath of the first, namely, 5° C., and if 25° C. constituted the limiting safe temperature elevation above normal, then the limit of self-elevation allotted to the second cable would be reduced to twenty degrees. The same process might be extended to any number of cables buried in one trench. A diagram could be prepared showing the relative positions of the cables, and the elevation of any one would be the sum of the elevations due to all the remaining active cables taken in turn as though each acted alone. This sum would represent for that cable the total elevation above normal due to mutual influence, and should be subtracted from the range of self-elevation in assigning the limiting current strength. This proceeding not only involves the previous assumption that the temperature elevation of the ground surface is negligible, but also that the insertion of parallel idle cables into an otherwise homogeneous environment does not affect the thermal distribution previously existing. This, of course, could be only true for cables of infinitesimally small cross section. The effect of the location of a sheathed cable in the vicinity of other active ones must be to equalize the temperature throughout the space it occupies, and this tendency must

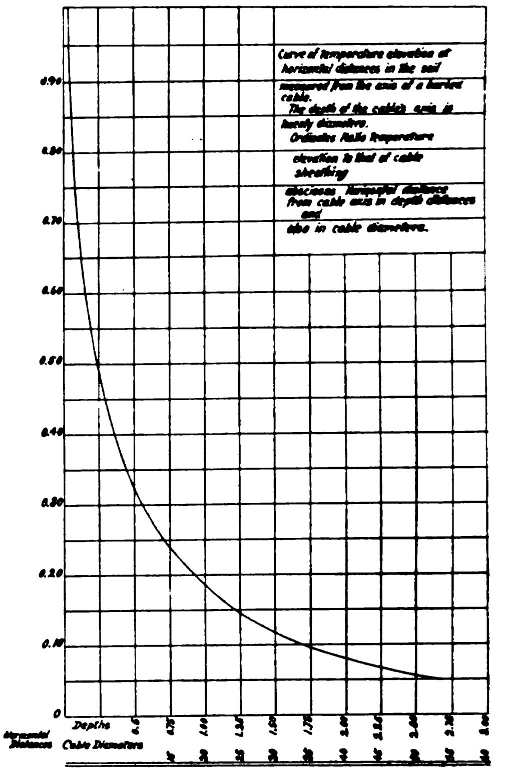

FIG. 3.

exert a disturbing influence, diminishing with distance, over all parts of the thermal field of distribution. The nearer the cables are packed together, and the greater the ratio of their diameters to their depths, the greater will be the discrepancy due to both these incorrect assumptions, but it would seem that for ordinary sizes, depths of from 60 to 120 cms. (2 to 4 feet), and distances apart of 30 to 90 cms. (1 to 3 feet), this error will not be serious. Observations made on cables horizontally separated by 11.4 diameters in the same trench showed that the temperature of one kept inactive acquired in three hours 38 per cent. of the temperature elevation at the sheath of its active neighbor, the calculated elevation being 42 per cent.

Fig. 3 shows that for the depth there considered the temperature elevation at a horizontal distance of twenty diameters is less than 20 per cent., while at five diameters it is nearly 50 per cent. of that at the sheath of a continuously active cable. With heavy cables, maintained for long periods of load in soils of high thermal resistivity, their distance apart in the trench may thus become an important matter.

INFLUENCE OF DURATION OF LOAD UPON TEMPERATURE ELEVATION.

The temperature elevation of a cable with a given steady current, in the sense ordinarily intended, is that maximum elevation which is only attained after an indefinitely long period of activity. The problem of the temperature development throughout time, in and round a buried cable, may be solved on the postulate of a constant normal temperature of the ground surface, by considering two equal and parallel cables in the same vertical plane and at a distance apart of twice the trench depth, but with the ground now distributed round them for an indefinite distance in all directions. If the lower cable generates heat at a given rate, and the upper cable absorbs (or generates negative heat) at the same rate, the temperature of the mid-plane between them, corresponding to the actual surface of the ground, must remain by symmetry undisturbed, and the distribution of temperature below this plane due to the independent temperature distributions from both cables, advancing with time, will in algebraic sum correspond to the distribution developed by the actual cable. The problem therefore reverts to that of determining the distribution of temperature in an indefinitely extended medium surrounding a long straight cable steadily supplying heat, and the materials for the solution of this case have been supplied by Fourier. It would appear that under practical conditions the temperature elevation in and near the cable tends to reach its maximum with comparative rapidity, the approximation to the final state being more tardy as the distance from the cable increases. In the measurements of the temperature elevation of buried samples, the elevation of sizes up to 200,000 circular mils (1.014 sq. cms.) appeared to attain 95 per cent. of their full value in the conductor within twenty minutes, and the increase became inappreciable after one hour. On the other hand, while, as already remarked, a parallel idle cable 11.4 diameters horizontally distant reached 38 per cent. of the active cable's sheath temperature in three hours out of 42 per cent. calculated, another idle cable at 22.8 diameters appeared to reach only 17 per cent. out of a calculated 29 per cent. in the same period, a discrepancy that may well have been due to time lag. It may therefore be safe to infer that the conductor of a buried cable will closely approximate to its ultimate temperature elevation in one hour of steady load, but there can be little doubt that many hours will be needed to establish an equal approximation to the final state at a distance of say forty diameters from the cable.

(To be continued.)

A New Incandescent Arc Light.—II.

BY L. B. MARKS, M.E.*

DISTRIBUTION OF LIGHT.

It will be seen that the distribution of light as shown by the candle power curve differs considerably from that of the ordinary arc. Especially is this true at angles greater than 50° below the horizontal. The turn in the curve is not so sharp as in the arc, and there is much less difference between the maximum and the mean amount of light; in fact to the naked eye the intensity of luminous radiation does not seem to vary much from 20° to 60° below the horizontal, while in the arc the change is very marked between these limits. Thus the formula of Gerard,[1] namely:

Hemi-spherical c. p. = ½ horizontal c. p. + ¼ maximum c. p., which may be used to advantage in arc light approximations, will not hold in this case; but the form of the curve, as well as the nature of efficiency curves above referred to, suggests the substitute.

Hemi-spherical c. p, = ½ horizontal c. p. + ½ maximum c. p.

The mean or hemi-spherical candle power below the horizontal, obtained by integration of curve Fig. 3 equals 431, thus allowing 1-17 watts per candle, or 637-6 candles per electrical horse-power, nearly three times the average illumination of the incandescent lamp using the same energy.

The results of tests show that the mean hemi-spherical candle power of the ordinary arc measured as in the above case averages about 600; the mean watts per candle, .84 or 888 candles per electrical horse-power.

Comparing these measurements with those of radiant efficiency, it appears that the ratio,

$$\left\{\frac{\textit{Hemi-spherical c. p., ``incandescent arc,''}}{\text{Hemi-spherical c. p., ordinary arc.}}\right\}$$

is considerably smaller than the ratio,

$$\left\{\frac{\textit{Hemi-spherical efficiency, ``incandescent arc.''}}{\text{Hemi-spherical efficiency, ordinary arc.}}\right\}$$

The explanation of this difference undoubtedly lies in the quality of *luminosity* of the light emitted by the *incandescent arc*. Nichols[2] has pointed out that the relative efficiency, as determined by the ratio

$$\left\{\frac{\textit{luminous radiation,}}{\text{total radiation,}}\right\}$$

"does not coincide with that obtained from the ratio of watts to candle power, for the reason that the various rays which make up the visible spectrum do not enter into the production of candle power in proportion to their energy.". Luminosity is a potent factor in determining the real efficiency of any source of illumination. Lack of time has prevented the investigation of this important phenomenon, but, at its maximum efficiency the light from this form of *incandescent arc*, though not so intense, unmistakably appears brighter than that of an ordinary arc of equal candle power as interpreted by the photometer.

LIFE TESTS.

Oxygen being practically excluded from the arc enclosing chamber, prolongation in the life of the electrodes is an implied concomitant.

In the ordinary arc "while the positive carbon loses by volatilization from its tip or crater, and by combustion from its sides, the negative gains no deposit, but wastes at a less rate than the other, and by *combustion only*."[3]

Hence, if the exclusion of oxygen were complete, we might expect an indestructible negative. This condition, however, has not been fulfilled in any of the tests made thus far, but the results fully substantiate the theory. Absence of combustion on the one hand, and the tension of the enclosed gases on the other, combine to greatly reduce the amount of disintegration of the positive electrode.

Table IV gives the results of life test with a pair of pure carbons, ½ in. diameter, and specially constructed for the purpose.

The lamp was placed in the circuit of a constant current dynamo, running about eight hours per day; readings were taken at given intervals and the total length of run was limited to 100 hours.

Table IV.—Life Tests.—½ in. Carbons.

Mean Currents 9 9-16 Amp. Mean P. D. 55 Volts.

Initial length [x] carbon *inches*	Initial length [—] carbon *inches*	Duration of run *hours*	Loss in length [x] carbon *inches*	Loss in length [—] carbon *inches*	Life per inch [x] carbon *hours*	Life per inch [—] carbon *hours*
10.31	4.63	100.	6.81	0.69	14.67	145.45

Thus taking 1.69 inches per hour as the average consumption of carbon in the commercial 350 watt lamp, run at 5½ amperes and 50 volts,[4] we note that although 525 watts, or one and one-half times the energy, have been expended in the case of the lamp under consideration, yet the life per inch of carbon consumed is more than *twenty times* that of the other. Indeed the figures show that the life of the negative was nearly *one hundred times* as great as that obtained in commercial practice to-day.

The preservation of the negative is a very interesting feature of this type of lamp. There is a marked tendency towards deposition of the products of volatilization of the upper electrode on tip of the lower, the carbon deposited, if not ruptured by the action of the lamp, forming an internal part of the negative.

In one case where, the arc having been sprung, the electrodes did not come in contact during the entire run, this "building up" process was beautifully exhibited, the negative electrode gaining practically all that the positive lost. The current in this instance was 10½ amperes, and the P. D. 50 volts. The duration of the run was eleven hours.

OBSERVATION OF THE ARC.

Relation of P. D. to Length of Arc and Quality of Carbon.

The effect of the enclosed gases on the form and character of the arc presents a large field for investigation.

On account of lack of sufficient data no attempt will now be made to state much of a definite nature regarding this subject; but it is hoped that the matter will be given due attention in the near future.

The difference in potential between the electrodes being equal, the *incandescent arc* is longer for a given current than the ordinary arc; under some conditions it has been found to be almost twice as long. If we accept the conclusion of S. P. Thompson, that "the arc is independent of the nature of the surrounding gas,"[5] we must then look to the effects of the tension or pressure of the heated gases upon the arc to explain this difference in length. It has been found that there is a constant increase of P. D. with pressure above atmosphere for a given current and length of arc.[6] But in spite of this fact, the decrease in resistance of the arc under the conditions named appears to allow of a greater length for the same P. D.

FLAMING AND HISSING.

In the ordinary arc the carbon vapor carried off from the positive is consumed by the oxygen of the air before it can deposit on the negative.

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* Paper read at International Electrical Congress at Chicago.

[1] M. Gerard: Candle Power of Arc Lamps. Centralblatt fur Elektrotechnic, January, 1890.

[2] Dr. Edw. L. Nichols: The Efficiency of Methods of Artificial Illumination. Trans. Amer. Inst. Elec. Eng., Vol. VI, No. 5, May, 1889.

[3] Elihu Thomson, l. c.

[4] E. F. Peck: Carbon Tests, paper read before the National Electric Light Association, February, 1890.

[5] S. P. Thompson: On the Physics of the Voltaic Arc. Paper read before the British Association, Section A, Edinburgh, August, 1892.

[6] Dr. Louis Duncan, A. J. Rowland, R. I. Todd. New York Elec. Eng., Vol. XVI, No. 274, page 99, 1893.

Hence the ever present "zone of flame" as distinguished from the arc-flux proper is really a zone of combustion. In the *incandescent arc*, however, there is naturally no zone of flame, consequently the phenomenon of *flaming* common to the ordinary arc does not occur. The arc tends to centre itself, being probably aided in so doing by the pressure of the surrounding gases; moreover, the slow consumption of the electrodes lessens the tendency to wander. With cored carbons there is a perceptible crater, but with solid pencils the tips become more or less flattened.

The quality of the carbon has an important bearing on the P. D. between the electrodes. Generally speaking it has been observed that with soft fine-grained carbons the P. D. is considerably lower for a given current than with harder or coarse-grained pencils. The tendency to *hiss*, however, is not so marked when the electrodes are consumed in the gas chamber as in the open air; in the former case the disintegration is so slow that the "electrolytic" vaporization, as it has been called, does not appear to explode the particles. It is interesting to note here that these results confirm a theory of *hissing* advanced by Prof. Thomson a few years ago.[7]

THE ALTERNATING CURRENT "INCANDESCENT ARC."

No measurements were made using the alternating current, but the appurtenance was applied to the alternating current arc-lamp to determine the effect on the noise of the arc. The *hum* was in a large measure reduced, but whether the reduction was due mainly to the mere fact of the arc being enclosed in an air-tight compartment or not is questionable. But, as the *hum* became much slighter after the lamp had been in operation several minutes, the action of the heated gases being then manifest, it is plausible that the diminution in the noise was not due entirely to the shielding property of the glass envelope.

While it has been proven that "the humming of the alternating arc due to the rapid periodic extinction and re-establishment of the discharge,"[8] the singing tone may be greatly modified, if not entirely overcome, by the substitution of any incandescent arc of the Reynier type. A few years ago the writer had occasion to test an alternating current arc-lamp trimmed with carbons which had been provided with a core of pulverized mica and carbon. The springing of the arc was accompanied by the usual *hum*, but as soon as the mica fused the noise ceased. The conditions were similar to those of an *incandescent arc*, the plastic mica-carbon core constituting a high-resistance medium between the plus and minus electrodes. There was really no true arc. The amount of light was naturally greatly reduced. In the case of the *incandescent arc* first alluded to, there seems to be an approach to these conditions, the arc-steam acted upon by the gases enclosed in the chamber appearing to have a greater density, if we may call it that, than under normal circumstances. The amount of light in this experiment was, however, apparently as great as in the direct current tests.

APPLICATION TO THE ARTS.

Unquestionably this form of *incandescent arc* must have a wide application to the arts. As a substitute for the ordinary arc-light, where greater steadiness or longer life is required, its superiority will be manifest. And its utilization, where at present the incandescent lamp is the only satisfactory source of illumination, also presents a large field. The effective distribution of luminous energy and the color of the light, make it for many purposes a desirable mean between the incandescent and the arc.

As a standard source of illumination for arc-light comparison and measurements, it may be of much scientific as well as utilitarian importance.

The investigations have been carried out under the direction of Mr. Louis E. Howard, and many of the facts herein stated are due to him. The writer is also indebted to Dr. Edw. L. Nichols, Franklin L. Pope and Rob't H. Read for valuable suggestions; to Mr. C. Ransom for life tests, and to Messrs. Wm. C. Hubbard and E. S. Ferry for assistance in the efficiency and candle power measurements.

(*Concluded.*)

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[7] Elihu Thomson: Trans. Amer. Inst. Elec. Eng., Vol. VII, Nos. 8 and 9, page 274.

[8] Dr. Edw. L. Nichols: A Photographic Study of the Electric Arc. Trans. Amer. Inst. Elec. Eng., Vol. III, Nos. 6 and 7, 1891.

American Electrical Works.

The 15th Annual Picnic and Gathering of the Clans for a General Jollification and Eating of Clams.

Yes, it was a remark full of truth which fell from a member of the electrical fraternity when he received an invitation to the fifteenth annual clambake, tendered by the American Electrical Works, Providence, that the little card was like an oasis greeting the eye in the midst of the arid desert of financial and commercial depression which at present extends from the Atlantic to the Pacific boundaries of this fair land; and, as events proved, the boys availed themselves of the kindly call to partake of the generosity tendered by "Little Rhody's" most popular citizen for and in behalf of a firm known and esteemed by every member of the great electrical fraternity.

Saturday last, September 2, was the date, and Haute Rieve, the rendezvous on the beautiful Providence River, where this notable gathering took place. The day broke dull and damp, and the weather man evidently was inclined to provide conditions almost as depressing as the times for the occasion, but his inclination, if such it was, failed to spoil what has come to be known as "Eugene's weather." Nevertheless, the unpromising outlook did something towards frightening a few of the less brave ones from journeying to Providence, there to participate in the slaughter of the innocents by immolation on the altar for the delectation of the gastronomic organs of a crowd of hungry picnickers. Those, however, who did brave the threatening elements, and they numbered 155, were more than amply repaid, for just as Providence was reached by the Boston contingent old Sol showed his radiant face from behind the dark clouds and was considerate enough to remain on view more or less the rest of the day—so the boys, as usual, had an ideal outing.

By way of a change, the trip to the trysting place was not by steam, but by electric cars, which run now down to Crescent Park, close by the picturesque grounds of Haute Rieve, alias the Union Club House.

Lunch was announced for 11:30, and to the minute the well-loaded tables were besieged, and a spirited attack made on the comestibles, which included clams, quohaugs, oysters, lobster, doughnuts, crackers and cheese, these toothsome dainties being pleasantly diversified by draughts of punch such as the greatest connoisseur might smile over and feel happy and good. This item of the day's programme ended, the registering of names and the attaching of badges completed, the day's fun began in right good earnest.

There was a phonograph, delivering speeches on the silver question, and singing songs composed by electrical men; a galvanic machine tying the arms in knots and compelling the bold ones to perform acrobatic feats of questionable grace; lifting machine for testing the strength; rifles and targets for those who fancied they knew how to handle a gun, and other attractions. Of course, the usual supply of white hats, and wide expanding sombreros was forthcoming to adorn the heads of many, and kicked round as freely as the ubiquitous football which found lodgment on many a pate as it was sent flying from point to point in the lunch room.

Soon a baseball game was arranged for, the contending teams representing Boston and Providence respectively, the result of five innings showing a record of 30 in favor of Boston to 12 for Providence.

And so the fun went on until the bake proper was announced, in a huge tent. And such a repast! It need not be here described, for all know that it included many delicacies and appetizing dishes besides the historic and succulent clams. The menus were passed around incased in miniature traveling rugs and straps, which novelty will long be preserved by the guests as a souvenir of this enjoyable gathering.

The esteemed host, Mr. Eugene Phillips, presided at the head of the tent, having Mr. C. E. Stump, of New York, as toastmaster. In opening the post-prandial exercises Mr. Phillips gave a hearty welcome to all present; expressed the pleasure it afforded himself and his associates to have as their guests so representative a gathering of men engaged in the electrical industry. Notwithstanding the business depression that almost universally prevailed, there were causes for congratulation all round, and he for one did not believe in giving way to feelings of despair, for he had the assurance that things would correct themselves very shortly, and in any event he desired that all should enjoy themselves thoroughly, and if they found it difficult to take their day's pleasure silently, why they were at perfect liberty to make all the noise they could.

Mr. Martin C. Day, the facetious city editor of the Providence *Journal*, then responded to a call with one of his funny speeches, which, as usual, convulsed the entire company. Mr. Frank Ridlon, as one who had attended many of those clambakes, spoke feelingly of the past and most appreciatively of the debt of gratitude Mr. Phillips had laid upon the whole electrical fraternity by his princely hospitality. Mr. H. M. Dagget, Jr., of Attleboro, made a few timely remarks on the great work which was being done by those present as representing one of the greatest industries of the age, and was followed by Captain Brophy, who, as one esteemed by everybody, spoke of what he wes always trying to do in harmonizing the two important interests, electricity and insurance. He eulogized Mr. Phillips as a gentleman who had done so much for this world that some day he might be invited to emigrate to some other planet and there show the inhabitants of another sphere what can be accomplished by an enterprising business man and a true, generous-hearted gentleman.

Mr. W. S. Key, representing the electrical press, said a few words for those engaged in journalism, expressing the hope that as the press had always striven to advance the science and art of electricity, so it would always stand for what was best in the business, aid it in its progress and throw in its influence towards restoring confidence and helping on renewed progress.

Mr. H. B. Cram, Boston, in a brief address pathetically alluded to those who were no longer to be found at these festive gatherings, having passed on to the great majority, while others equally familiar and well known had found it impossible to be present because of important duties they were now discharging at Chicago and elsewhere in connection with the electrical business in which all present were so deeply interested.

The speeches were necessarily brief, as the boys had lots of fun left in them, and at the close of the exercises, which had been interspersed by music discoursed by an orchestra, the fun was resumed until the morn, when many had to start for home, quite a number on their way to the depot visiting by invitation the Narragansett Electric Light and Power Station, to see the starting up of the huge 500 kilowatt alternating machine, which proved a great attraction to all who saw the monster and watched its start. It will be many a long day ere those who were privileged to be present will forget the pleasure and enjoyment of the American Electrical Works' 15th annual clambake.

Boston Notes.

Slowly but surely confidence in business circles is returning hereabouts, and local electrical firms are already beginning to feel its effects. The all but complete paralysis that was induced and became so general two or three weeks ago has not, by any means, been replaced by a healthy condition of trade such as prevailed ere the sudden panicky feeling struck the country; nevertheless there is a perceptibly healthy reaction, which, of course, everyone is hoping will continue. Several firms actually report themselves busy, and their reports are substantiated by the activity that abounds in their factories. Not only are these not laying off their men, working short time, or reducing wages, but, on the contrary, they are running full blast, and experience some difficulty in keeping pace with their orders. Several New England firms are in that notable condition, and we trust it may be our pleasure to have to report continued progress and improvement next week. If nothing else will, the devastation and havoc wrought among electric wires this week by the frightful storms should cause the wire trade to brisk up promptly, and this is just what it has done.

The electrical fountain that is to adorn the beautiful Lynn common, in the heart of the City of Shoes, as a gift from a late wealthy citizen named William Shute, is getting well under way and is to be inaugurated, all being well, on September 15. The one difficulty the designer and builders have to contend with is the low pressure in the street mains, which will limit the main stream of water from the fountain to a height of 25 feet only.

A few weeks ago we announced the fact of the City Council of Manchester, N. H., having been indicted by leading citizens for having made what was considered an illegal contract with the Manchester Electric Light Company for lighting the city for a term of ten years. There are rival electric lighting companies in Manchester, and this fact is at the bottom of the trouble. On Tuesday last the Mayor was served with a notice that at the September term of the Supreme Court certain petitioners, citizens of Manchester, would ask the court to break the contract recently made by the city government with the above company. The petitioners allege that the contract of ten years duration is beyond the authority of the city to make; that the Mayor and City Council are but the public agents of the city as a corporation, hold their authority in the nature of a trust, and this trust is grossly violated by the action of said officers and the misrepresentation and fraud of said light company in making said contract. Complainants further allege that under this pretended contract the city agrees to pay over $30,000 a year, or over $500,000 for ten years, for lighting the streets of the city, while a contract might have been made at a saving to the city of $10,000 or more a year. Other allegations were also made in the petition, which is signed by some twenty-five taxpayers. It is understood to be pressed by the rival electric company, but a move is believed to be on foot to consolidate the two companies, in which event the suit would probably be permitted to fall through.

The Usher storage battery, which is doing such excellent service and practically demonstrating its high efficiency on the Milford and Hopedale Street Railway, every car on which is operated by this battery, has attracted so much attention among capitalists and representative railway men in England that negotiations are now in progress with a view to the sale of European rights to a wealthy syndicate on the other side. An expert has gone to England, and it is confidently believed that as soon as the foreigners have had an opportunity of seeing this battery at work they will secure all rights in it for Europe.

There is a new electric car motor in process of construction in this city, which has two armatures so arranged that they will revolve at two different speeds, the fundamental idea at the basis of this peculiar construction being to secure a more ready and easy method of taking curves on street railways with the two armatures, it being found that the speeds are differentiated according to the radii of the two rails on every curve. As will readily be appreciated, the varying speed of the wheels on the outer and inner rails will do away with the friction incidental to the usual method of both wheels revolving at the same speed.

General News.

What is Going on in the Electrical World.

Auburn, N. Y.—The common council has decided to use electric lights only for street lighting; hitherto gas has been used.

Martin's Ferry, W. Va.—The property of the Martin's Ferry Construction Company, consisting of the ruins of the electric plant, poles, wires, franchise, etc., are to be sold.

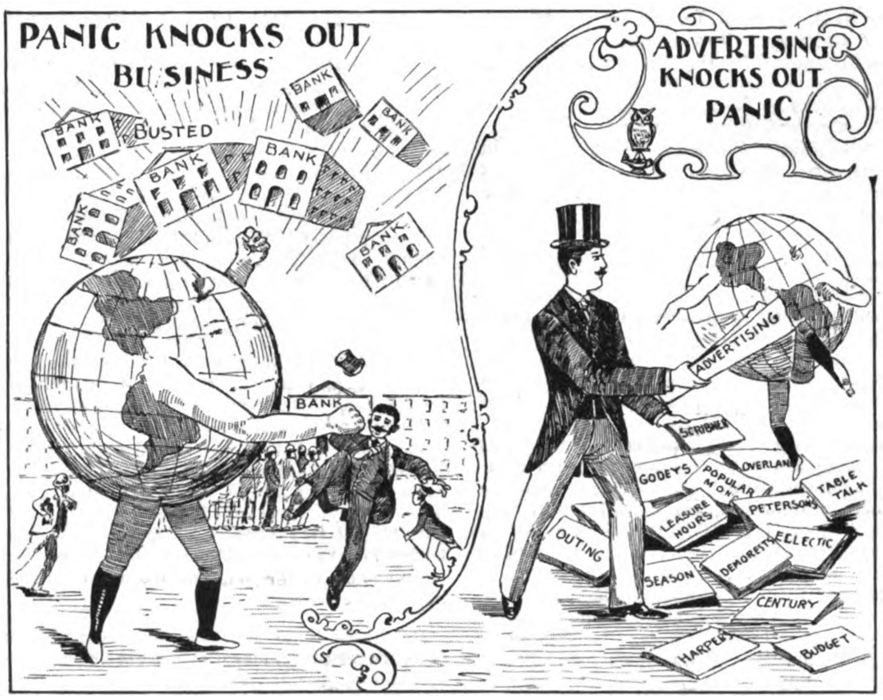
Clinton, Mass.—Surveys have been made for an electric road between Clinton and Sterling Junction, the scene of large annual camp meetings and a favorite summer resort.

St. Paul, Minn.—The East Seventh Street cable line has been transformed into an electric line at an expense, including losses by the change, of between $300,000 and $400,000.

Columbia. S. C.—The city council, owing to some disagreement with the electric light company, have under consideration the question of putting in a plant under city ownership.

Muncie, Ind.—The city council has granted a franchise that covers nearly every street in the city to the Citizens' Street Railway Company and consolidates the motor and electric lines.

Pikesville, Md.—Committees have been appointed to dispose of stock in a proposed electric road from Pikesville to Emory Grove, by way of Owing's Mills, Reistertown and Glyndon.



AN EXPERT'S SUGGESTION.

J. WALTER THOMPSON'S VIEW OF THE SITUATION.

Paterson, N. J.—The State Electrical Subway Commission have granted permission to the Paterson and Passaic Electrical Railway Company to erect poles and run lines in Paterson.

Piqua, Ohio.—The Miami Valley Electric Railway Company has completed the building of its track between Troy and Piqua. The line will probably be extended to Dayton at an early day.

Shelbyville, Ind.—The city council has repealed the ordinance granting the franchise to the Shelbyville Electric Street Railway Company. There appears to have been some irregularity in bonding the road.

East Boston, Mass.—The Boston & Winthrop Street Railway Company has petitioned the board of aldermen for the right to construct and maintain an overhead trolley system in and through Saratoga street.

Whitesboro, N. Y.—On the occasion of turning on the electric arc lights for the first time in the streets of this place, a few nights ago, there was great rejoicing; a band paraded the lighted streets playing merry tunes.

Bridgeton, N. J.—The injunction stopping the stringing of the trolley wires of the Bridgeton and Milville Rapid Transit Company in the streets of Bridgeton has been revoked by the Electric Subway Commission.

Brooklyn, N. Y.—The Brooklyn City Railroad Company has dispensed with its horse cars, and are using the trolley only.—The Lee and Nostrand Avenue line will be operated by electricity in about three weeks.

Watertown, Mass.—The citizens of this place will no longer have to depend on the Fitchburg Railroad after the middle of September, when the electric line from Newton to Boston will be completed, the line running through Watertown.

Ansonia, Conn.—The *Sentinel* says, in relation to the Ansonia Electric Company, that "no time can be stated when resumption will take place, but it will be very soon." About 125 persons were employed in the factory at Ansonia.

Franklin, Pa.—The Franklin and Oil City Electric Railroad Company has been granted a franchise for constructing and operating a railway in the streets of this city for thirty years. The company is to pay the city $250 a year for the privilege.

Orange, N. J.—Two companies, the Consolidated Traction Company and the Suburban Traction Company, have applied to the board of trustees of South Orange for a franchise to construct and operate an electric railway from South Orange to Orange.

Toledo, Ohio.—The scheme to build an electric road between Toledo and Detroit is revived. H. J. Warner, of Brooklyn, N. Y.; H. H. Johnson, of Philadelphia, and J. H. Dawson, of Toledo, are said to be at the head of the syndicate interested in the project.

Independence, Kan.—The Continental Telephone Company has been organized here with a capital stock of $50,000, for the purpose of connecting the towns of Montgomery County with Independence, the county seat, by telephone. J. C. Reynolds, is the treasurer.

Savannah, Ga. — The insurance companies here have notified their policyholders who are using electric appliances that the latter must be made to conform to the latest rules of the Southeastern Tariff Association, otherwise an increase of 50 to 75 cents on the $100 would be charged.

Norwich, Conn.—The Quinebaug Electric Company have mortgaged their property for $300,000 with the Knickerbocker Loan and Trust Company, and intend to erect a dam twenty-two feet higher than the Greeneville dam and otherwise increase their facilities for furnishing power by electricity, lighting, etc., to surrounding towns.

Hartford, Conn.—The council has again shown its hostility to the trolley system by refusing to reconsider its former action against an application from the Horse Railroad Company to use it on their lines. The councillors demand a trial of the storage system by the company. If that proves a failure, they may accept the trolley.

Atchison, Kan.—A Salina paper states that Morton & Company, bankers and brokers, of New York, have offered $35,000 cash for the Atchison Street Railway, and will operate it with electricity if a bargain is made. All they ask of Atchison is that the city donate a site for a power house and an ice manufactory.

Utica, N. Y.—A meeting of the stockholders of the Baxter Overland Telephone and Telegraph Company has been called for September 15, at the office of the secretary, in this city. At this meeting an attempt will be made to secure the consent of three-fourths of the stockholders to mortgage the property of the company for the sum of $10,000 in order to satisfy several judgments held against the company.

Kansas City, Mo.—F. F. Hadley and W. E. Winner have filed an application in the county court for a license to construct and operate an electric line on East Fifteenth street from the end of the cable line to the Blue river, tapping Manchester and Centropolis, manufacturing suburbs of Kansas City. The applicants are owners of a tract of 100 acres on the Blue River lying on the route of the proposed line. This tract they say they intend to convert into a park.

Lawrence, Mass.—A company with a capital stock of $90,000 has been formed to build an op-

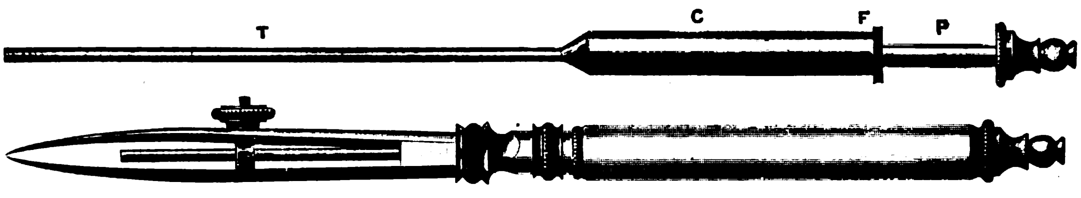
position line to the Lowell, Lawrence and Haverhill Electric Railway. The tracks of the proposed line will extend along the south bank of the Merrimac River through the towns of Andover and Tewksbury to Lowell. Among the promoters of the new line are: Maynard E. Clemons and Winslow Goodwin of Andover, C. T. Guild of North Attleboro, A. C. Russell, J. I. Chalifoux and Larkin T. Trull of Lowell, and W. S. Knox of Lawrence.

The "Injector" Reservoir Drawing Pen.

Draughtsmen know well the trouble and bother experienced (especially in doing details, etc., in which strong lines are employed) in being repeatedly called upon to "dip, dip, dip, and wipe, wipe, wipe," when using an ordinary ruling pen. An invention which obviates this in a very high degree must indeed, to quote a hackneyed phrase, "meet a long felt want."

Such an invention is now on the market. It consists of an ordinary hinged-nib Drawing Pen, provided with a hollow celluloid handle, into which fits a cylinder C, which is shown withdrawn from the handle in the lower illustration. The rod or plunger P serves to draw the Indian ink into the cylinder C, while the tube T is provided to carry the ink to between the nibs of the pen; the whole reservoir attachment, as will be seen from the lower illustration, constituting in reality a miniature hand pump.

To use the "Injector" Pen, withdraw the cylinder C from the handle (taking hold of the milled gland F) and fill it with ink by dipping the lower end of the tube T into the liquid and pulling out the plunger P to its extreme position. After wiping the tube, insert the whole cylinder (without, of course, disturbing the plunger) into the handle of the pen again. A slight push forward of the plunger P then serves to feed the pen with ink. When this is exhausted the plunger is again pushed slightly forward and the pen is again replenished, and so on.



JACKSON BROS.' "INJECTOR" RESERVOIR PEN.

Excellent points in this new invention not already mentioned are:

1. If it is wished to interrupt the work it is only necessary to blow out the ink remaining between the nibs of the pen; the ink in the cylinder will keep good for days.
2. If it is desired at any time when the reservoir is empty to add a line or two to a drawing without replenishing the reservoir, this can be done, for the pen can be used exactly as an ordinary pen, and further, should the reservoir attachment be lost or damaged an excellent Drawing Pen still remains.
3. If the top of the cylinder is unscrewed by means of the milled gland F, the plunger P can be easily withdrawn for tightening or renewing the packing.
4. The price at which the "Injector" Reservoir Pen is offered is actually less than is often charged for ordinary hinged-nib Drawing Pens, viz., 4s. each.

The pens are made by Jackson Bros., Limited, 50 Call Lane, Leeds, Eng., and are offered at 4s. each. American agents are wanted.

The "Novak" Lamp.

Mr. Arthur E. Bowers, New York manager for Claflin & Kimball, selling agents for the "Novak" Lamp, has removed his office to Room 63, *Tribune* Building. The following features of merit are claimed for the "Novak" lamp, by the manufacturers:

"The lamp now manufactured by us is a total departure in principle from all other incandescent lamps. Our lamp will maintain its initial candle power at its initial efficiency throughout the usual average life of incandescent lamps.

"The importance of this improvement can only be realized by those who have had the usual experience with lamps which begin to lose their candle power and at the same time increase their consumption of energy as soon as the lamps are put into service.

"The 'Novak' lamp maintains its full candle power at the same efficiency throughout its life.

"The 'Novak' lamp is fully protected by patents of our own, and is free from any possible claims of infringement of other patents.

"The efficiency and average life of the 'Novak' lamp are fully equal to those of any other lamp ever offered.

"The filament used in the 'Novak' lamp is the celebrated 'Perkins' filament, the superior quality of which is too well known to need comment by us.

"We respectfully solicit correspondence in regard to the 'Novak' lamp, feeling sure that a lamp possessing the superior qualities of this lamp, and manufactured by a company whose business it is to supply the general public without discrimination, will be appreciated."

COMMERCIAL PARAGRAPHS.

The Electric Heat Alarm Company of Boston has just had issued to it a patent on a Testing and Recording Apparatus to be used in conjunction with its Electric Heat Alarm, which has proved itself to be one of the most infallible safeguards against dangers by fire now on the market. This company is achieving signal success with its special devices, which are being installed in factories, warehouses and other buildings. To be the better able to handle its increasing business the chief offices are now located at the factory, 15 Chardot street. The attractive exhibit the Electric Heat Alarm Company has at the World's Fair is bringing some excellent contracts from the West and shipments are being made right along.

Mr. R. T. White, of Boston, the well-known inventor and manufacturer of street railway tracks, cable roads, car fenders and other specialties for street railway work, has published a handsomely illustrated catalogue of his many devices, and invites in the "Introductory" all street railway companies carefully to look into the merits of his inventions. Mr. White has been a prominent man in street railway work for years and his own exclusive lines of goods have become very popular. A street railway—whether for horses, electricity or cable—constructed on R. T. White's plans and material cannot fail to be one of the best built roads in the country.

The Whitney Electrical Instrument Company of Boston reports a very satisfactory business in its particular line of voltmeters, ammeters and other measuring instruments. It is now about to place on the market a voltmeter of a special type that will work with accuracy on alternating circuits. This instrument will be made in unusually large sizes for use in central stations where it has to be consulted often from the further side of a dynamo. Hence the various parts, including particularly the index and figures, are of such size as to be easily distinguishable from quite a distance.

Mr. George W. Finch, who represents the Ball Electric Company and the Reliance Gauge Company at Escanaba, Mich., reports a decided improvement in the business feeling in that section, his sales being very flattering.

The Roessler & Hasslacher Chemical Company of New York, which has an attractive exhibit in the Electricity Building at the Fair, is receiving compliments on all sides for its enterprise. Everything needed in the line of chemicals is supplied by this firm, which is one of the most reliable houses in the trade.

A little folder with the title "Echoes from Electricity Building" is sent out by the irrepressible George Cutter of Chicago. In it are set forth the merits of Cutter's Combination Shades, Simplex Wire, etc., etc.

INCORPORATIONS.

The Pontiac Light, Heat and Power Company, Pontiac, Ill.—to deal in electric light, steam or electric power. Capital stock, $20,000. Promoters: Henry A. Foster, C. M. Hamilton and A. P. Foster.

The American Railway and Electric Light Company (incorporated in West Virginia), New York City—to manufacture and sell devices, etc., for lighting railway cars by electricity, acquire letters patent and dispose of same. Capital stock, $2,500,000. Incoporators: A. B. Cornell, Ithaca, N. Y.; Henry B. Wibert, Beriah G. Payne, New York City.

The Gas and Electric Light Company of Lincoln, Ill., has certified to a decrease of capital stock from $80,000 to $50,000.

Brown Dynamo-Electric Telephone Company, Moline Ill.—to manufacture and sell telephones, telegraphs and other electrical devices and appliances, and mechanical devices and instruments. Capital stock, $2,000,000. Promoters: James A. Brown, C. S. Brown, Henry T. Moss.

Laconia Water Power Company, Laconia, N. H.—to buy and sell real-estate and water privileges; buy and sell power by water, steam, electricity, etc. Capital stock $96,000. Promoters: Wm. C. Marshall, Jno. C. Moulton, Frank P. Holt, Sam Hodgson, J. W. Bushiel & Company.

National Thermograph and Electric Company, Chicago, Ill.—to manufacture and deal in water and steam pressure recorders, grain staffs, electric batteries, etc. Capital stock, $500,000. Promoters: E.W. Applegate, John T. Todd, Wm. J. Marks.

St. Clair Flats Telegraph, Telephone and Marine Reporting Company. Capital stock, $6,000. Promoters: William H. Conner, F. C. Gray, Lucius H. Collins, George P. Quinn, William C. Heaslop, of Jackson; Moses Schott and Sigmund Rothschild.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED AUG. 8, 1893

ELECTRIC RAILWAYS AND APPLIANCES.

502,821. Subway for Electric Railway Conductors. Isaac La Rue Johnson, Washington, D. C. Filed Oct. 10, 1890. Renewed Dec. 16, 1892.

502,826. Trolley-Wire Insulator. Louis McCarthy, Boston, Mass. Filed March 27, 1893.

502,842. Electric-Railway Conduit. Robert R. Zell, Baltimore, Md., assignor of one-half to Henry C. Kirk, Jr., same place, Filed Aug. 8, 1892.

502,858. Supply System for Electric Railways. Wilton F. Jenkins, Richmond, Va. Filed June 3, 1892.

503,101. Electric Rail-Bond. Benjamin C. Seaton, Nashville, Tenn., assignor of one-half to William S. Barkley, Indianapolis. Ind. Filed March 2, 1893.

ELECTRIC LIGHTS AND APPLIANCES.

502,702. Electric-Lighting System. Cummings C. Chesney, Pittsfield, Mass., assignor to the Stanley Laboratory Company, same place. Filed April 3, 1893.

502,948. Electric-Arc Lamp. Luther H. Buchanan, Pasadena, Cal. Filed Sept. 25, 1891. Renewed Jan. 5, 1893.

503,108. Incandescent Electric Lamp. James H. Bates, Hoboken, N. J. Filed Jan. 19, 1893.

DYNAMOS, MOTORS, ETC.

502,777. Alternating-Electric Current Generator. Samuel Sheldon and John J. Rooney, Brooklyn, N. Y. Filed Sept. 28, 1892.

502,788. Regulator for Electric Generators. Elihu Thomson, Swampscott, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed May 23, 1892.

502,988. Armature and Method of Constructing Same. Horace F. Parshall, Lynn, assignor to the General Electric Company, Boston, Mass. Filed April 10, 1893.

503,038. Regulation of Alernating-Current Motors. Michel von Dolivo-Dobrowolsky, Berlin, Germany, assignor to the Allgemeine Elektricitats Gesellschaft, same place. Filed Dec. 23, 1890.

503,106. Armature for Dynamo-Electric Machines and Motors. Schuyler S. Wheeler, New York, N. Y., assignor to the Crocker-Wheeler Electric Company of New Jersey. Filed April 24, 1893.

BATTERIES.

502,824. Secondary Battery. Lansing Morse, Brooklyn, N. Y. Filed July 25, 1892.

TELEPHONE AND TELEGRAPH APPARATUS.

502,770. Telephone-Exchange Apparatus. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Oct. 15, 1888.

ALARM AND SIGNALING APPARATUS.

502,695. Synchronism-Indicator. Louis Bell, Boston, Mass., assignor to the General Electric Company of New York. Filed Dec 24, 1892.

502,734. Fire-Alarm Apparatus. Samuel W. Ludlow. Madisonville, Ohio. Filed Nov. 1, 1892.

502,811. Electric Alarm-Clock. William H. Deane, Brooklyn, N. Y. Filed Dec. 15, 1892.

503,100. Electrical Railway-Signal. Benjamin G. Seaton, Nashville, Tenn. Filed March 2, 1893.

SWITCHBOARDS AND SWITCHES.

502,768. Test Circuit for Multiple Switchboards. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Dec. 27, 1886.

502,769. Lock-Switch for Electric Switchboards. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Nov. 19, 1887.

502,771. Transfer System for Switchboards. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Oct. 27, 1890.

502,772. Test-Signal for Multiple Switchboards. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Feb. 24, 1891.

502,773. Testing System for Multiple Switchboards. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed June 29, 1891.

502,774. Test-Circuit for Multiple Switchboards. Charles E. Scribner. Chicago, Ill., assignor to the Western Electric Company, same place. Filed July 7, 1891.

502,775. Testing Apparatus for Multiple Switchboards. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Aug. 1, 1891.

502,825. Electric Switch. Lansing Morse, Brooklyn, N. Y. Filed Aug. 22, 1892.

502,983. Electric Switch. Joseph H. McEvoy, Waterbury, Conn. Filed Dec. 31, 1892.

503,099. Multiple Switchboard System. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Oct. 13, 1891.

MISCELLANEOUS.

502,749. Circuit Closer. Augustus J. Oehring, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Feb. 7, 1889.

502,753. Electric Body Wear. William H. Payne, Philadelphia, Pa., assignor of one-half to Gustav G. Altorfer, same place. Filed Feb. 18, 1893.

502,776. Electric Belt. Jean H. Se Creverell, Jefferson, O., assignor to Henry N. Bancroft, same place. Filed June 15, 1892.

502,804. Electric Belt. Duane P. Andrus, St. Louis, Mo. Filed Oct. 31, 1892.

502,889. Circuit Testing Apparatus. Fred. S. Palmer, Boston, Mass. Filed March 20, 1893.

502,935. Self-Winding Electric Clock. Frederick M. Schmidt, Brooklyn, assignor to the Self Winding Clock Company, New York, N. Y. Filed Jan. 19, 1893.

502,965. Electrode for Firing Explosives. Joseph N. Harrison and Henry J. Harrison, San Francisco, Cal. Filed June 8, 1892.

502,981. Electrically-Operated Hydraulic Elevator. Elias Marshall, Boston, Mass. Filed Nov. 19, 1892.

503,016. Electric Igniting Device for Gas-Engines. Frank E. Tremper, New York, N. Y., assignor to the Safety Vapor Engine Company of New Jersey. Filed Feb. 8, 1893.

503,039. Conductor Support and Insulator. William B. Essick, Manley, Neb. Filed Feb. 1, 1893.

503,076. Apparatus for the Electrolytic Manufacture of Tubes. Alexander S. Elmore, Leeds, assignor to the Elmore's American and Canadian Patent Copper Depositing Company, Limited, London, England. Filed Sept. 21, 1892.

ELECTRICITY.

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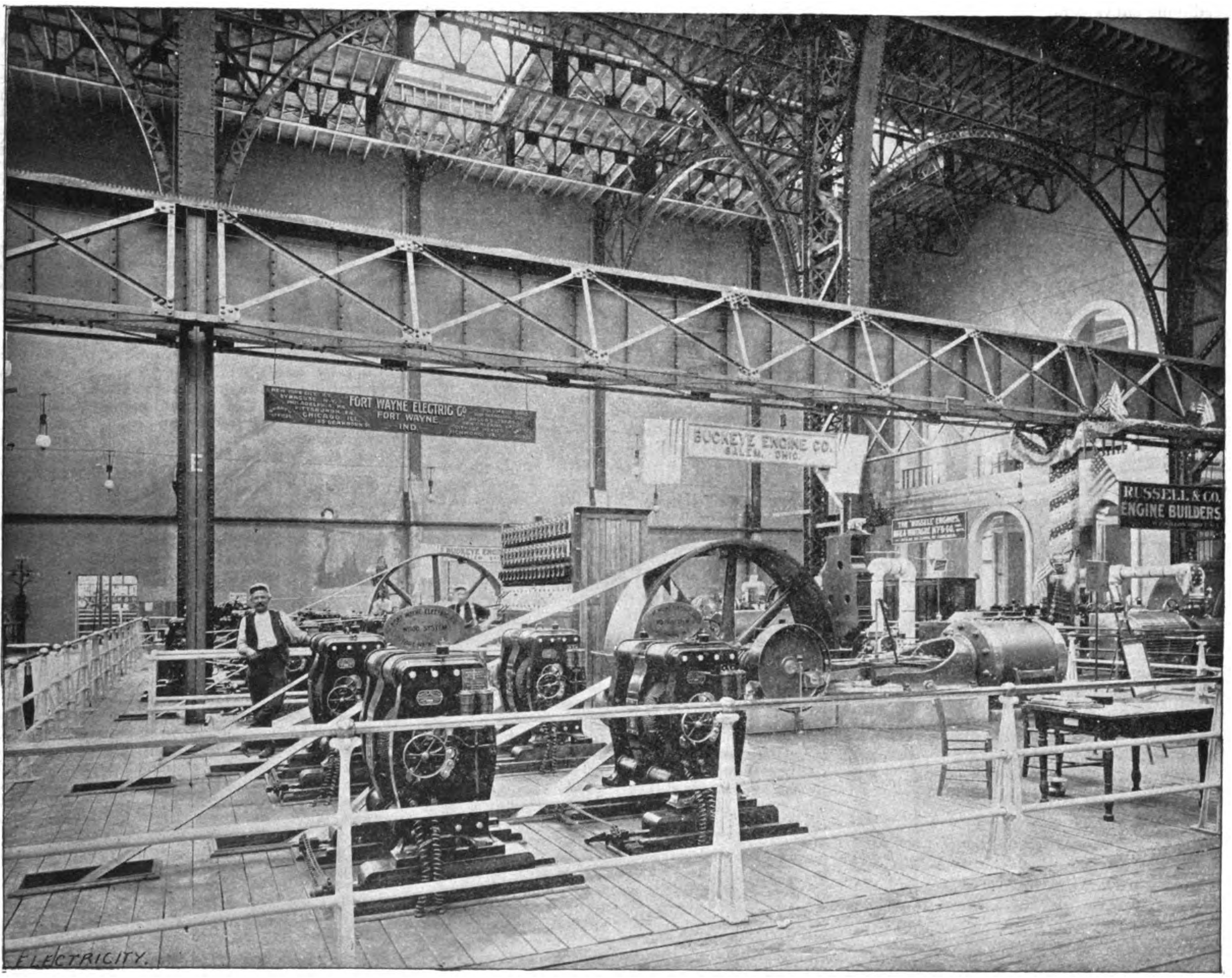

FORT WAYNE ELECTRIC COMPANY'S EXHIBIT, MACHINERY HALL, WORLD'S FAIR. (SEE PAGE 110.)

Long Distance Transmission.

Exhibit of the Tesla Polyphase System at the World's Fair.

BY C. F. SCOTT.*

An exhibit of power transmission at the World's Fair which is of exceptional interest is the Tesla polyphase system, which constituted a part of the exhibit of the Westinghouse Electric and Manufacturing Company in Electricity Building. The exhibit includes generators, motors, transformers and other apparatus of various sizes and types. The system itself is not new in its general plan. There are but few features of novelty in the electrical system which have not been the subjects of publications or patents. The purpose of the exhibit is not so much to bring out what is novel in electrical invention as it is to give a complete exhibit of commercial machinery constituting the elements of a power system on a large scale. The exhibit will attract practical electrical engineers rather than those who are interested only in electrical inventions.

The purpose of the exhibit is therefore to show a complete working system for generating, transmitting and distributing power on a large commercial scale. The system includes

I. A prime mover.

II. A generating dynamo.

III. Raising converters and transmission line, and reducing converters.

IV. Motors and rotary transformers for general power and electrical service.

The prime mover in general practice is water power, but here the motor serves as prime mover. The current for this motor is received from one of the 750 K.W. two-phase Westinghouse generators of the lighting plant in Machinery Hall. The number of alternations is 7,200, and the pressure is reduced from 2,000 volts to 200 volts before being delivered to the motor. The current is delivered to the rotating element of the motor through brushes resting on four collecting rings. The winding is a drum winding laid in small slots in the surface. The stationary element of the motor is of laminated iron set in an outside casting. Large copper rods are run through holes in the iron plates near the inner surface, and are suitably connected at the ends. Resistances are put in circuit with this winding for starting the motor, and when speed is attained these resistances are short-circuited, leaving this winding completely closed on itself.

This motor drives a 500 H. P. two-phase alternating current generator. This machine is of the ordinary type of railway generator. There is a field of six poles which is excited by a small direct current machine driven by a H.P. two-phase Tesla motor of the rotary field type. The exciter in general practice would be driven by a water wheel. The large generator delivers from four collecting rings two currents differing in phase ninety degrees. The number of alternations is about 4,000 per minute, or $33\frac{1}{3}$ periods per second at a potential of 360 volts on each circuit. The machine is also provided with a direct current commutator connected with the same winding, delivering current at 500 volts. This commutator would not be used when the machine is intended as an alternating current generator only. The current from this machine is delivered to a marble switchboard, where it is regulated and connected with the various transmission circuits, as desired. This board will afford facilities for connecting various circuits with any one of the several generators which may be placed in a large generating station. The current from the switchboard is received by alternate current converters or transformers by which the potential is raised in the present plant to 1,200 volts. In practice, the transformation would be a much higher voltage, depending upon the distance of transmission. The transmission circuit conveys the current to the receiving station, where it is reduced by transformers to electromotive forces appropriate to the machines to be supplied. The current passes through a marble switchboard in which there are suitable provisions for operating the various machines in the receiving station.

The largest machine in this station is a 500 H.P. two-phase Tesla motor and rotary transformer. This machine is similar in general construction to the generator above described. The alternating current at 360 volts is passed into four collecting rings on the armature. Special connections of the field circuit are made for starting the machine, and when the motor has attained full speed a switch is turned giving the final connections and running the machine as a self-exciting synchronous motor, which maintains the exact speed of the generator by which it is driven, except in cases of extreme over load. The armature of this machine is provided with a double pulley with belts driving a Worthington pump and a 40-light Westinghouse alternating current arc light dynamo. The armature is supplied with a direct current commutator, connected with the same winding, which receives the alternating current, and delivers direct current at a potential of 500 volts. This current is utilized for operating two 30 H. P. street railway motors mounted upon a truck, and also a 60 H.P. direct current motor mounted upon an Ingersoll-Sergeant air compressor. The direct current also supplies a series of direct current constant potential arc lamps. The current from the switchboard is also carried directly to a 60 H. P. two-phase motor and rotary transformer, which receives the current at 36 volts and delivers direct current at 50 volts adapted to electrolytic work, charging of storage batteries, and is at present used for operating the large Shuckert searchlight in an adjoining space. The current from the switchboard also operates a 60 H. P. two-phase Tesla motor of the synchronous type, which is adapted for any kind of constant speed work. In the present exhibit, it is direct coupled to a 45 K. W. slow speed alternator of the constant potential type used for incandescent lighting. Current from the switchboard is also directly utilized for supplying incandescent lamps.

It is commonly recognized that the mechanical design and workmanship upon electrical apparatus has fully as important a bearing upon its successful operation as the electrical design. In fact, in actual experience, it is found that electrical enterprises which have failed, or have been unsuccessful, have been deficient usually in mechanical rather than in electrical elements. It is therefore of especial importance to note the mechanical features of a new system, and to observe whether simplicity and strength and durability are insured Visitors to the present exhibit are struck with the general similarity in construction of the machines employed for widely different electrical purposes. The general form and construction of the large Tesla motor of the rotating field type, the alternate current generator, the alternate current motors, the rotary transformers, the alternating current arc machine, and the constant potential alternator have the appearance of general similarity.

The main castings are two in number. The lower one contains half of the field magnets and the bearings for the armature shaft. This simple form insures rigid bearings for the armature. The upper casting contains the remaining field magnets. The field magnets are made of laminated soft steel plates of high permeability, which are cast into the yoke of the machine. The armature is built of thin disks of soft steel with grooves in the surface for receiving the windings. The armatures are drum wound with, in general, large conductors placed in special heavy insulating tubes through the slots. This construction affords excellent insulation and protection of the wires, and the strains upon the wires, which in case of sudden heavy loads or short circuits may be very great, are transmitted directly to the iron core without chance for slipping or abrasion. In general, no band wires are required. The winding and connections of the armature of the multipolar machines for delivering direct current are such that there are always two, and only two, parts of the winding in multiple. This insures electrical symmetry, which prevents the improper distribution of current in the armature conductors, which would result if there were a greater number of armature circuits in multiple and the armature should get slightly out of centre from excessive wear in the bearings or other cause.

Attention is called to these points of simplicity and solidity of construction because they are so vital to the success of electrical working, and because the general improvement which is constantly being made in the mechanical development of electrical apparatus has been fully utilized in the design of this system. It is much to the credit of the system, and confidence in its success is assured for the very reason that it uses and makes but slight modification in types of machines which have been worked out in practice in other lines of service.

This system possesses characteristics which adapt it to a wide field of service, as it combines the requisites for transmitting power over long distances, and for transforming it into suitable forms for distribution and application to a wide range of uses. The employment of the alternate current transformer permits the use of low potential machines, securing greater cheapness, efficiency and a higher factor of safety than is possible in high potential machines. By the use of alternating current the difficulties in construction and operation, which are inherent to commutators, are avoided on generators and motors. The low pressure of the machine is readily transformed to potentials adapted to great distances. The alternating current supplies two-phase motors of either the rotary field non-synchronous type or of the synchronous type, and the rotary transformer transforms alternating into direct current. The work of this machine is equivalent to that of an alternating current motor driving a direct current generator. The two armatures, however, have been combined in one and placed in one field, and not only is the second machine eliminated, but the output of the single machine is greater than that of the two machines together, and the efficiency is increased and the commutation of a greater current is readily effected. The alternating current circuits can supply therefore constant potential direct current at any voltage, and is available for all kinds of work in which direct current is necessary or is preferable to alternating current. Incandescent lighting may be supplied from the alternating current circuits, and arc lamps may be supplied by direct current from the rotary transformer or from arc machines driven by synchronous motors.

It should be noted that the idea of complication may result from the grouping of several applications of the system with the transmission system proper. The transmission system proper ends with the switchboard and rotary transformer in the receiving station—other apparatus would be located where it may be required for use—distributed over a city or through mills or mines.

The alternating and direct currents at various potentials for these various lines of service are secured from one generator and one transmission line. This is of practical importance both in small plants where it would be impracticable to install different generators and circuits for different kinds of service, and also in large plants where there are numerous generators. In such plants similarity and interchangeability of machines and circuits are of great economy and value in practical service.

Electrical inventors have done their part well in discovering the principles and laws which form the basis for a complete electrical system. Designers and mechanics have taken up these inventions and have developed them and constructed apparatus for practical working, which is now presented to the electrical engineer for adaptation to the various demands for the transmission and distribution of power. He may take up the work with full assurance, as plants are already in operation which place beyond question the practicability not only of general distribution and service, but also of transmission over long distances and at high potentials. The successful installation and operation of a lighting plant for over 100 H.P., using 10,000 volts over a 23-mile circuit, in southern California, is an initial step which covers a distance greater than is required in a majority of the cases in which power transmission is proposed.

This exhibit of the Tesla polyphase system is the mechanical realization of one of the most unique and beautiful discoveries in electricity in recent years.

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* Paper read at the International Electrical Congress, Chicago.

Direct Current Dynamos of Very High Potential.

BY PROF. F. B. CROCKER.*

This treatment of the subject is in no sense a formal paper, being merely a note of some experimental results which I have obtained from two dynamos with very high potential, and it is well, I think, to define what I mean by that expression, which is in some doubt. By very high potential I mean from 5,000 to 10,000 volts. Machines of this character have received comparatively little attention, either from scientific experimenters or practical engineers. The speaker has long believed that facts of theoretical and commercial importance might be derived from the investigation of such machines. Considering these machines historically, the first fact that meets our attention is the fact that there exists a general and deeply rooted idea that direct current dynamos of very high potential are not at all practical. This unfavorable opinion is particularly strong in regard to the use of such machines for the transmission of power for any considerable distance; in fact, such a system is considered to be almost out of the question. It is partly with the object of bringing this system into notice—in fact, only that—that I am now reading the paper. The actual historical and practical facts are that the high potential direct current machines were more extensively and successfully operated when the dynamo first came into general use, about 1880, than any other type, either direct or alternate. Furthermore, their number and size have largely increased, and the voltage at which they can be practically worked has been steadily raised until we now have about 60 light arc dynamos of the standard size on large machines generating about 3,000 volts at 10 amperes. Arc dynamos of 90 light capacity are also regularly made by several manufacturers, and 120 or even 125 light machines are built and used. I happen to know of one station where there are four arc dynamos rated at 125 lights, which run every night with a load of from 100 to 105 lights. These machines must have force to generate about 5,000 volts each. No great practical or other difficulty is found in operating arc machines, except that of danger to persons, but this is merely due to the high potential and does not depend very much upon the type of machine or character of current. Nevertheless, when it is suggested to use direct currents in the transmission of power, we are told that nothing over 1,000, or at the most 2,000, volts is at all practical. Why this discrepancy between the 5,000 volts which are practically used in arc lighting and the 1,000 or 2,000 volts that are considered the limitation of such machines for power transmission? Perhaps the first answer to this question would be to say that the current is limited, that when you have 5,000 volts you cannot have more than 10 amperes, and if you want more amperes you must have less volts; consequently the number of watts, which, of course, is the entire question in power transmission, is limited. For example, the machines which I cited and which are in practical and successful use are 5,000 volts electromotive force, generate only 10 amperes, and consequently have a capacity of 50 kilowatts, which is a small power, comparatively speaking, for power transmission, but is sufficient for ordinary arc lighting circuits. That, of course, is a fairly good explanation of why such machines are not applicable to power transmission, but is there any such limit as 10 amperes to the current? I myself always look with very much suspicion and doubt upon any such arbitrary limit as that. Experience has shown me that those arbitrary limits are usually imaginery. I would like to cite one simple case to show exactly what I mean. I can remember when, in connection with a design for motors, small motors, I desired to use drop forge for the field magnet. I was told that the largest drop forging that could possibly be made was two pounds, and the best drop forger in this country would not undertake to make a larger one than that. I now have no difficulty in getting drop forging to 90 pounds, and the percentage of increase in weight per annum has been about 100. Now, that will not go on indefinitely, of course, but the limit of two pounds was purely arbitrary. No such limit existed in that case, and I doubt if any such limit exists in this case. I do not believe that nature decided that it would be impossible to generate currents of more than one absolute unit, and that it happens to be that of 10 amperes with a high potential direct current machine. Now, it is a fact, however, that should be added to this historical consideration of the subject, that numerous attempts have been made to employ such machines for power transmission and other purposes, and it cannot be said that those attempts have been successful; in fact, it can be said that they have been unsuccessful, but there again we have merely the negative of it. That same statement could have been applied to the steam engine for several hundred years, and it has only been true of the direct current machine for say ten years, consequently the case is by no means hopeless. But nevertheless numerous attempts have been made by competent persons, involving the expenditure of many thousand dollars, and that is a fact that cannot be ignored and should receive proper consideration, but it by no means puts the use of direct current machines of very high potential—over 5,000 volts or about that—out of the question for power transmission or any other purpose.

Now, when we come to the actual construction of such machines, and that is really the only substantial point that I can bring before you, I have actual results, although I cannot say that there is any particular feature of such machines which is radical or which will insure their successful operation. The first point, of course, is insulation. That must be above suspicion. The ordinary limit of one megohm of insulation is simply nothing for such machines. One megohm of insulation resistance, with a voltage of 10,000, would give 1/100 of an ampere and 100 watts; consequently the machine insulation would be rapidly heated up and destroyed; therefore you must realize that a megohm, or even several megohms, is no insulation at all for such a machine. It should be at least 1,000 megohms.

The next point is the commutator, because although the commutator might be considered the first point, as a matter of fact we must have the insulation before we can operate the machine at all, even for a few moments. The commutator, of course, must have a number of sections. It must have a considerable thickness of mica insulation between the bars—more than is ordinarily employed; I should say a full 1-16 of an inch. That does not sound very large, but as a matter of fact it is large, from 1-16 to 1-8 of an inch between the bars. On the end of the commutator, where you get much more than the ordinary voltage between the bars, you require very much more thickness of mica insulation or some other insulation than is ordinarily given. I should say that at that point we should have an actual thickness of insulation of a quarter of an inch, and if possible the surface distance should be increased by having the insulation project.

The next point is the material for brushes, and I have found in that particular feature the most peculiar and important differences. In the first place, I consider that it is impossible to run an ordinary mica insulated commutator with copper brushes at that potential, the reason being that this film of copper which is worn off of the copper brushes by the mica is a sufficiently good conductor at that electromotive force to carry many watts of current. At an electromotive force of say 500 volts, comparatively speaking, for instance, the ordinary railway generator, we have no such difficulty, because even if we use common brush connections the film of copper that is rubbed on to the surface of the mica would not carry sufficient watts to cause any trouble, but at 10,000 volts, with a total electromotive force in the neighborhood of 100 volts between the bars, the amount of copper even although it is an almost infinitesimal film is sufficient to carry, as I say, many watts of current.

Now, I have found that in a high potential, of only 5,000 volts, which I have experimented with, copper brushes could not be used for half a minute; that the copper was worn off on that mica and immediately produced a ring of fire all around the commutator. Naturally one would use carbon brushes in such a case, because the current is very small, comparatively speaking. I simply state the fact decidedly that you cannot use copper brushes for the reason given. When you come to the carbon brushes, I have also found that the hardened carbon is better, for the reason that it does not produce a deposit or layer of carbon on the commutator to produce the same effect which the copper does, but not to the same degree, because carbon is a much poorer conductor than copper; therefore carbon brushes, with a comparatively small area of contact and a fairly good pressure—not very great but sufficient to insure good contact—seem to be the proper working conditions.

Now, the machines I have actually constructed are two. One was a small machine of one horsepower capacity, and the armature was a fluted armature. Some persons may think that is exactly wrong, but the results do not seem to show that it was. The fact that it was a fluted armature is one reason why I was successful with these machines. I will not say that. I simply say that it may be, because I think that heretofore machines of very high potential have not been made with fluted armature. It was of the ordinary Crocker-Wheeler type, and very perfectly insulated with mica and wound with double silk covered wire. The potential of that machine was intended to be 5,000, and I have succeeded, by slightly raising the speed, in getting 5,500 volts out of it. It had only 32 commutator bars. That is the remarkable fact, with 5,500 volts, 32 commutators, say 350 volts difference of potential between the bars. I was told, I remember, a good many years ago, that you could not have more than 19 volts. I could never understand why they gave us 19 instead of 20, but such was the case. Now, this certainly shows that any such limit as that does not exist, but that machine is not, of course, a practical machine, but it did run for hours at 5,000 volts, for an hour and a half at 5,500 volts, and several times without any difference. Now, that simply shows the minimum number of commutator bars that you can use, I should say. Now, as to the current possible to get from that machine, of course that is small. As soon as you draw a current from a machine of that small number of commutator bars, there would be a tendency to stop the working, and that, of course, produces a ring of fire around the commutator.

The next machine, which is a much more practical machine, was of five horse power capacity, and designed to generate 10,000 volts. It did generate 10,000 volts at a little below the calculated speed, strange to say, and gave 11,000 volts at about the speed it was designed for, which was 1,800, not a high speed. This machine had 108 commutator bars, a much more practical number for such a voltage. The current of that machine was intended to be between three and four tenths amperes, which gives about its capacity. It must be remembered that these machines did not give their full capacity, owing to the fact that the wire is extremely small, and therefore the percentage of copper in the winding is small. The winding is largely made up of silk, consequently the capacity of the machine is reduced by that fact. That is inherent in any machine wound with extremely small wire. The current actually obtained from these machines is in the neighborhood of their rated capacity.

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* Address before the International Electrical Congress at Chicago.

It would be unfair to myself and to you to deny the fact that there is a spark when you approach the current capacity of the machine, and I think at the current capacity the spark would be too great. I have approached this 11,000 volt machine, and am a little bit afraid of it, to tell the exact truth, and I have not drawn the full capacity from it, but at about half its capacity it begins to spark, not badly, and a little above that it sparks a little more, and I should imagine it could not be run at its full nominal current capacity. The machine has only been recently finished, and since it was finished I have only had a few days to experiment with it, so I cannot give you full facts on it, as I did not want to rush in and break it down the first day, because I wanted to have two or three days with it. I might say that both machines broke down one or more times before I succeeded in getting them running, but that was simply due to inadvertence or accident. It was not inherent at all. There was some palpable error in their constructing. In one case the mica insulation in a slot was defective through the laziness of the winder. The proper way, of course, is to have that entire slot filled with a number of thin pieces of mica bent into the shape of the slot. It is impossible to bend a thick piece of mica that way. All that is necessary is to subdivide it into a number of pieces, and bend it into the form and put it into the slot, and get any degree of thickness desired. About one millimeter of insulation is sufficient, provided it is made up of mica which is bent into the proper form and not simply joined.

Now, I intended to have had this machine here, but I anticipated that it would not be a particularly good place to show it, and in the hurry and confusion of the Congress I thought that it would probably ruin the machine and would not do anybody very much good, so I would simply announce the facts, and probably later I will publish a more detailed description.

There is probably one point that strikes you as peculiar, and that is the very high internal resistance of such a machine. This machine has something like 1,500 ohms internal resistance. Now, as a matter of fact that is perfectly normal. The voltage is so high and the current is so small that an armature resistance of 1,500 ohms is perfectly proper. In that connection I might argue that of course the proper or allowable armature resistance varies as the square of the electromotive force with a given number of watts. The precaution necessary in operating such a machine is to prevent the spark from starting. It is like the smoke nuisance. The way to get rid of the smoke is not to produce it. That prevention of sparking in the first place is secured, as I say, largely by the use of hard carbon brushes, smooth, hardened carbons of fine grain.

Another point is, the tension of the frame must be kept half-way between the terminal electromotive force. That is an important point. My friend, Mr. Bradley, who has also advocated the use of these machines for power transmission, has a system of this sort where he purposely and positively keeps the potential at the proper point half way between the terminal force. By that I mean, if the total electromotive force is 10,000 volts between the two brushes, that the frame should be 5,000 volts to a potential between it and the positive brush, and the same way with the negative. If that frame was grounded on the negative brush or connected with the negative brush, more properly speaking, you would get the total difference of potential at that point or at the commutator, tending to produce a ground, and the difference between 10,000 volts and 5,000 volts is very material in producing a ground. It is almost necessary to keep that potential at that point. Now, in regard to how to keep it there, as I say, Mr. Bradley has a system by which he positively does it, but if the machine is highly insulated it takes care of itself. I have measured these machines when in proper working condition, and the potential of the frame will be almost exactly half way between the terminal potential, within two or three per cent., and that is quite remarkable. The rubbing, which of course occurs even in the insulation, is 1,000 megohms, which will produce a balance, and if the general insulation is uniform it will fall about half way between. That is quite an interesting fact. I may say that these measurements of the voltage were made by an electrostatic voltmeter of the Sir William Thompson pattern, made by White, of Glasgow, and compared at the lower voltages with the Weston voltmeter. It seemed to be in perfect working condition, and gave very satisfactory results. Nothing could be more convenient and satisfactory for the purpose, because an electrostatic voltmeter has the advantage of not carrying any current and producing no drop or trouble of that kind. I think there is no other precaution that I have found to offer.

As to the applications of these machines, I would say that the purposes to which I have applied them have been ordinary experimental work. For example, one of these machines at 3,000 or 4,000 volts will run a Geissler tube very beautifully. It will produce any other of the so-called electrostatic effects, that is to say, effects produced by very high potential in small quantities. It will, for instance, act very much like an electrostatic machine or a friction machine. It will cause one of these electrical flyers to revolve. In other words, you can get all the electrostatic effects similar to this potential from an ordinary frictional machine.

Another purpose to which the machine is applicable is testing of insulation, and in fact that is one purpose for which I made it. It is a very good way to test insulation. You will immediately ask, why not use a high potential transformer as being more convenient and not having a commutator?

I answer that by saying that I do not think that is the same test. If the wire is exposed to a direct current strain, I do not think an alternating current test is proper. If a wire is subjected to a direct current strain, it should be subjected to a direct current test. If it is subjected to an alternating current strain, it should be subjected to an alternating current test. That is simply my idea. The other application is, of course, power transmission, and that will be discussed hereafter, and I would say that of course it is not necessary to have the total voltage generated by one machine. In any plant no one dynamo should constitute more than a comparatively small fraction of the total plant, and if you have five dynamos in a central station or power transmission station, there is no reason why they should not be connected in series as well as in parallel, and if you want five machines, as I think you do, in order to guard against the trouble from breakdowns, five to ten machines, then you can easily connect them in series and subdivide the voltage just to that extent. Each machine can generate a few thousand volts, two to five, and you could get the total voltage by the proper series connections of several machines.

On the Carrying Capacity of Electric Cables, Submerged, Buried or Suspended in Air.—III.

BY A. E. KENNELLY.*

CARRYING CAPACITY OF CABLES IN AIR.

Although the condition of an active cable supported in air is only a special case of the general heating of aerial conductors, yet it merits separate consideration owing to the comparatively high thermal resistance of the insulating covering in such cables, and the leading influence of this resistance upon the carrying capacity.

The current strength that will elevate the temperature of this conductor θ° C. when supported horizontally in air is

$$C = \sqrt{\frac{\theta}{P\left(S+\frac{1}{\varepsilon}\right)}} \quad . \quad . \quad . \quad (11)$$

where ε is the total emission of heat from the external surface per linear centimeter, by convection, radiation and wind, per degree centigrade of temperature elevation there existing. As the temperature elevation of the sheath will in practice be less than 20° C., ε may be taken as constant within that range, and as being expressed by the equation

$$\varepsilon = 0.00111 \times O + 0.00175 \quad . \quad . \quad (12)$$

where the first term on the right hand refers to the radiation, O being the external circumference in cms. and the second term to convection. The cable is supported in still air. These constants appear to satisfy the observations very fairly. Also $\frac{1}{\varepsilon}$ may be regarded as the equivalent thermal resistance of the air round the cable under these circumstances, corresponding to the resistance G of the soil in a buried cable.

Example: The cable previously considered, instead of being buried, is supported in still air. Required the limiting current. Here O = 3.23 and $\varepsilon = 0.005335 \quad \frac{1}{\varepsilon} = 187.4$.

The total thermal resistance is

$$81.36 + 187.4 = 268.76,$$

and

$$C = \frac{5}{\sqrt{0.000009417 \times 268.76}} = 99.42 \text{ amperes.}$$

It appears that $\frac{1}{\varepsilon}$ is greater than G in most cases that are likely to occur in practice (exceptions occur in heavily insulated cables), so that the thermal resistance to the escape of heat from a cable is usually less when the cable is buried than when supported in still air. Consequently the temperature elevation will be the greater in the latter case for a given current strength. Also, if a cable is first supported in the air of a vault, and then enters a trench, there will be no overheating of the buried portion by load, if it is known that the buried portion is within the safety limits of temperature elevation, and the temperature of the sheath in the buried portion will be lower than the temperature of the sheath in the vault, assuming that the normal temperature of the soil and of the vault are equal.

THERMAL RESISTIVITIES.

Comparatively few measurements have been made of the thermal resistivities of bodies. They are known to be functions of the temperature of the substance. There is also reason to believe that good heat conductors conduct better, and good heat insulators insulate better at low temperatures,† in analogy to the electrical properties of similar materials. In the absence of better information the resistivities taken in dealing with these cables are assumed to be constant throughout the range of temperature employed.

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* Read before the Association of Edison Illuminating Companies.

† Professor Forbes l.c., also Everett's Units and Physicall Constants Article "Heat."

Appendix III gives the computed limiting current strengths of Siemens cables as manufactured in 1892 at the Schenectady Works, from measurements of the dimensions of samples, and from the constants arrived at by measurement and alluded to above.

APPENDIX I. PARTICULARS OF MEASUREMENTS MADE ON SAMPLE SIEMENS CABLES.

Four samples of Siemens cable, each about thirty feet long, were employed, viz., No. 12 B.& S., No. 6 B. & S., 80,000 cir. mils and 200,000 cir. mils. The two last had stranded conductors.

The insulator was jute soaked in special compound. The sheath was a cold rolled leaden tube fitting over the insulator.

Each cable was tested three times, once in flowing water, once supported in still air, and once buried in the ground.

In the first test the cable occupied an iron pipe 880 cms. long and 3.3 cms. internal, 4.1 cms. external diameter, resting upon the ground upon a slight incline. Short right angle pieces were attached vertically to the ends of the pipe, and water was kept flowing through this pipe with sufficient velocity to maintain the temperature of the water within one degree centigrade at ingress and egress. The mean of the water temperatures at the two ends was assumed to coincide with the mean temperature of the sheathing. Measured currents were delivered through the cable, and the resistance of the conductor measured by differential galvanometer in comparison with a platinoid standard. The increase of resistance in the conductor covered by the pipe gave by Matthiessen's table of temperature coefficients the temperature elevation of the copper. The electrical connections were practically the same as those described and illustrated in the report upon the heating of conductors submitted at the Convention of Edison Illuminating Companies at Niagara Falls in August, 1889. From these temperature elevations, measured current strengths, and the dimensions of the cable, the thermal resistivity of the insulating material was determined.

In the second test, the cable was supported in still air, the remaining conditions being otherwise unchanged. The temperature of the sheath was measured with thermometers as a check upon the computed values.

In the third test, all four cables were buried at a depth of 76 cms. in sandy soil and parallel to each other in the same trench, the axes of adjacent pairs being 16 cms. distant. The length of each cable resting on the bottom of the trench was 720 cms., 90 cms. being required at each end for the ascent to the surface of the ground. Pressure wires were soldered to the conductors at the upward bends, so that only the resistance of the lengths at the full depth was measured. The same method of testing was employed throughout. The approximation to final temperature elevations was rapid in the water covered samples, the increase in resistance with a given current being almost inappreciable after fifteen minutes' application. It was somewhat delayed in the tests in air, twenty-five minutes being generally required, and with the buried samples readings continued to advance until forty or fifty minutes after application of load.

APPENDIX II. DATA FOR CONSTRUCTING A DIAGRAM OF ISOTHERMAL SURFACE SECTIONS.

Let D be the depth of the cable's axis in cms.
" R " the external radius of the cable sheathing (cms.)
" y " the depth of the axis of an isothermal cylinder (cms)
" x " the distance at which the isothermal cylinder intersects the horizontal plane through the cable axis (cms.)
Let a be the radius of the isothermal cylinder (cms.)
" v " the ratio of the temperature on the isothermal to the temperature at the external surface of the cable.

Then

$$a = \frac{2\,D\,B}{B^2 - 1}$$

$$y = D\,\frac{B^2 + 1}{B^2 - 1}$$

$$x = \frac{2\,D}{\sqrt{B^2 - 1}}$$

Where

$$B = \varepsilon\ v\ \log_e\left(\frac{2\,D}{R} - 1\right)$$

Example: D = 100, R = 5, find the isothermal of half sheath temperature elevation, or v = 0.5.

Here

$$B = \varepsilon\ 0.5 \log_e 79 = 8.888$$

$$a = 22.79 \text{ cms.}$$

$$y = 102.6 \text{ cms.}$$

$$x = 22.65 \text{ cms.}$$

APPENDIX III. COMPUTED SAFE CARRYING CAPACITY STANDARD SIEMENS CABLES MANUFACTURED AT SCHENECTADY WORKS IN 1892. (Capacity in Amperes.)

Size.	Water.	Soil.	Air.	Water.	Soil.	Air.	Water.	Soil.	Air.	Water.	Soil.	Air.	Water.	Soil.	Air.
1,000,000	1580	1120	830	1280	910	800				1160	820	800			
800,000	1630	1150	710	1140	810	700				1070	760	700			
600,000										860	600	590	820	580	620
500,000	1060	750	510	770	550	480				760	540	510	690	490	580
400,000	1010	710	490	860	610	450				680	480	520	630	450	490
350,000	900	640	450	670	470	410				630	440	440	600	430	480
250,000	740	530	350	540	380	340				520	370	350	460	330	360
200,000	640	450	300	460	320	290				440	310	300	380	270	300
180,000	490	350	260	420	300	260				370	260	260	370	260	280
150,000	470	330	250	390	280	250				360	260	250	320	230	260
120,000	440	310	220	340	240	220				330	230	230	300	210	240
100,000	370	260	200	290	210	200				280	200	200	280	200	220
80,000	300	210	170	270	190	170				260	180	180	230	160	180
60,000	260	180	140							180	120	130			
50,000	220	160	140							180	130	130	180	130	140
No. 4 B.&S.	200	150	110	150	110	105	160	115	115						
" 6 "	150	100	80	120	80	80	120	83	85						
" 8 "	110	76	61	87	62	61	90	63	65						
" 10 "	81	57	47	65	46	47	70	49	51						
" 12 "	58	41	36	52	37	37	49	35	37						
" 14 "	50	35	29	40	28	29	33	27	32						
" 16 "	34	24	21	29	21	22	27	19	21						

In reference to the above table it may be pointed out that additional carrying capacity of a cable when in water over that it possesses when in air can seldom be availed of for the reason that a cable passing through water will usually have at least a short length in air or soil, which portion would become overheated if the length in water were worked to full capacity.

For the buried cables, a temperature elevation of 12.50° at the sheathing surface has been allowed.

(Concluded.)

Note on the Variation of Capacity of Insulated Wires with Temperature.

BY HERMANN S. HERING.*

While making some tests of insulated wire for the Chicago Electric Company, I determined the capacity, resistance and electrification at various temperatures, and found that there was a decided variation of the capacity with the temperature of the wires. The samples of wire tested were of Nos. 12 and 16 B. & S. gauge covered with vulcanized rubber, the patented process of this company, and invented by Mr. H. B. Cobb, of Wilmington, Del. The radial thickness of the insulation was about 1-16 inch. In two of the samples furnished, Nos. 3 and 5, the insulation was loose upon the wire, and in Nos. 1, 2 and 6 it was tight.

By referring to the diagram it will be observed that the curves are distinct and have a definite shape, and that there is a decided increase of capacity within the usual ranges of temperature met in practice.

All the tests were made in the same manner, with the same instruments and with all possible errors eliminated. Readings were taken after the wire had been charged twenty seconds.

The curves represented by solid lines were made during an immersion of the wire of from five to ten days. Those represented by broken lines were made after an immersion of from twenty to thirty days. It will be observed also that the capacity increased slightly with the length of immersion, and that the capacity of samples Nos. 3 and 5, whose insulation was loose, not only had a smaller capacity per mile than samples No. 1, 2 and 6, whose insulation was tight, but also had less variation within the same ranges of temperature.

The cause of this increase of capacity with the increase of temperature is not easily explained unless the expansion and contraction of the insulation acts inwardly as well as outwardly, but yet that does not offer an entire explanation. I thought at least that the results would be interesting, notwithstanding that I had no satisfactory theory with which to explain them.

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* Read before the International Electrical Congress, Chicago.

Current Items.

A short time before Dr. Charcot died he said in a lecture that semi-scientists had for more than fifty years ridiculed the idea that the full of the moon was a dangerous time for mad people. Better informed men are coming back to the old-time notion, said Dr. Charcot, as the result of increased learning on the subject of earth tides, similar to the oscillation of sea tides.

The Elektricitats Aktien Gesellschaft of Nürnberg announce that they have completed a new installation for lighting up the stages of theatres. It admits of modifying the degree of intensity of the lamps at pleasure, and of varying the character of the light by the introduction and removal of colored lamps. White, red and green lamps come into use, and the "Regulator" gives the facility of causing two groups of lamps to burn simultaneously, either white and red, white and green, or red and green. It is possible to produce the following changing effects: Bright daylight passes into evening twilight, and this again into a nocturnal effect with moonlight. This again gives place to a red morning dawn, which is succeeded by daylight. The invention has been brought into successful action in various theatres in Germany, Denmark and Russia.

The N. Y. State Street Railway Association.

The N. Y. State Street Railway Association holds its annual convention at Rochester, beginning next Tuesday.

There should be a liberal attendance from this section. The ride through the State at this time of the year, on the New York Central Railroad, is a pleasure, and the proceedings of the convention are sure to be up to the standard.

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Long Distance Transmission. The question of long-distance transmission of power is one of the most prominent ones which confronts the electrical engineer to-day. At the introduction of electricity on a commercial scale, electric lighting occupied the minds of electricians almost exclusively, and at that time the method of distribution of current from a central station was the problem which engaged universal attention, and arguments were heard favoring either the two-wire or the three-wire system of distribution, or the alternating current against the direct current, or vice versa. At first the direct current had almost a monopoly of the lighting field, but as the alternating current became perfected in its methods of distribution its merits were gradually recognized, and it has since become a prominent factor in electric light distribution.

When the practice in electric lighting work had assumed a tolerably definite character the electric railway problem was launched, and for a time the developments in this direction almost overshadowed electric lighting. Here the question was confined to details of the direct current system, as at that time, and even at present, no motor suitable to this class of service had been invented for alternating currents. The controversy in this case was confined to the methods of regulation on car motors and the character of the overhead and track construction. Patents on almost every conceivable point in electric railway work were taken out, but these did not appear to obstruct the advances in this line in the least. Every manufacturer of electric railway apparatus eventually came into possession of fundamental patents which were infringed by every other manufacturer of these goods, and the business in this way settled down to a practically common practice, and the price of car equipments fell from three thousand dollars and more down to fifteen or sixteen hundred dollars under the salutary effects of competition. At present the method of distribution and the track wiring are almost identical in all electric railway systems, and the principal difference lies only in the design of the machinery.

What might be considered the third era in the application of electricity is just coming prominently in view, viz., the transmission of power. This phase of electrical work, although the simplest theoretically, is likely to prove the most difficult to put into actual practice. It is impossible in the present state of the science to prescribe either a direct, simple, alternating or multiphase current as a general solution of long-distance transmission, and it is not improbable that each of these systems will find application in various places, according to their individual requirements.

The multiphase current, being the latest development, is at present attracting a monopoly of the attentions of electrical engineers, and at first sight the peculiar properties which it possesses make it specially adapted for both lighting and power, but multiphase motors are as yet comparatively new, and the test of time is needed, as well as a more extensive use, to determine the efficiency and practicability of multiphase systems. The simple alternating current, while giving a good efficiency, is handicapped for the want of a self-starting motor under load, which puts this system at a disadvantage for a general distributing plant. It has been successfully operated, however, in the case of mines and other places where a special starting device was used for the motors.

The direct current system has been largely lost sight of in discussing long-distance transmission, but there are many engineers who believe that high tension direct-current machines will, nevertheless, play an important part in long distance work. For large motors and street railway work the direct current is as yet almost indespensable, and there can be no question but that much higher working pressures than are now in general use are perfectly feasible. In an address by Prof. Crocker, printed elsewhere, he points out that raising the voltage of these machines to 5,000 and even 10,000 volts is quite possible with sufficient care in the matter of insulation.

The commutator is of course the great bugbear in machines of this sort, and in general the trouble at that point will prevent the use of a single machine of such a high voltage as would be required for a very long line, but connecting several machines in series would largely overcome this difficulty.

In the matter of transformation the direct current is still at a disadvantage compared with the alternating, and it is obviously impossible to use a pressure of several thousand volts for the service of small consumers. For local distribution the use of direct current transformers would be imperative, but these dynamotors can be built to reach an efficiency of ninety per cent. or more, and in this way a certain proportion of the current could be economically distributed for small customers.

While the voltages mentioned seem at first sight to be impracticable, it must be remembered that in arc light work sixty and eighty light machines are in general and successful use generating from three thousand to four thousand volts, and while in most places alternating and multiphase currents will, perhaps, be found the most practical, the advantages of a direct current for many kinds of work render its application to long distance transmission worthy of more study and experiment than it has yet received.

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MR. CLARK confessed to having paid Ashton $1,200. Ashton says it was over $2,000. But admitting that it was only $1,200, where did the money come from? We suggest that Mr. Twombly, who cannot take kindly to this kind of "business," look up the records, and find out who passed the bill.

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THE PITTSBURG trial must have a wholesome effect in one particular. Young men will no longer feel it an honor to be delegated by Mr. Coffin to do foul work. It should be a warning to all the "special agents," etc.

A Humiliating Episode. There can be but one feeling among thoughtful men in regard to the revelations in the blue-print case at Pittsburgh, a condensed report of which is printed in another column. The electrical trade has been disgraced, the cover has been lifted from a sewer of filth, and we know that Electricity voices the wish of every decent man in the business in expressing the hope that there will be no further trial of the three defendants who have just been saved from the penitentiary through a disagreement of the jury.

It seems to us that the object of the proceedings has now been fully attained. The jury has disagreed, true enough, standing eight to four for conviction, but notwithstanding that the defendants have not been convicted before the law, they have been thoroughly convicted before the bar of public opinion.

No man in this trade doubts to-day that the General Electric Company, meeting in the Westinghouse Company a competitor with which it was not fitted to cope fairly, resorted to conspiracy, bribery and theft to obtain information from the factory of its rival, with the immediate object of securing thereby certain specific contracts. These contracts it did not get.

Any further proceedings to be justified should be against the prime mover in the conspiracy, the chief culprit, Mr. Charles A. Coffin. At present it seems that he cannot be reached. To whatever depths Mr. W. J. Clark descended in his mistaken loyalty to his chief, whatever be the measure of contempt which Mr. Mead's part in the matter deserves, the impressive and lamentable fact remains that a second trial of the three defendants, even though resulting in a conviction, would be but the punishment of the servant for obeying the commands of the master.

Mr. C. A. Coffin dare not go to Pittsburgh and testify that he did not give Mr. Clark exact verbal instructions as to the information wanted, nor that he did not tell him the amount of money which he might spend in obtaining it, nor that the expense sheets embracing the amounts of money so paid were not passed by him.

Until the author of the infamy can be brought to book it would avail little to have Messrs. Clark and Hamilton suffer further. Already the reputations of half a dozen young men have been blackened; they have lost the respect of even their best friends; they must suffer under the stigma until they have lived it down by years of correct conduct. They have been punished enough.

Let us cover up the stench, in the full assurance that Mr. Coffin will not soon be able to find other young men ready to sacrifice their manhood in his service and to protect him at the expense of their own reputations.

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Mr. Coffin is welcome to all the satisfaction he can extract from the fact that his part in the blue print steal was only a misdemeanor, and not an extraditable offence.

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The industry of stealing blue prints has met with a permanent set-back.

Municipal Lighting Plants. We print elsewhere in this issue an interesting letter recently sent by one of our larger manufacturing companies to a prospective customer.

Much has been said both for and against municipal ownership, but the subject is not exhausted, and is not likely to be very soon. New municipal plants are continually being installed. Many of those already installed are successful, and, in spite of adverse criticism of the electrical papers, the idea seems to be growing in popular favor.

Mr. W. H. Preece, in a recent letter to the Governor of Malta, referring to some English municipal plants, points out that while capital expended by the vestry of St. Pancras and the Corporation of Brighton has exceeded the original estimate, it is because, "owing to the unexpected and rapid success of the industry in both places, the increased demand for light has necessitated increased plant and therefore expenditure. In each case a commencement was made in a very small fraction of the estimated area to be served.

"In Huddersfield, before the first contract is completed and before a single lamp is lighted, the Corporation have found the demand for light so far in excess of their anticipations that they have had to increase their plant and their capital expenditure.

"I cannot too strongly point out that in England there has been no single instance of financial failure when Corporations have taken the matter in their own hands. The rates have never once been called upon to supply any deficiency.

"Success in all instances has been assured, and the rate of growth of the business has exceeded the wildest anticipation."

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The Chief Culprit. Let it not be forgotten that all the bills for the corrupt expenditure of money in the blue print steal, as also in the dozens and scores of bribery cases not yet uncovered, were necessarily passed for payment by a high official of the General Electric Company.

Let us ask ourselves who could have passed them.

Not Mr. Beves, the treasurer, nor Mr. Ord, the controller, not Capt. Griffin nor Lieut. Greene, for large amounts, as their authority is not broad enough; surely not Mr. Peach, who is the soul of honor; not by Mr. Garfield alone, because he never wiggled his thumb without Mr. Coffin's direction. Who is left? In all reason, no other man than Charles A. Coffin could be cognizant of what this money was spent for, or could O. K. the corrupt expense sheets for payment.

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The events of the past three weeks are all the exemplification which Electricity needs for its continued attacks on Trust methods. That we have not seen fit to disassociate the methods from the man, is already admitted by most of our critics to have been fully justified by our evident knowledge of the man and his methods. The end is not yet.

"There are lawyers enough in the electric conspiracy case to account for the present depression in the price of electric stocks."—*Pittsburgh Times.*

This was intended as a joke, but contains too much truth to be funny. The General Electric Company's legal expenses for their first fiscal year would have more than paid two quarterly dividends on the common stock on an eight per cent. basis. If the large manufacturing companies in years past had pushed their own businesses and refrained from pushing so many foolish patent suits, the lawyers would be poorer but the trade at large would be far richer.

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We are in receipt of a long communication from Miss A. E. Post, which is chiefly an argument in support of the claims of Mr. Adolph Berrenberg for the invention of the mechanical vacuum pump. We do not think the readers of Electricity are interested in this subject, and consequently cannot publish the communication.

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The retirement of Mr. Paul T. Brady from the service of the General Electric Company is but natural. Under present conditions the clergy of Central New York cannot be worked to invest in General Electric, and it is commonly understood that work of that nature was Mr. Brady's specialty.

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We have learned incidentally that one of the largest of the closed-down lamp factories will be opened for business early in November next, proceeding on the assumption that the Edison patent expires on November 10.

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About ten weeks after Electricity announced the fact, our old fogy contemporaries, the *Electrical World* and the *Electrical Engineer*, learned that there was a rupture between the Fort Wayne and General Electric Companies.

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Mr. C. A. Coffin ought to feel highly gratified over some recent events. He has seen his employees at Pittsburgh sacrifice honor, friends, and future prospects rather than expose him, the author of all the villany.

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As predicted many months ago in Electricity, Mr. H. M. Whitney has retired from the management of the West End Road.

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The law presumes that when a man testifie that he is a villain he is to be believed in that statement but in nothing further.

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The news of the day can only be found in one electrical paper, and that is Electricity.

Execution Against the A. B. C. Company.

Deputy Sheriff Finn has received an execution for $16,549 against Alexander, Barney & Chapin, in favor of Patrick Gray on assigned claims of Luke A. Burke. The business was started by P. H. Alexander, of Hyde Park, Mass.; General C. H Barney and Charles B. Chapin, of Hartford, Conn. They incorporated it in November, 1890, with a capital stock of $100,000. Luke A. Burke, a builder, obtained control of the company in 1891, becoming vice-president, and Messrs. Alexander, Barney and Chapin retired from the concern.

The Rape of the Blue Prints.

Three of the Indicted Men on Trial at Pittsburg.

The Jury Disagreed—Summary of Proceedings.

On Monday, September 4, in the Court of Quarter Sessions at Pittsburg, three of the indicted men in the much-talked of Blue Print case, Messrs. W. J. Clark, Morris Mead and M. H. Hamilton, were placed on trial. They were charged with conspiring to cheat and defraud the Westinghouse Electric and Manufacturing Company of certain letters, writings, tracings, etc., on the 18th day of February, 1893. Information was made May 5, 1893, and a true bill was found June 6, 1893.

The blue prints, etc., were procured for the General Electric Company, under orders from Mr. C. A. Coffin, president of the company, who was also indicted, as were Messrs. E. W. Rice and W. H. Knight, of the Lynn Works. None of the latter has yet been tried.

The attorneys for the defence were Lyon, McKea & Sanderson, Thomas M. Marshall and John S. Robb, of Pittsburg; W. S. Hamilton, W. J. Jenks, W. B. Whitney and W. B. Putney, of New York, and E. M. Bentley, of Boston. Dalzell, Scott & Gordon and D. F. Patterson, of Pittsburg, and C. L. Cravath, of New York, assisted District Attorney Burleigh in the prosecution.

THE CASE FOR THE PROSECUTION.

Mr. D. F. Patterson in opening for the prosecution said: The prosecution would be able to show these defendants had conspired together to cheat and defraud the Westinghouse Electric and Manufacturing Company. He dwelt at some length on the development of electricity and the necessity that all the plans and ideas of promoters of electrical devices should be protected from the inspection of rivals. The purpose of this alleged conspiracy, he said, was for the unlawful and dishonest purpose of securing from the Westinghouse Company plans and blue prints to aid the General Electric Company in bidding on certain contracts for which the two companies were rival bidders. He said the results of the superior genius of the Westinghouse Company had been corruptly secured by the defendants for the benefit of its rival, to the great advantage of the General Electric Company.

ASHTON'S TESTIMONY.

H. F. Ashton was the first and chief witness for the prosecution. He was on the stand the greater part of two days, and testified in part :

"July, 1893, I was employed by the Westinghouse Company. This lasted till January, 1893. From September 1 last I was also employed by Morris Mead and W. J. Clark, of the General Electric Company. I first mentioned the matter to Mr. Mead. He told me to stay with the Westinghouse Company and also work for the other person. The other person was W. J. Clark. I first met Clark in Youngstown, Ohio. Mr. Mead was with me. I had some sketches with me which I gave to Mr. Clark. The sketches were specialties being gotten up by the engineers of the Westinghouse Company. I made the sketches. I had access to all the specialties. Before I met Clark I had copies of voltmeters, etc. I gave Mr. Clark all the information I had. I gave him among other things the plan for the new lamp Mr. Westinghouse was working on. Mr. Clark said he wanted me to get everything I could from the Westinghouse Company for the use of the General Electric Company, plans, drawings, estimates, drawings and plans of new and proposed inventions. I gave him about fifteen sketches. Mr. Mead engaged me to get these sketches. He told me to get copies of all new ideas the Westinghouse people were working out at that time."

Mead paid his expenses to Youngstown and showed him two hundred-dollar bills, one of which he gave him Mead also told him that he would be put on the pay roll of the General Electric Company at $150 per month and expenses. He got the money regularly through Mead, who took $25 per month as a commission. He said he got about $2,000 altogether out of it, clear of expenses.

Ashton, continuing, gave detailed accounts of meetings with Mead, Clark and Hamilton, the defendants, at which he gave them blue prints, sketches and other information. These meetings occurred in Pittsburg, New York and Boston. Among the important matters communicated to the General Electric Company were the Westinghouse plans and estimates for the World's Fair contract, the big Niagara Falls electric machines and a Sacramento, Cal., contract. He bribed an office boy to steal one of the new stopper lamps, then being perfected. This lamp he gave to Mead, who delivered it to Hamilton. It exploded while being unpacked at New York and he had to bribe a boy to get another, which was delivered safely. He also got plans of the direct and the alternating current generators and motors, and of various other Westinghouse machines, some of which were entirely new and had not been patented. He bribed the office boys to steal the prints and articles he wanted, because he said he had had a consultation with Mead, and they decided it would be the safer way. He identified the secret code used in carrying out the plans, and he said it was in the handwriting of Clark.

"Mr. Mead furnished me with the code. I saw a similar one in Mr. Hamilton's room in New York. I destroyed some of the telegrams, but kept some others I received."

A number of letters from Hamilton to Mead were identified by the witness.

"May 1, I was at the works of the General Electric Company and met Mr. Knight in his office. While there I saw, in Mr. Rice's office, some of the blue prints I had taken from the Westinghouse Company and delivered to Clark and Hamilton. When I was there the first time Mr. Rice took the blue prints I had furnished from the drawer where I found them on the last visit. I identified them as the ones I had obtained, because when I made them I numbered them and could positively identify them. There were about fourteen of them."

OTHER TESTIMONY FOR THE PROSECUTION.

Frank Carey was called, and he said he was 18 years old. Up to May 5, 1893, he worked for the Westinghouse Company. He made blue prints and later drawings. He knew Ashton since June 1892. "I gave Ashton some blue prints of the new motor and switchboard last December. They belonged to the Westinghouse Company. Mr. Ashton asked me to get them. He asked me to get blue prints of the World's Fair job, the noiseless motor and others. He gave me $14. I gave him eight He was at the Electric Club. He said if he wasn't there to deliver them to Morris Mead. I was introduced to him by Mr. Ashton. I had no authority to take these blue prints."

Charles Christian—I am 17. I worked for the Westinghouse Company till May 5, 1893. I traced. I know Ashton, he and I worked in the same room. I met Morris Mead in February, this year, in his office. At that time I gave him two blue prints which belonged to the Westinghouse Company. I was sent there by Mr. Ashton. I also gave Ashton 15 blue prints of all the new machinery. The first I gave him was in January and the last in March. Mr. Ashton told me to get blue prints of all new machinery, especially the World's Fair and Niagara Falls machines. He was not my boss and had no right to tell me to get any blue prints. He paid me $30. I gave him the Niagara Falls blue prints a week after the drawings were made.

Clerk McCullough, of Newell's Hotel, was called, and from his register showed that Mr. Hopkins was Hamilton, one of the defendants, who stopped there from February 8 to February 16. A typewriter was taken to his room. Mr. Morris Mead and Mr. Ashton called on "Mr. Hopkins" frequently. They didn't call together.

Clerk Cunningham, of the Monongahela House, also had his register with him. Attention was called to December 22, 1892, to names Chas. E. Clark and brother, of Chicago. It is claimed one of them was W. J. Clark.

Levi Shaffer, a waiter at the Monongahela House, said he served meals in the room occupied by Clark. Mr. Mead and Mr. Ashton were in the room and took meals there, and seemed to have lots of work on hand.

Mr. Martin told of having sent a typewriter to Newell's Hotel, February 8, for Mr. Hopkins. It was used two days.

THE DEFENCE.

The cross-examination of Ashton by the defence failed to elicit much that was new. The witness was perfectly cool, and could not be made to contradict himself. He seemed to be oblivious of the fact that his own position in this matter is even worse than Mead's or Clark's.

The defence attempted to show that Ashton's services to the General Electric Company were in the line of procuring information in regard to the stopper lamp, and to various machines, etc., on which the General Electric Company claimed infringement by the Westinghouse Company.

Mr. Clark testified further that he had reason to suspect that drawings of new machines, etc., had been surreptitiously obtained from the Lynn factory, and conveyed to the Westinghouse Company by Messrs. Morris and Mayer, and that one object in employing Ashton was to verify these suspicions. He was forced to admit that no evidence had been secured of any such scheme, but endeavored to convey the impression that he believed it to be an actual fact.

In response to Mr. Sanderson's questions, Ashton said :

"During the interview at Youngstown, October 15, with Messrs. Clark and Mead, did Clark say that he had evidence that the Westinghouse Company was procuring information from the General Electric Company, and ask you to investigate as to how information was being received ?"

"He did."

"Did you see any Thomson-Houston blue prints in the Westinghouse works ?"

"I did see some."

"Did you tell him that you suspected anyone was sending them from the Thomson-Houston Company, afterward merged into the General Electric Company ?"

"I did tell him that I thought it was a man named Morris who was sending them."

"You stated, did you not, that while Hamilton was at the Newell House the letters offered in evidence were printed on a typewriter purchased there, and that the machine was also being used for copying some documents relating to a South American scheme of Mr. Mead's ?"

"I did so."

"Did you ever report to Clark having seen Mr. Mayer and Mr. Morris in consultation ?"

"Yes."

"Did you not obtain from the Westinghouse office and send to Mr. Clark a blue print of an alleged infringement of a rheostat or power regulator."

"Yes, sir."

"Did you get a blue print of a thirty horse power railway motor ?"

"I did not."

"Did you try ?

"Yes, I tried, but failed to secure it."

It was then shown that Ashton has been for some weeks practically under the control of Messrs. Good, Scott & Hood, of the Westinghouse Company.

Clark admitted having paid money to Mead at various times amounting to about $12,000.

In behalf of Clark, the following gentlemen were called to testify to his good character: John P. Steidley, of New Haven, Conn., Judge of the Common Pleas; Lucius P. Deming, of New Haven, Conn., a lawyer and ex-Judge of the Common Pleas of New Haven County; N. B. Sperry, postmaster of New Haven; Robert O. Gates, sheriff of New Haven County; D. M. Bassett, of Derby, Conn., a hardware manufacturer; John Jamison, general superintendent of the Subway Company of New York, and L. H. McIntyre, of Philadelphia, chief engineer of the People's Traction Company.

A half dozen of his acquaintances testified to the general unreliability of Ashton, and to the fact that he was a close friend of Morris Mead's.

In their argument, attorneys for the defence laid great stress on one of the main points of Clark's defence—that he was only a subordinate, working under the orders of his superiors, Messrs. Coffin, Knight and Rice. Mr Marshall raised the question why these latter gentlemen had not been called to appear.

District Attorney Burleigh responded that an attempt to extradite Messrs. Coffin, Knight and Rice had proved unsuccessful through the opposition of the very attorneys who were now defending Clark. The prosecution also wanted to know—would be very glad to know—why Messrs. Coffin, Knight and Rice had not appeared voluntarily, and had kept out of the reach of the Pennsylvania courts.

THE CHARGE TO THE JURY.

Judge Collier's charge to the jury consumed fifteen minutes, and was in part as follows:

> "If the testimony of Ashton is true, these defendants are guilty as charged—guilty of one of the most dishonest and dishonorable acts in business life, and a most foul conspiracy. Do you believe Ashton? It is my duty to warn you to scan the testimony of an accomplice, and it is not safe to convict alone on the uncorroborated evidence of Ashton. The true course is to direct an acquittal where the evidence of an accomplice is not corroborated in some material point; not all the testimony of an accomplice need be corroborated, but some material point. The question is, has he been so corroborated? This the Commonwealth strongly contends has been done, not only by its witnesses, but by one of the defendants. That is for you to say. If you so find, there is no doubt of the guilt of these defendants.
>
> "Evidence of good character is always in favor of innocence. It does not mean that a man of good character can commit no crime, because we all know men of excellent characters have committed crimes, and when such men do commit crimes it is the more unpardonable."

THE JURY COULD NOT AGREE.

At 9.50 A.M. on Friday the case went to the jury. When no verdict was reached at noon, suspense was manifested; when it had not agreed at 1 P.M., when court reconvened, belief that there would be an acquittal was general; but when, at 5 P.M., court adjourned and no conclusion had been reached, the general opinion was that a mistrial would result, and when at the opening of court no verdict was handed in, it became a certainty that the case must be retried.

On Saturday, after having been out 24 hours, the jury came into court and announced it impossible to agree.

HOW THE JURY STOOD.

When the jury went out and took its first ballot the result was six to six. The second, third, fourth, fifth and sixth ballots resulted the same way. On the seventh, the vote stood seven to five for conviction.

The voting continued until 2 A.M., when the vote was eight to four in favor of conviction.

No more votes were taken till after breakfast, when the final vote was taken, and the result was eight to four for conviction.

District Attorney Burleigh says the case will be retried within the next two or three weeks.

THE POSSIBLE PENALTY.

The act of March 31, 1860, provides that if any two or more persons shall falsely and maliciously conspire and agree to cheat and defraud any person or body corporate of his or their money, goods, chattels or other property, or to do any dishonest, malicious, or unlawful act to the prejudice of another, they shall be guilty of a misdemeanor, and on conviction be sentenced to pay a fine not exceeding $500, and to undergo an imprisonment by separate or solitary confinement at labor or by simple imprisonment not exceeding two years. There are five counts in the indictment, and the penalty provided for may be imposed on each count of the indictment.

Municipal Plants.

Some Suggestions offered by an Advocate of City Ownership.

The following letter, which was sent to a customer by one of the large electrical companies, is published as a contribution to the literature of the much vexed question of municipal ownership of electric light plants:

"The most serious question now before municipalities in this country is, 'Will it pay for us to purchase an electric light plant and do our own city lighting?' While every city in the country (except St. Paul, Minn.,) recognizes the superior advantages of electricity as an illuminating agent, and the statement that 'every electric light is as good as a policeman,' has become an aphorism, yet our cities find that these glowing arc lamps cost money, and that in hard times such as are now upon us taxpayers are apt to grumble at the expenditure and oppose extensions. City officials and taxpayers are apt to believe that a plant operated by the city can be so managed as to effect a large annual saving in the cost of public illumination while at the same time permitting of extensions to remoter parts of the city without unduly increasing the expense.

"If such a plant can be divorced from politics, if it is erected on scientific principles and managed with good business tact, there is no reason why the hopes of the public may not be realized and a great economy secured. In this opinion we differ from the published statements of many of our competitors, whose business interests in existing plants may have something to do with the sharpness of their vision.

"Our reasons for holding this opinion are very simple. The ordinary electric light plant in the ordinary American city is a very different thing from what it ought to be, and the revenue which its proprietor fails to derive from the public he must get out of the municipal lighting.

"To illustrate: An individual or a company decides to locate an electric light plant in a town. There is usually a scarcity of ready funds for the enterprise, so that the plant is installed in a haphazard, get-there-as-you-please kind of a way, trusting to future profits to supply the things lacking for a good job. A single-acting slide valve engine of the commonest type is purchased, from two to six dynamos of the highest possible speed and least possible amount of metal are installed, wire with a cheap grade of insulation is put up in a slipshod way, and the alleged 'plant' is complete. Possibly a transformer is stuck in front of each residence as a current and coal pile consumer, while the arc lamps are full of dust and junebugs in the summer, and loaded up with snow by the fag end of every stray blizzard which wanders around from the Dakota banana belt in the winter. No one knows how much steam is wasted through leaky valves, because the engine is never indicated. No comprehensive system of electrical testing is in use to determine the leakages in this direction. Some customers pay by a meter, which may or may not be right; some pay by contract, and some do not pay at all. It is safe to assume that none pay for what they use. We have tested stations in which only 40 per cent. of the current was paid for, the remaining 60 being dead waste. We have found engines using 12 pounds of coal per horse power, instead of 4 as they should. We have found dynamos so badly built, used or abused, that they could not possibly develop 70 per cent. of efficiency. For these reasons and others many plants do not pay. Therefore the city must be charged an exorbitant price for its street lighting to keep the moribund concern in existence. Where the conditions are as we have indicated, or even where matters are not so bad, a good city plant will pay and render good service, if the errors so commonly made are avoided.

"The usual custom when a city desires to purchase an electric light plant is to have plans and specifications prepared by some local civil or mechanical engineer who may or may not have some knowledge of the latest inventions and improvements in electric science. Bids are called for from the manufacturers of apparatus, and the contract is let either to the man who will do the work the cheapest or to him who has the strongest 'pull' in the Council. The result is that the successful bidder furnishes the cheapest possible plant, and in five years the city has a scrap heap on its hands, worth its weight in old iron and copper.

"The correct way would be to employ in the first instance a draughtsman competent to make a plan of the city and locate the lights, not forgetting to put in the public buildings with the probable number of incandescent lights used in each. Then send blue prints of this plan to all the manufacturers, with a brief statement of the necessities of the work, asking each to submit a bid for the best possible plant according to the system which he think will do the work. Then, and not before, call in the advice of an expert. The professors in those universities which have an electrical engineering course can usually be depended upon for an impartial opinion, and these gentlemen are almost without exception men of the highest scientific attainments. It is also well for the Council to send a commission to visit the factories of any company which may seem disposed to exhibit its methods of construction, and such commission should include at least one competent mechanical engineer.

"In this way any city may be reasonably sure of getting the best in the market. It may not be the cheapest in the first cost, but it will demonstrate its value with time.

"When your plant is erected and running, employ a competent electrical and mechanical engineer to operate it, and pay him a handsome salary. Then allow no interference. The usual custom is to have one autocrat at the engine end of the dynamo room and another at the dynamo end. Each is profoundly ignorant of matters in the other's department. This is all wrong. Men can be had in plenty who have had both technical training and practical experience. Get one of this kind, and, if possible, go about 2,500 miles away from home to find him. He will then have no entangling alliances, political or social, and if his salary depends upon the amount of the annual operating expenses, as it ought to, he will hustle to save money.

"In Europe, nearly all municipalities are far better administered than in this country, and at very much less expense. It has there been found that municipal ownership is the safest plan, and most of the large plants now in operation as well as those now in course of installation are owned by the cities. Great care is used in purchasing in order to get the very best, and the results in every instance have been the most satisfactory. There is no reason why the same may not be true in this country.

"In conclusion, a most important point should be brought to public attention. During the late panic, when scarcely any class of business escaped the most serious losses, the large illuminating companies went on serenely about their business, kept their stocks and bonds far above par and paid their usual handsome dividends. No better proof of the absolute safety of electric lighting as a business, when conducted properly, can be given than this magnificent demonstration."

Miss Bertha Lamme, of Pittsburgh, enjoys the unique distinction of being the first and only woman in the world upon whom the degree of electrical engineer has been conferred.

Rapid Transit Plans.

The Commission Receives a Business-like Proposition.

The following statement, made by Mr. William Steinway, president of the New York Rapid Transit Commission, shows that there is still a reasonable prospect that New York will soon have a rapid transit system underground:

"At the last meeting of the Commission we were approached by a firm of financiers, whose name is well known to everybody and is a guarantee of their entire responsibility, and who informed us that they represented a syndicate of capitalists who were ready to bid for the franchise to construct the underground system as laid down by us, to make the deposit we would require, and to ask no help of any kind from the city. This news was exceedingly gratifying to the Commission, for although we have scores of applications for the franchise, up to this time this is the only application from responsible people which has not been saddled with a proviso that the city should guarantee the bonds and have a first lien on the property.

"The firm did not mention the number or the names of the syndicate they represented, but they said that already three-fifths of the capital required had been secured. As this proportion was based upon our estimate of the cost of the system, and that was $45,000,000, the amount ready to be subscribed for the undertaking is a large one. The promise was not distinctly made to have the system in operation in two years, but it has been estimated by engineers and contractors that the system could be completed within that period. There is no doubt that if the enterprise were once undertaken it would be pushed to the earliest possible completion, as every moment lost would mean money lost."

A COMPROMISE.

The Edison Lamp Patent in New York.

In the suit of the Edison Electric Light Company et al. vs. The Mt. Morris Electric Light Company, which is now before Judge Lacombe for decision, a compromise has been effected, and the Mt. Morris Company will hereafter supply its customers with Edison lamps.

The Packard Lamp Case.

Another Non-Infringing Lamp Will Soon be on the Market.

Judge Ricks in the United States Circuit Court at Cleveland has refused the injunction asked for by the Edison Electric Light Company against the Packard Electric Company, but has granted an injunction against J. W. and W. D. Packard as individuals and as officers of the New York and Ohio Company.

This stops the manufacture of the old Packard lamp, but the factory will be utilized in the manufacture of a non-infringing lamp which will be on the market in about a month.

Proposed Electrical Club in Toledo.

A meeting will be held in Toledo, Ohio, on the 18th inst., for the purpose of forming an electrical club or society for study and research in the electrical field. The committee in charge of the project is composed of C. O. Brigham, J. C. DeLong, J. M. McNamara, William Kline, F. B. Perkins, F. Bissell and J. W. Cherry.

In order to reproduce magnetic fields of identical intensity, Dr. d'Arsonval uses a subsidiary coil in series with the main solenoid, and inserts a mercurial thermometer in it. The eddy currents generated in the mercury by the alternating field cause a rise of temperature in the subsidiary coil, which is a measure of the field strength; with four Leyden jars the temperature rises to 150 degs. C. in a few seconds in Dr. d'Arsonval's apparatus.

World's Fair News.

Fort Wayne Company's Plant.

In addition to the Fort Wayne Company's exhibit in the Electricity Building at the World's Fair, which was illustrated and described in the issue of ELECTRICITY of August 23, this company has equipped an important plant at the Fair, of which a general view is given in our Frontispiece this week.

The plant alluded to is situated in the central aisle in Machinery Hall, and in addition to forming an attractive exhibit serves the purpose of supplying current for a large number of arc lights which illuminate the Fair grounds and several of the buildings. These arc light dynamos are of the "Wood" type, and seventeen machines of this well known system are included in this plant. Fourteen of these are 60-light machines, all but one of which supply current for the lamps on the Midway Plaisance, the Casino Pier and the spar buoys in the channel from Van Buren street to the Fair grounds. The power generators, one 80 and one 60 light machine, supply part of the lighting and power circuits in Electricity Building.

All these machines are driven by Buckeye engines, of which there are five of different types and capacities.

Personal.

Mr. W. J. Davidson, of the Short Electric Railway Company, who went to Bangkok, Siam to construct an electric street railway, has returned to his home, having been absent nearly a year.

The new electric lighting system which is now being experimented with on the New York Central Railroad is the invention of Lieut. I. M. Lewis, U.S.A., whose home is in this city.

Wm. H. McKinlock wishes to announce that he is located in rooms 319–320 Manhattan Building, where any communications can reach him, and where he shall be glad to see his friends.

It Beats the Electrical Business.

At the annual meeting of the Westinghouse Air Brake Company, the annual report of President Westinghouse was submitted, and showed total receipts from all sources of about $5,000,000. The net profits figured a little more than $2,000,000.

Legal Notes.

An attachment for $3,000 has been obtained against the Electrical Development Company in favor of Thomas D. Bowen, on thirty notes dated March 1, 1893, payable six months after date to the order of Eaton & Lewis. The company was incorporated about three years ago with a capital stock of $150,000, and was interested in an electric light plant and street railway at Schenectady, N. Y. Samuel Insull was formerly president, but has been succeeded by J. H. Herrick.

William H. Ricketts has been appointed receiver of the Julien Electric Company, formerly of No. 120 Broadway, on the application of David E. Austin, as receiver of taxes.

The sale of the plant of the National Electric Manufacturing Company at Eau Claire has been postponed till November 1 by order of the Court. Judge Bailey, before whom the proceedings were brought, remarked that if, as stated in documents filed, the property was worth $100,000, he would not feel justified in confirming a sale at less than $50,000.

The plant and other property of the Camden, Ark., Electric Light and Power Company has been disposed of at receiver's sale. The property was bought in by the General Electric Company of Chicago. The price paid was $30,000.

Justice Pratt has handed down an order directing the receiver of the Staten Island Electric Light and Power Company to dispose of the property and wind up the affairs of the corporation. Washburn & Moen, the wire manufacturers, objected to the disposal of any of the property until their claims were satisfied.

Foreclosure suits have been instituted against the Beverly and Edgewater Park (N.J.) Electric Light Company.

Proceedings have recently been commenced in the United States Court at Chicago by the American Bell Telephone Company, against several Chicago firms, for alleged infringement of the Bell patent. The defendants in the several suits are: Willis L. Adams, Western Telephone Construction Company, Electric Appliance Company, D'Unger Electric Telephone Manufacturing Company and the Brown Telephone and Telegraph Company. The Bell Company complains that defendants have furnished telephones at less than established prices, and that they have refused to pay royalties. A decree is asked to recover the profits obtained by the sale of such instruments, and also damages.

Motion has been made for the appointment of a receiver for the Thomson-Houston Electric Company of New York in a judgment-creditors' action brought for the sequestration of the company's franchise and property on the ground of insolvency. A judgment was filed for $123 against the company late in June, and the sheriff has returned the execution unsatisfied. The Durand Land Improvement Company holds a judgment for over $80,000 for rent, from which the company's appeal is now pending in the court of last resort. Should the appeal be unsuccessful, the company will be, it is admitted by its officers, in an insolvent condition. This company was formerly known as the East River Electric Light Company.

Boston Notes.

The town of Rockport, Mass., is to be lighted by electricity, the Gloucester Electric Company having made a contract to erect and operate 125 arc lights. The line will be 18 miles long and will be a very difficult one to build owing to the rocky nature of the soil; one section of the line, five miles in length, will require blasting for nearly every post hole.

It is reported in Boston financial circles that the treasurer's office of the General Electric Co. is to be removed from New York to Boston, it having been decided that this department would be most conveniently located in this city.

The topic engaging most public attention in Boston business circles this week has been the resignation of Mr. H. M. Whitney, president of the West End Railway, and its acceptance by the board of directors, to take effect Saturday. Such an important step has been in contemplation for some time past, Mr. Whitney having sold out largely of his interest in the road and being desirous of taking a more active interest in the management of the Metropolitan Steamship and Dominion Coal Companies, in both of which Mr. Whitney is a prime factor. Since 1889 Mr. Whitney has pushed ahead with the electrical equipment of the West End system, which is the most extensive in the world and is now well nigh completed. It has been a mighty heavy load to carry, but Mr. Whitney has carried the load and surmounted about every obstacle. Whatever criticisms may be made of certain phases of Mr. Whitney's administration, the opinion is almost unanimous that he has accomplished a great work for Boston and its suburbs and earned the right and title to retire from the responsible position he so long held.

One of the unmistakable signs and indications that the electrical business is not long to remain depressed and overshadowed by the clouds of financial stringency is the fact that the American Electrical Works, Providence, whose guests the boys were last Saturday at the 15th annual clambake, has seen fit to purchase a very large group of factory buildings covering several acres, and finding that even this extensive new factory will not quite accommodate all the machinery it will need for filling the increasing number of big orders that are constantly flowing in, has had to build additional stories to some parts of the factory. When complete, the American Electrical Works will have one of the most extensive plants of the kind in this country.

Were it not for the large number of hands that are laid off and doing nothing because of the changes that are pending in the control, management and future operations of the General Electric Company, we should be able to report that the electrical firms in and around Boston are busy, which is a fact, and substantially feeling the effects of the improved condition in trade generally.

The new incandescent lamps, both of which may be regarded as Boston specialties, the "Novak" and "New Beacon," are giving good accounts of themselves wherever they are in use. The Waring Electric Company and the Beacon Vacuum Pump and Electrical Company, which manufacture these lamps, are enjoying all the business they can handle. The Beacon Company having announced their readiness to grant licenses to other companies to make the "New Beacon" under royalty, already several lamp firms have opened correspondence with a view to securing such a license. The indisputable fact of the expiration of the Edison lamp patent in November next is going to be a good thing for lamp makers everywhere as well as for the public generally. It looks as if for the present the General Electric Company had more than enough on its hands to take care of without trying to squelch others through the law courts.

Canadian Notes.

Mr. Martin, Q. C., of Cayuga, was in Brantford last week, trying to float a scheme for the construction of an electric railway from Brantford to Selkirk, via Cayuga.

The Gaynor Electric Fire Alarm Company of Louisville, Kentucky, are considering the extension of their business in Canada, and their representative has paid a visit to a number of the more important points in Ontario during the past week.

The Standard Electric Light Company of Ottawa are putting in a new seven thousand light apparatus in their power-house. A new waterwheel is also being added, which will give an additional five hundred horse-power.

The London West Council have passed a bylaw granting an exclusive franchise to the London Street Railway Company to construct an electric line within its confines. The road is to run along Dundas street from the city, across Kensington Bridge, thence along the Wharncliffe highway north to Oxford street, thence east into the city. When this has gone into working order application is to be made for a bridge across the river, into London south, and then the company intend running a circuit through London township by Petersburg. Construction will probably be commenced immediately, and it is expected the road will be in operation by the latter end of October. Power in the meantime will be obtained from the General Electric Company.

The Chaudiere Electric Light Company and the Ottawa Electric Light Company have formed a business amalgamation, to be followed by actual and legal amalgamation as soon as the latter can be consummated. Mr. Robert Blackburn is president of the new company, Senator Clemow vice president, and Mr. Thomas Ahearn general manager.

Peterboro Town Council has passed a by-law granting a bonus of $5,000 to the Canadian General Electric Company upon their locating there all the industries in Canada controlled by them. The chief addition to the present works will be the lamp factory now in Hamilton.

Work in connection with the Kingston Electric Railway has just been commenced.

The storm of last week did considerable damage to the wires of the telegraph companies in many sections of Canada, direct connection with New York being completely cut off for forty-eight hours.

The Niagara Falls Park and River Railway, in order to add new railway stock and machinery to accommodate its large traffic, is now offering to the public $300,000 of stock at par. Although a new enterprise, being in existence only a few months, the road has been taxed to its utmost capacity in transporting passengers.

General News.

What is Going on in the Electrical World.

Kansas City, Mo.—The Consolidated Electric Light Company has resumed the lighting of the city.

Troy, Ohio.—The Miami Valley Electric Road, connecting Troy and Piqua, has been formally opened.

Memphis.—The Citizens' Street Railway Company has in contemplation several extensions of its lines.

Leavenworth. — The Leavenworth Electric Street Railway Company has been reorganized, and matters will soon be in shape for a resumption of work.

Brooklyn, N. Y.—The Brooklyn City Railroad Company has placed an order with the General Electric Company for 200 additional car equipments.

Denver, Col.—The Tramway having become a U. S. mail line, the motorman on each car carrying the mail is obliged to carry a revolver to protect the sack placed in his charge.

Ellicott City, Md.—The Ellicott City Electric Light and Power Company has decided to increase the power and enlarge the plant. John G. Rogers is the president of the company.

Camden, N. J.—It is understood that the West Jersey Traction Company has secured a controlling interest in the Haddonfield and Camden Turnpike Company, and will at once set men to work on the electric road to Haddonfield.

Savannah, Ga.—The Electric Railway Company has secured control of the Belt Line Railway and will improve the line. The capitalization of the Electric Railway Company will be increased to $600,000, and the bonded debt will be $800,000.

Lancaster, Pa.—The Columbia and Donegal Electric Railway Company has decided to extend the road to Marietta and to commence work as soon as possible. The proposed line will be three miles in length. Mr. F. A. Given is the superintendent.

Niagara Falls, N. Y.—The Canadian Electrical Association during their convention at Toronto this month purpose taking a trip to Niagara Falls to inspect the great tunnel and connecting works. They are expected at the Falls on the 14th inst.

Bridgeport, O.—The opening of the Wheeling, Martin's Ferry, Bridgeport and Bellaire Street Railway Company was the occasion of a public celebration. The road has been completed in five months under charge of Manager J. K. Jolly and Chief Electrician C. B. White.

Troy, N. Y.—A telephone company, managed and controlled, it is authoritatively said, by Lieut. Gov. Sheehan, John H. Gleason, M. A. Tierney, and others very close to Senator Murphy, is about to enter the field as the competitor of the Commercial Telephone Company.

Jersey City.—The Jersey City and Bergen Railroad Company has begun work upon the alteration of the street car route through Bayonne from a mule line to the trolley electric system. The company has promised to have electric cars in operation by December 1.

Warsaw, Ill.—H. C. Riner, of Keokuk, has been granted a franchise to erect poles and wire the city for the transmission of electricity for illuminating, heating and power purposes, with a proviso that work should be commenced within one year and completed within two years.

Toledo, Ohio.—The gentlemen representing the company which proposes to construct an electric line between Detroit and Toledo are working hard getting the right of way, and are holding meetings through the county with farmers, with a view to obtaining the right of way in different townships.

San Francisco. — The San Francisco and San Mateo Electric Railroad Company has secured a contract to carry the United States mail between this city and Ocean View, Colma, Holy Cross and Baden. The agreement is for two years and will commence on October 1, when regular trips will be made.

Salem, Mass.—The new power station of the Lynn and Boston street railroad is rapidly approaching completion. Expert machinists from the Hamilton-Corliss engine company, Dayton, Ohio, are at work setting up the three 500 horsepower engines which will drive the three 300 horse-power generators.

Wilmington, Del.—The incorporators of the Wilmington, Chester and Philadelphia Electric Railway have decided to build a trolley link to join the Chester Railway at Linwood so as to connect all the above points. The railroad will be commenced and completed within one year. The line will pass through Essington, Chester, Thurlow, Ridley Park, Lamokin and Linwood.

Scranton, Pa.—The Scranton Traction Company have secured a fifty years' lease of the track, poles, etc., of the Scranton and Pittston Traction Company's line, sixteen miles in length, and running through Taylorville, Minooka, Duryea, Moosic and Old Forge. The road will be continued to Pittston, and within a short time cars will be running on the whole route from Pittston to Scranton.

Selkirk, Can.—A project of an electric railway from Brantford via Oshweekin (Indian Reserve), Hagersville, Nelles Corners, Balmoral to Selkirk and the lake port south of here, and the dredging out of the bar across the mouth of the creek and making of Selkirk a summer resort, is under consideration by several interested residents. The distance would be about thirty miles over a level country without any engineering difficulties.

Pottstown, Pa. —An electric railway company composed of local capitalists has been organized here to run a line to Ringing Rocks, a well-known resort north of Pottstown, where 250 acres of land have been purchased for a park. The officers of the company are: President, Cyrus Q. Guildin; vice-president, Samuel Fronheiser; secretary, R. E. Shaner; treasurer, A. K. Shaner; directors, Frank S. Brant, George C. Hollenback, Jacob S. Bahr, M. R. Davidheiser, H. M. Boone.

Cincinnati.—On the 4th inst. the brake on an East End electric car refused to work on a steep down grade; the car, loaded with passengers, rushed down the hill with frightful velocity, but fortunately became derailed at a curve, and after plowing up several yards of cobblestone came to a standstill. Some of the passengers were badly bruised in jumping from the car, but no one was killed. On the previous Sunday night a similar accident, from the same cause, occurred on the Avondale line, resulting in fatal or serious injuries to several passengers.

Washington, D. C.—A bill for the incorporation of the Washington Traction Company of the District of Columbia, with a capital of $1,000,000, was introduced in the Senate. The incorporators are R. N. Batchelder, E. W. Rollins, E. O. McNeir, S. W. Curriden, J. R. Baldwin, A. J. Warner, H. S. Cummings, C. P. Williams, N. B. Sweitzer, H. M. Earle and A. G. Wheeler. It will use the underground traction system in use on the Rock Creek Railroad Company's U street line, and outside of the city limits will operate with an overhead trolley.

Interior Conduit Company Claim Infringement.

It is apparent by the vigorous manner in which the Interior Conduit and Insulation Company push their patent litigation that they at least believe they own and control the conduit system of wiring. Their last move in this direction is the suit they have brought against the firm of Carpenter & Tremaine, contractors, who are doing the wiring in the new City Hall at Brockton, Mass., and using the Vulca ducts in the installation. Moreover, it is stated on very good authority that bills of complaint are now being drawn up by the attorneys of the Interior Conduit and Insulation Company against other contractors and owners who are making use of the Vulca tube in other infringing installations.

Shultz Belting.

The following testimonial has been received by the New York agent for the Shultz Belting Company:

A. B. LAURENCE, Esq., New York.

Dear Sir: Enclosed find our check for $8.55 to balance account.

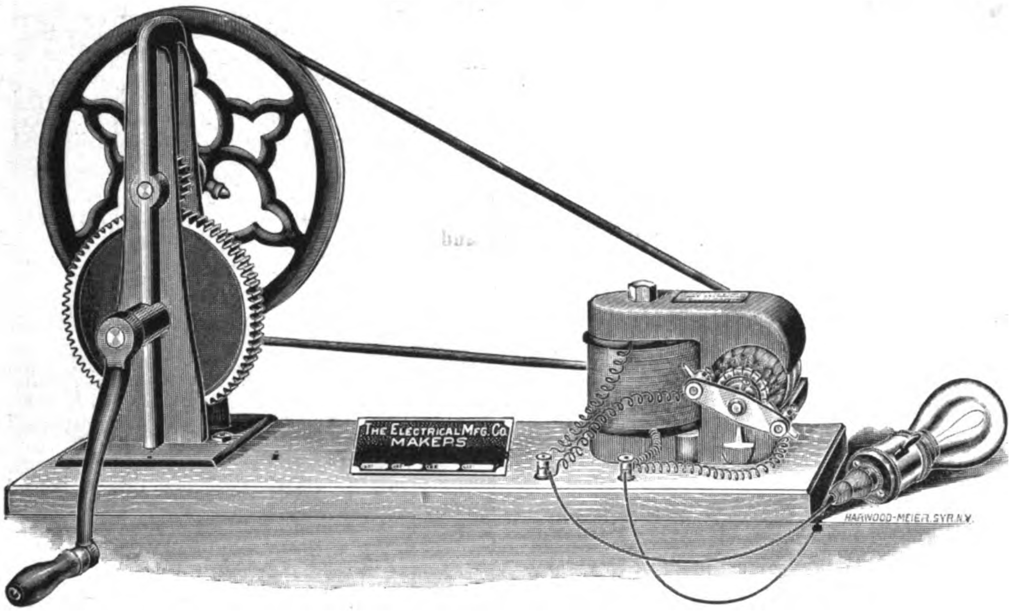
The pulley covering fits perfectly and works like a charm. A belt which we were formerly obliged to run so tight that the bearings were always hot we can now run so loose that it almost drags on the floor.

You are at liberty to use us as reference if you wish.

Yours very truly.
GEO. K. PAGE,
Manager Perry Electric Light Co., Perry, N. Y.

New Model Experimental Dynamo.

The accompanying engraving shows the improved Model Dynamo manufactured by the Elbridge Electrical Manufacturing Company of Elbridge, N. Y. The machine was designed especially for the use of schools and students of electricity, and to them is invaluable since it gives the whole theory of the modern dynamo and follows in construction every detail found in large generators. It is made for actual use, all parts being made of the best material and in the most substantial manner. The armature core is laminated and wound with double covered wire; its shaft is of steel and runs in brass bearings. The commutator has sixteen bars, ample brush contact and will wear for years. All machines are shunt wound, unless otherwise ordered.


THE ELECTRICAL MFG. CO. MAKERS
HARWOOD-MEIER. SYR. N.Y.

The New Model Experimental Dynamo.

The hand power has gears cut from solid metal which run without noise, steel shafts and the pulley turned and balanced.

Each dynamo before leaving the factory is set up and tested to 50 per cent. in excess of the rated voltage as marked on the base.

The machines are furnished wound for from 5 to 25 volts.

The company also manufacture for use in connection with this machine a voltmeter reading from 1 to 25 volts, an ammeter, apparatus for electrolysis, induction coils, magnets—in short, almost any apparatus that would be required by the teacher or student of electricity.

See their advertisement in this issue, and if interested send for circular.

Deservedly Honored.

The high favor in which the well known electrical measuring instruments produced by the Weston Electrical Instrument Co. of Newark, N. J., are held by the most prominent electricians at home and abroad is again illustrated in a very pleasing manner. We refer to the adoption of these instruments at the suggestion of Prof. Ayrton for all tests to be made by the Committee of Judges in the Department of Electricity at the World's Columbian Exposition. The compliment is assuredly deserved and the action of the committee is universally applauded.

INCORPORATIONS.

The Ringing Rocks Electric Railway Company, Pottstown, Pa.—to construct and operate an electric railway in Pottstown, Pa. Capital stock. $100,000. Promoters: Cyrus Q. Guldin, Pottstown, Pa.; Geo. C. Hollenback, Sanatoga, Pa.; Ralph E. Shauler, Pottstown, Pa.

The Susquehanna Electric Light, Heat and Power Company, Spangler, Pa.—to furnish electricity for light, heat and power, etc. Capital stock, $20,000. Promoters: Jas. A. McClain, Bellefonte, Pa.; J. J. Hauk, Carrolltown, Pa.: W. F. Taylor, Altoona, Pa.

The Lititz Electric Light, Heat and Power Company, Lititz, Pa.—to supply light, heat and power by means of electricity to the public in Lititz Borough, Lancaster County. Capital stock, $4,200. Promoters: Jas. E. Brobst, J. Frank Buch, H. S. Kauffman, Lititz, Pa.

The Knoxville Electric Light and Power Company, Knoxville, Ill.—to manufacture and furnish electric light. Capital stock, $20,000. Promoters: Aaron L. Warfel, Chas. F. Foote, Wm. H. Moorehouse.

The C. H. Brown Electric Battery Company. Portland, Ore.—to supply electricity for lighting and heating purposes, and to generate power for manufactories. Capital stock, $100,000. Promoters: Charles H. Brown, Aderville P. Armstrong, Thomas Walker, Louis Pranger, Charles E. Wilber, James Posey, Thomas M. Rogers and Thomas R. Demorest.

The North American Automatic Manufacturing Company, of New York City—to manufacture automatically and electrically operated machines. Capital stock, $15,000. Directors: Thomas F. O'Conner, Daniel P. Regan and Earl G. McQuaide, of New York City.

The Citizens' Electric Light, Heat and Power Company, Lykens, Pa. Capital stock, $10,000. Promoters: F. J. Douden, J. J. Nutt, J. B. Whitney, Lykens; M. R. Keiper, Elizabethville, R. E. Moyer, Millersburg; A. Fortenbaugh, Halifax.

The Electric Letter Box Company, of Meriden, Conn. Caital stock, $8.000. Incorporators: R. L. Baldwin, Benjamin Barnes and John Tederick, all of Meriden.

Empire Electric Company, at Chicago. Capital stock, $15,000. Incorporators: David A. Bennett, Henry G. Hinkle and Gustave Schroeder.

ELECTRICAL PATENT RECORD.

Letters Patent Issued Aug. 15-22, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

503,136. Trolley Wheel. John F. Hall, Lincoln, Neb. Filed April 1, 1893.

503,421. Trolley Wire Finder. Henry C. Jones, Montgomery, Ala. Filed May 31, 1893.

503,562. Electric Trolley Wheel. John W. Clark, Menanda, assignor of one-half to Samuel J. Haight, Albany, N.Y. Filed Feb. 23, 1893.

503,566. Electrical Supply System for Railways. Joseph W. Bates, Minneapolis, Minn. Filed Feb. 8, 1892.

503,570. Electric Railway Trolley Switch. John H. Allison, Elkhart, Ind., assignor of one-half to John G. Rich, Auburn, N. Y., and Daniel G. Reed, Richmond, Ind. Filed March 3, 1893.

503,710. Contact for Conduit Electric Railways. Adolph Worner, Buda-Pesth, Austria-Hungary, assignor to Siemens & Halske, Berlin, Germany. Filed May 18, 1893.

ELECTRIC LIGHTS AND APPLIANCES.

503,349. Incandescent Lamp Socket. Charles T. Lee, Boston, Mass. Filed May 3, 1892.

503,538. Electric Arc Lamp. Louis E. Howard, Plainfield, N. J. Filed Dec. 20, 1892.

503,539. Electric Arc Lamp. Louis E. Howard, Plainfield, N. J. Filed June 9, 1893.

503,602. Electric Search-Light Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company of Connecticut. Filed June 19, 1893.

503,650. Incandescent Electric Lamp. Edward E. Cary, Boston, and William E. Nickerson, Cambridge, Mass. Filed April 3, 1893.

503,669. Incandescent Electric Lamp. William E. Nickerson, Cambridge, Mass Filed April 7, 1893.

503,670. Incandescent Electric Lamp. William E. Nickerson, Cambridge, Mass. Filed July 19, 1893.

503,671. Incandescent Electric Lamp. William E. Nickerson, Cambridge, Mass. Filed July 17, 1893.

503,688. Electric Lighting System. Lucien Vialet-Chabrand, Ciotat, France. Filed April 2, 1892.

503,693. Switch for Electric Lights. Ernest Blasser, Boston, Mass. Filed Aug. 3, 1892.

503,770. Incandescent Electric Lamp. William E. Nickerson, Cambridge, Mass. Filed July 3, 1893.

503,799. Electric Arc Lamp. Walter W. Millard, Fenton, Mich. Filed April 3, 1893.

503,912. Combined Gas and Electric Light Fixture. James A. O'Neill, Boston, Mass., assignor of one-half to John C. Hollings, same place. Filed Oct. 29, 1892.

DYNAMOS, MOTORS, ETC.

503,183. Alternating Current Electric Motor. Ferdinand A. Wessel, Boston, Mass. Filed April 3, 1888.

503,213. Electrical Reciprocating Motor. Henry S. McKay, Boston, Mass. Filed May 13, 1892.

503,420. Clutch for Electric Motors. William A. Johnston and Arthur W. Browne, Prince's Bay, N. Y., assignors to the S. S. White Dental Manufacturing Company, Philadelphia, Pa. Filed March 3, 1893.

503,445. Method of Winding Coils for Dynamo-Electric Armatures. Elihu Thomson, Swampscott, assignor to the General Electric Company, Boston, Mass. Filed April 19, 1893.

503,449. Method of Winding Coils for Dynamo-Electric Armatures. John B. Blood, Lynn, assignor to the General Electric Company, Boston, Mass. Filed April 19, 1893.

503,458. Regulator for Electric Motors. John C. Davidson, Prince's Bay, N. Y., assignor to the S. S. White Dental Manufacturing Company, Philadelphia, Pa. Filed March 8, 1893.

503,487. Electric Engine. William Lawrence, New York. N. Y., assignor to the Lawrence Electric Company, same place. Filed Aug. 17, 1892.

503,568. Starting Device for Electric Motors. Alton D. Adams, St. Paul, Minn. Filed Oct. 19, 1891.

503,574. Dynamo-Electric Machine or Motor. Charles S. Bradley, Avon. N. Y. Filed April 15, 1893

503,[illegible]61. Self-Exciting Alternate-Current Electric Generator. Philip Diehl, Elizabeth, N. J., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Filed April 11, 1887.

503,690. Apparatus for Controlling Electric Motors. Schuyler S. Wheeler, New York, N. Y., assignor to the Crocker-Wheeler Electric Company, same place. Filed June 6, 1892.

503,750. Regulating Apparatus for Electric Motors. Charles H. Richardson, Philadelphia, Pa., assignor to the S. S. White Dental Manufacturing Campany, same place. Filed April 27. 1893.

TELEPHONE AND TELEGRAPH APPARATUS.

503,272. Telegraphic Apparatus. Albrecht Heil, Frankisch Crumbach, Germany. Filed Feb. 13, 1893.

503,590. Telegraphy. Stephen D. Field, Yonkers, N. Y. Filed Jan. 16, 1893.

BATTERIES, ETC.

503,182. Battery Jar. Alvah M. Gee, Edgar, Neb. Filed Feb. 18, 1893.

503,415. Electric Dry Cell. Ramon Gabarra, Barcelona, Spain. Filed Jan. 18, 1893.

503,567. Galvanic Battery. Charles H. Brown, Portland, Ore. Filed May 3, 1893.

MEASURING INSTRUMENTS.

503,589. Electric Measuring Apparatus for Alternate Currents. Sydney Evershed, London, England. Filed Dec. 22, 1891.

503,595. Electric Meter. Fred L. Gregory, Niagara Falls, N. Y. Filed May 14, 1892.

503,805. Electric Meter. Anthony Reckenzaun, London, England, assignor to James A. Pentz, Philadelphia, Pa. Filed Nov. 26, 1892.

SWITCHBOARDS AND SWITCHES.

503,115. Test System for Multiple Switchboards. William D. Allison, Chicago, Ill., assignor to the Western Electric Company, same place. Filed May 14, 1888.

503,157. Switch for Electric Circuits. William McNeill and James H. Tinder, Winchester, Ky., assignors to the McNeill-Tinder Electric Company, same place. Filed May 31, 1892.

503,180. Electric Switch. Ernest P. Warner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Oct. 29, 1892.

503,279. Controlling Switch for Electrically-Propelled Vehicles. Harry P. Davis, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Co., same place. Filed Jan. 7, 1893.

503,443. Trolley Wire Switch. Elmer A. Sperry, Chicago, Ill., assignor to the Sperry Electric Railway Company, Cleveland, Ohio. Filed April 1, 1892.

ALARM AND SIGNALING APPARATUS.

503,187. Fire-Alarm and Individual Electric Call. John Young, Chicago, Ill., assignor to the Western Electric Company, same place. Filed July 18, 1884.

503,252. Electric Switchboards Signals. Frank A. Pickernell, Newark, N. J., assignor to the American Telephone and Telegraph Company of New York Filed May 15, 1893.

503,505. Railway Signaling. Illius A. Timmis, London, England. Filed Oct. 13, 1892.

503,709. Electric Signal Device. Carl Schwennicke, Berlin, Germany, assignor to Siemens & Halske, same place. Filed March 30, 1893.

503,718. Block Signal Indicating Mechanism. Johann H. Frischen, Berlin, Germany, assignor to Siemens & Halske, same place. Filed May 1, 1893.

MISCELLANEOUS.

503,181. Connector. Herbert L. Webb, New York, N. Y. Filed Feb. 28, 1891.

503,186. Electrical Condenser. Alexander Wurts, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, same place. Filed Oct. 5. 1892.

503,193. Cleat. Douglas B. Bronson, Chicago, Ill., assignor of one-half to Thomas B. Wrigley, same place. Filed Feb. 14, 1893.

503,321. Method of and Apparatus for the Transmission of Electrical Energy. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Nov. 21, 1892.

503,384. Cleat for Electric Wires. Jacob Pawolowski, Cincinnati, Ohio. Filed Jan. 7, 1893.

503 427. Binding Post for Electrical Connections. Arnold Kohl, Centralia, Ill. Filed March 24, 1893.

503,451. Apparatus for Electrolysis of Fused Salts. Willard E. Case, Auburn, N. Y. Filed Jan. 17, 1891. Renewed Jan. 21, 1893.

503,519. Conductor Support and Insulator. David T. Bennett, Trenton, N. J. Filed May 15, 1893.

503,549. Insulator. Louis McCarthy, Boston, Mass. Filed Jan. 14, 1893.

503,604. Electric Cable. Milo G. Kellogg, Chicago, Ill. Filed Nov. 15, 1890.

503,621. System of Electrical Distribution. Oliver B. Shallenberger, Rochester, Pa. Filed March 3, 1887.

503,622. System of Electrical Conversion and Distribution. William Stanley, Jr., Great Barrington, Mass., assignor, by mesne assignments, to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Filed March 28, 1887.

503,727. Electro-Magnetic Safety-Coupling. Ernest Richter and Carl Hoffmann, Berlin, Germany, assignors to Siemens & Halske, same place. Filed Jan. 14, 1893.

503,749. Section-Insulator. Louis McCarthy, Boston, Mass. Filed April 15, 1893.

503,775. Electrical Contact Device. James K. Pritchard, Providence, R. I. Filed March 20, 1893.

503,778. Insulator for Electric Wires. William D. Trimble, Hanesville, Md. Filed April 14, 1893.

503,788. Lightning Arrester. William Le R. Emmet, Chicago, Ill. Filed July 11, 1892.

503,811. Electric Belt. Adolph Stephenson and Jonas Backstrom, Stromsburg, Neb. Filed Feb. 23, 1893.

503,867. Electrical Cut-Out. Lewis B. Matson, Elmira, N. Y. Filed Jan. 19, 1893.

503,873. Electrical Conduit for Buildings. James J. Powers and Robert Van Buren, Brooklyn, N. Y. Filed April 27, 1893.

ELECTRICITY.

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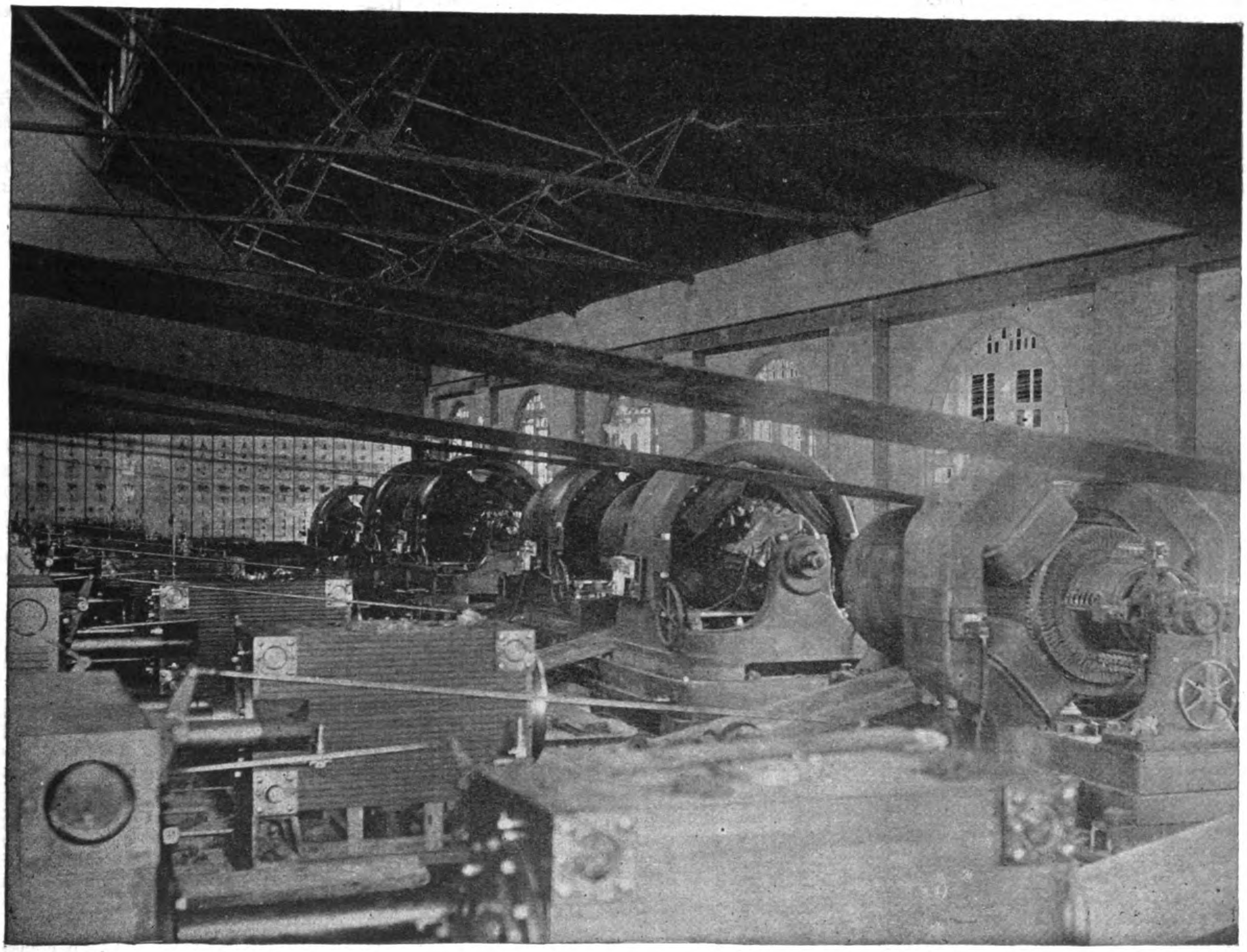

POWER HOUSE, ATLANTIC AVENUE RAILWAY COMPANY, BROOKLYN. (SEE PAGE 114.)

Brooklyn's Latest Electric Railway.

The progress of electricity as a motive power for street railways in Brooklyn has been so rapid during the past year that a horse car in that city will soon be considered a curiosity. Most of the large roads there are already equipped with the trolley, and the latest accession to this field is the Atlantic Avenue Railroad Company, which is just completing its large power station at the corner of Third avenue and Second street.

The building is 268 feet long and 225 feet wide with brick walls and an iron trussed roof. The boiler room occupies 75 feet of the rear end of the building and is separated by a brick partition wall from the engine and dynamo room. It is equipped with six batteries of boilers of the Babcock & Wilcox make, the boilers having a capacity of 250 horse power each. To insure against accident they are provided with three independent feed systems. For ordinary use each engine is belted to a feed pump which operates with it, the feed being regulated by a by-pass which allows some of the water to return through the pump. Two injectors are also installed and there is besides a large pump which is capable of feeding all the boilers.

The piping to the engines is carried entirely underground, and connections are made to the bottom of the engine cylinders.

The engines are of the C. & G. Cooper Company's make and are eight in number. The further engine shown in the Frontispiece has a normal capacity of 375 horse power; the three intermediate ones are rated at 500 horse power, and the other four are 700 horse power each.

To economize space the dynamos are belted back from the engines, which are driven backwards to keep the slack on the upper side of the belts. The engines have a speed of about 75 revolutions per minute, and the distance between centres of pulleys is 45 feet.

The electrical equipment of the road is that of the Westinghouse system, five of the generators being furnished by that company and three by the General Electric Company. The switchboard is made of white marble, and extends nearly across the building. Each dynamo has a separate set of switches and instruments, and each section of the road, of which there are eight, is supplied by separate feeders, any of which may be controlled independently at the switchboard, so that a short circuit or other accident on any section will not interfere with any of the other branches. This station has been in operation for some time, but considerable work remains to be done before its completion.

A Powerful Eel.

It Causes a Total Blockade of an Entire Street Car System.

An eel caused a blockade on the line of the Union Railroad Co. Sunday evening that lasted more than an hour. The company was running 70 cars yesterday, and most of these were loaded with persons returning from a visit to the city's northern suburbs when they were brought to a sudden stop at 6:45 o'clock. An eel three feet long had gotten into the water pipe that supplies the boilers in the power house at West Farms, and the engineer was compelled to stop the engines and blow off the boilers to get at and remove it.—*New York Sun.*

The Ansonia Company's Factory Reopened.

The Ansonia Electric Company has resumed work in every department but one, and with full force. The wire department will not require all the old hands at present, but they will be taken back as needed, and as everything is inventoried it is expected that work will now be carried on continuously.

Convention of the Canadian Electrical Association.

The Third Annual Convention of the Canadian Electrical Association opened in Toronto on Tuesday, the 12th inst. The Exhibition grounds during fair week were chosen as the spot of meeting, and through the courtesy of the authorities ample provision was made for the comfortable accommodation of all concerned. The hall over the public offices was appropriately fitted up for the occasion, and the first day's attendance was fully up to expectations. At 1 o'clock the Executive Committee was called together, and for an hour transacted business of a private character. At 2:30 the meeting was called to order, when the president, J. J. Wright, delivered his annual address. Mr. Wright spoke in part as follows:

Gentlemen of the Electrical Association: It has again become my pleasing duty to meet you in convention assembled, and at this our annual session to congratulate you upon the progress we have made as an association, and on the success which has attended our efforts to advance the interests of the electrical fraternity.

It is not necessary for me to elaborate any platitudes on the wonderful progress being made in the utilization of electricity. This is evident enough to impress even the most thoughtless. The multiplicity of electric cars on our street railroads, the telephones in our houses and the electric motors in our workshops are eloquent realities that impress the fact upon our notice. Apart from the rapid increase of what may be termed the standard uses of electricity, the most notable development appears to be in the increasing use of alternating currents, especially of higher tension than has heretofore been considered practical or advisable.

The use of these currents for light and power will increase with the advent of a practical motor, and it is possible in the near future that current for arc and incandescent lighting and motoric power will be distributed from one source of supply. The chief obstacle to a complete and comprehensive distributing system is the difficulty in running these generators into mains in multiple arc, though even in that line what now is experimental may become in the near future a practical method of operation. We are looking for further developments in this line, as it appears to be at present the most promising field for the enterprising inventor.

I would impress upon the members of this Association, if they would become a power for usefulness, the necessity of taking hold of questions as they arise and dealing with them on new and original lines. It is the duty of an organization of this calibre to lead—not to follow. I am still hoping you will take in hand and endorse with your authority a standard of illuminating power for arc lamps; one that shall be recognized in this country at least as authoritative and final, and shall be referred to as the Canadian Electrical Association standard. If this had been done at the Hamilton Convention when first proposed, we should have led the world. The opportunity still exists, however, as the Chicago Congress failed to take definite action. It still exists, though not to the exclusive extent that it might have done. It will not do to be satisfied to fall in at the tail of the procession and take a back seat as we did, simply because the cross-roads village Podunk has had a four ampere system palmed off on it for 2,000 candle power. If we are to adopt nothing but American ideas we may as well cease to exist and let other people do our thinking for us.

The first day's gathering was a fairly representative one, among the more prominent members present being Fred Nicholls, General Manager Canadian General Electric Company; H. P. Dwight, President G. N.W. Tel. Company; L. B. McFarlane, Manager E. D. Bell Telephone Company; Carl Breithaupt, Berlin; John Langton, Toronto; Prof. Rosebrugh, Toronto; J. L. Armstrong, Toronto; A. A. Wright, Pembroke; John Carroll, Montreal; E. B. Merrill, Toronto; Hugh Neilson, Superintendent Trunk Lines Bell Telephone Company; A. B. Smith, General Superintendent G. N. W. Tel. Company; Geo. Black, Hamilton, etc., etc.

The secretary-treasurer's report was read, showing a most satisfactory condition of affairs and a considerable increase of funds on hand over the previous year, as well as a constantly increasing membership. This was followed by reports of the committees. The report of the Committee on Statistics was read, but as the figures were still incomplete, the press were kindly requested to defer their publication on this account.

It has been ascertained that over $900,000,000 is at present involved in Canada in electric light plants, and the total number of horse power in use 50,000, with something over 4,000 employees.

The Bell Telephone Company has a wire mileage in Canada at the present day of 36,000, with close on to 1,200 employees. There are in the neighborhood of 100,000 incandescent lights in use, 80,000 of which are supplied by the alternating system, and the majority of the remainder by direct current. Total horse power in use for street railways is in the neighborhood of 25,000.

Following the report of the Committee on Statistics, Mr. F. C. Robertson, of Toronto, read a paper on the Causes of Interruption to Telegraph Circuits, which was listened to with considerable interest. Mr. Robertson carefully enumerated the "troubles" common on telegraph circuits, drawing attention to the fact that the Canadian Pacific Telegraph Company was the first in Canada to successfully work a quad. circuit by means of a metallic return during the heavy magnetic storms of last year.

Mr. H. B. Smith thought that Mr. Robertson had omitted probably the most dangerous cause of trouble to which telegraph and telephone companies are now almost daily subjected—a through contact with electric light and trolley wires throughout the country. Mr. Smith strongly denounced the careless methods in vogue among many electric light companies in this respect, which have been the direct cause in many instances of great loss to property in various parts of the country.

"Turbine Water Wheels," a most able paper by A. C. McCallum, C. E., was next read, and the convention adjourned at 5 P. M.

WEDNESDAY.

The Convention was called to order at 10:30, when unfinished business of the previous day was first transacted, and next year's place of meeting fixed upon as Montreal.

The first paper read was by Mr. L. B. McFarlane, of Montreal, giving a history of the telephone in Canada. Mr. McFarlane afterwards stated that the first successful experiment in long distance telephony on the Continent was made by Prof. Bell, between Brantford and Paris, in the year 1875, or one year before that gentleman gave his first exhibition of the practical working of the telephone in the United States, at the Philadelphia Exposition.

Mr. E. B. Merrill, of Toronto, followed with a carefully prepared paper on "Electrical Education," which gave rise to considerable discussion among the members of the Association present as to the value from a commercial standpoint of the theoretical training imparted in the various schools and colleges throughout the country. It was generally conceded that a mixture of both theoretical and practical training was desirable when possible, but the fact that a majority of the important positions in the country were occupied by men whose knowledge has been gained in the field of practice was pointed out as a warning for students that manual work should not be eschewed in their course of training.

The Convention adjourned at 12:30 for lunch and reassembled again at 2 P. M., when the election of officers for the ensuing year was proceeded with. J. J. Wright, of Toronto, was unanimously re-elected president, as were also K. J. Dunstan and John Carroll as first and second vice-president respectively. C. H. Mortimer was elected secretary and treasurer. Papers were read in the afternoon by Mr. John Langton on "Direct Connected Dynamos and Steam Engines," and by Mr. E. Carl Breithaupt on "Electric Street Railways."

Thursday.

The third day of the Convention was devoted to a trip across the lake to Queenston, where a special train was placed at the disposal of the Association by the Niagara Falls Park and River Electric Railway Company from Queenston to Chippewa, and inspection made of the power houses and plant generally.

By invitation the members also visited the Falls at Table Rock and Prospect Park, the works in the tunnel district, the tower, etc., and made a trip around the Falls on the steamer "Maid of the Mist." Luncheon was provided at the Cliff House and dinner on the boat during the return trip.

Long Distance Transmission.

Multiphase Motors.

BY PROF. GEORGE FORBES.*

I read in the morning papers that there has been an organized conspiracy among the American engineers, led by no less a man than our esteemed friend, Dr. Duncan, to "draw" the foreign engineers on the subject of the transmission of power and multiphase motors. Now, in the first place, I presume that has no reference to me. I must say from the relationships which I have had with every one here, I have ceased to look upon myself as a foreign engineer; but even if such an attempt has been made to "draw" the foreign engineers out, I do not see what the object of it was. I do not see that they need any drawing out. They are only too glad to enter into the discussion of the things which are of mutual benefit to everybody.

Your chairman has been good enough to ask me to commence this discussion with some further remarks on the transmission of power and on the use of alternating currents and multiphase motors. I feel that before such an assembly it is a very fitting time that one should say a few words about one of the great works on which I myself have been engaged, and the history of the progress in connection with that work, and the condition of affairs at the present moment in the way of utilizing the Falls of Niagara. A great deal of time and thought has been given to selecting the best system to be adopted for this work, and for a long time the question was open whether the power should be used directly by wheelpits communicating with each separate mill that was going to take the power. It was a resolution of the deepest importance which was arrived at by the president of the Cataract Construction Company when, after having inspected all that was being done in Europe, and knowing all that was being done in America, in the way of transmission of power, he telegraphed to the New York office that it must be a question of starting central stations at the Falls of Niagara. That was the first step that was taken. The question then was whether the power should be transmitted to the workshops requiring power by compressed air, by rope transmission or by electricity, and I may say that for a long time there was a great preponderance of opinion in favor of compressed air. Finally we have all to congratulate ourselves that the resolution was adopted to do the whole of the transmission by means of electricity.

In the year 1890 a number of plans were invited from different engineers and manufacturing firms as to the best means of utilizing this power. These plans were submitted before an international congress consisting of members well known in the engineering and electrical worlds of all countries, who met in London at the beginning of 1891. At that time there was one report which used these words: "It will be somewhat surprising to engineers in general, as it was to myself, to find that the only possible means of transmitting this power to Buffalo, and the best means for using it in the neighborhood of the Falls, is by means of the alternating current." I made that statement in my report after having considered carefully every means which was then available. I am glad to say that I have never had any reason to change my opinion from the year 1890 to the present day. I proposed then that the work should be done by alternating currents generated in two phases; that these should be sent along separate circuits at high voltage; that the transformers should be used for reducing the pressure down and introducing a safe pressure into the workshops; that in the workshops synchronizing alternating motors should be used in some cases, and that in other cases two-phase motors should be employed, and that in the cases where the direct current was necessary alternating motors should be used to drive continuous current dynamo machines. That was in the year 1890, and in the present year, 1893, there is hardly a change to be made upon that system which has been proposed. In the interval of that time, however, we have been only too anxious to hear all that could be said in favor of every different system, and I myself have felt a perfectly open mind in the matter since my having expressed an opinion in 1890; in fact I would not have had the least shame, in view of the rapid progress made during those three years, in changing my views entirely, and to have said that the continuous current was the best for the purpose, but we studied the question very thoroughly. At the time when that international congress was held there was an attempt made among the members of the commission to pass a resolution which was to be transmitted to the Cataract Construction Company, informing them that the alternating current could not be used for the purpose. At the present moment every single member of that commission has changed his views, except perhaps one, and I must say that there is this that electricians can congratulate themselves on in the present state of the art of transmission of power, that whenever a definite problem is brought forward, I notice that if half a dozen able electricians consider the question independently and without personal interests to consult, they are generally very close in accordance in the methods which they advise for adoption. You cannot say that one system is always the best, and undoubtedly each system has times when it ought to be used, but in any one scheme I am bound to say that from what I have seen most engineers will agree if they have got data placed before them.

I mentioned yesterday the chief considerations objectionable in the use of continuous currents for the transmission of power at Niagara Falls. There are many cases where the continuous current is the most desirable to use for transmission of power, and the chief disadvantage is the necessity of putting all your motors in series at the receiving end of the line. But in all these cases that come before the practical engineer the most important thing to consider is the question of cost. At every stage of the working out of the scheme the cost is really the thing that governs the engineer most of all, and it is fortunate when we find that the best harmonizes with the cheapest, as sometimes happens in great engineering works, and as I am glad to say it has happened in the case of this great work of the utilization of Niagara Falls. After the congress closed its labors, and when electricity was decided upon for the purpose, projects were asked for from all the greatest firms in the world. They were asked to submit plans for dealing with this problem. Some were continuous currents and some were alternating currents. The greatest difficulty was experienced in nearly every case by those who were proposing continuous currents to meet the requirements in any way whatever, and in every case the cause was largely in excess of the cost with the alternating currents. One of the things which we have decided upon is that we are to use the same system for the distant transmission as we are to use for the near-by transmission. Nearly every person, when he has begun to tackle this problem, has thought that it was desirable to use a lower voltage for the near-by transmission. One or two thousand volts seemed to be able when you were only transmitting a distance of a mile or two, whereas 10,000 or 20,000 volts was considered nearer right for the distant transmission, but the advantages which we gain by using the higher pressure to a great distance are also gained in using the near-by distribution. Moreover, in all these cases it is almost impossible to grasp the full conditions of the problem until you come down to drawing out the details. Suppose you do start with 1,000 volts for a distribution, say of the first 50,000 H. P. in the neighborhood of the Falls, you will find that the mass of conductors that you have to deal with is something simply impossible. The most convincing argument that I was able to adduce on this point was by drawing a full scale section of a subway carrying the conductors which would be necessary at 50,000 H. P., and it filled a large subway through which a man could walk. It filled the subway up with conduction in such a way as to show, without any further demonstration, that it was impracticable. Moreover, the simplicity of having the whole of the system all in one voltage is something which cannot be overestimated, and this is the way in which we propose to work.

I am glad to feel that the universal opinion is in favor of the adoption of alternating currents. I can only quote one man of any eminence who seriously and persistently considers that it is the greatest mistake to use the alternating current for such a purpose. I will not mention that gentleman's name, and it is a very well known name, one that bears the greatest influence, so great influence that I and those with whom I have been associated have considered with the utmost care every single point in the matter before rejecting the advice that has been given us. The opinion was stated in a general way, but the concrete way in which it was stated by this authority was that on the top of our vertical shafts which come from the turbines we should have a building four stories high for each turbine. Each floor should be insulated completely from the rest of the building. At each floor there should be a large toothed wheel driving five other toothed wheels, on each one of which should be a dynamo of vertical shape. We should have twenty dynamos, each of 1,000 volts, all continuous current dynamos, all connected in series. That plan we have considered most carefully, owing to the source from which it came, and we have rejected it. We are now going ahead with the alternating current, and at every point the question of cost has been considered, and the results which we have arrived at I believe are the best, and I may also say that they are certainly the most economical.

In the year 1890, at the time that I proposed the adoption of synchronizing alternators in some cases and Tesla motors in other cases, there were comparatively few who had much experience of either one or other of these alternating motors. The Tesla motors I had fortunately been able to see at the Pittsburg works of the Westinghouse Company, and they had been placed at my disposal for experiments, and I put a high value on the outcome of these motors, what they would be developed into. I regret to say that during the intervening years there was very little done in the way of developing these Tesla motors at Pittsburg, but in the meantime the question was being taken up in other countries, and in Europe at the time of the Frankfort Exhibition there was a great deal of multiphase work shown in action. This directed the attention of the world to it, and I am glad to say now that in America also the multiphase motors have made more progress. Professor Silvanus Thompson yesterday said that he thought multiphase motors would disappear from general distribution, and that the single phase motors with a multiphase means of starting the motor might be the more universally adopted. That is one of the possibilities of the future. There are several possibilities of the future that we must consider in any very great scheme like that which I am speaking of at the present moment, but in the meantime we must deal with the possibilities of the present. I consider that the multiphase motors at the present moment are not only a possibility, but are a valuable adjunct to the other uses for which the alternating current can be used. Now, a great part of the work in any large system of distribution like that is the continuous working, day and night, or from early morning till late night. A mill is started in the morning and never needs to be shut off during the day, and there are other mills of a character most likely to be attracted to such a situation that run day and night from week's end to week's end. The largest consumers of power which we have at present are the pulp mills for making wood pulp for paper, consuming thousands of horse power, and next to these come the electric deposition works, where power is required from week's end to week's end continuously running. In these cases, if it is simply power you require, a synchronous motor is admirably adapted and thoroughly satisfactory, but in all ordinary workshop practice where we wish to be stopping, starting and reversing our machinery, the most convenient alternating motor, which is a thing not of the future but ready for practical use at the present moment, is the multiphase motor. It is possible to do without the multiphase motor perfectly well, but it is a valuable adjunct at the present moment.

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*Address before the International Electrical Congress at Chicago.

I will speak of a few other of the possibilities which are immediately before us and within our sight at the present moment, and which there can be little doubt will be available to us in the course of the next few years, but which it would be unwise entirely to depend upon at the present moment. Among these it will be said that I am very careful, perhaps, if I include those commutating machines which have been given the name of rotating transformer, a misleading term, but machines which commutate the alternating current into the continuous current by the rotation of the armature, and this machine was first largely shown to the world at Frankfort in 1891, and chiefly by the firm of Schnecker & Company, and has been largely introduced in America for experimental purposes, at any rate, and to show how thoroughly convenient they are, and there are several specimens of them at the World's Fair. These machines involve rotations of a full sized armature with all the losses involved in the armature of a dynamo machine, and consequently they add to the general losses of the system a loss of some, let us say 10 or 15, per cent. This loss is undesirable. Remember that the sole function of these machines is to commutate the current, and it does seem to me as if the world is speedily advancing in the applications of electricity to be able to devise a commutating machine which shall simply do the act of commutating a current without this great loss of power. A great many attempts have been made in this direction. It is a very desirable aim, in order that we may have machines at a distance from our generating station to work our street railways, which at present are worked by continuous current. If we can carry our high tension alternating current to a distance, to Buffalo, to Rochester, to Utica, Syracuse, Albany, to transform it down to a low pressure, and then commutate it by a simple commutator that is not absorbing power to an appreciable extent, we have a valuable adjunct to our machinery. This is one of the possibilities which is almost certain to arrive in the course of the next few years, and which we must look forward to and not leave out of account.

Mr. Pollak has shown us an extremely valuable and simple way of doing this. As to the successful operation of it in practice many of us have still to learn a great deal, and I am sure that each one of us who is interested in the transmission of power to a distance will take advantage of the offer which has been made to us to inspect his machinery at the World's Fair. Other attempts have been made in the same direction by Hutin and LeBlanc in Paris, and by various other inventors, but I may say that a commutator of a simple kind, not losing over 15 per cent., is a thing which is going to come, and we must look forward to it, although we cannot depend upon the possibilities of the future in the organization of our schemes of the present.

Other things are likewise coming. You have heard of the numerous attempts that have been made to devise single-phase alternating current motors which can be put upon our lighting circuits. These have hitherto been not an entire success so far as they have been actually put upon the lighting circuits. We have seen, however, lately in Switzerland the successful construction of such a motor, which can be put even on such circuits as are ordinarily used for lighting purposes, and this even when the frequency of alternations amounts to 133 periods per second, as is very generally used in this country. Such motors have been produced which work efficiently on those circuits, but there are a large number of motors which, although not quite successful on this high frequency, at some lower frequencies are very efficient and satisfactory. I need not mention the names of all the inventors who have been at work in this direction, for they are countless, and I have seen myself with my own eyes, and worked with my own hands, machines of this class of a great number of different types, all capable of doing good work on a rather lower frequency than what has been used with the lighting circuits in this country.

By-the-by, there is also a type of machine which I proposed for adoption as a possibility in the future with alternating currents in the year 1883, and that is the direct current motor with a laminated field; and that also has a certain amount of possibility in the future, at any rate, with lower frequency than what we have been using. There are some difficulties in its use, but such men as Eickemeyer, Prof. Anthony, N. Tesla and various other gentlemen have been engaged upon work in this direction and it has promise for the future.

Now, another of those things which are promising for the future is the question of arc lighting. At the present moment we could use alternate currents for arc lighting. It is being used for arc lighting in Europe; it is being very largely used in some places for arc lighting. At the present moment in this country it has not been so very largely used for the arc lighting, and most of us are of the opinion that the continuous current arc lamp is a more successful thing than the alternating current arc lamp. In the first stations which have to be supplied from Niagara Falls for the purposes either of traction or of arc lighting, there are existing companies at present doing that work. They have got steam engines driving their dynamos, generating currents for these street railways and for these arc lamps. What they want us to do first is to throw out the steam engines, put in motors to drive these dynamos which they have there, not to throw away their whole plant; therefore these at present come under the consideration of the power stations which have to be supplied. But we shall have to deal with arc lighting systems, and if we can get the direct current easily and satisfactorily from the alternating current, it is a very desirable thing to aim at. This, gentlemen, is one of the possibilities of the future.

Mr. Ferrenti has been at work during the last year in developing a combination of a transformer and a simple commutator which shall convert the alternating current into the continuous current whose value is constant, a current of ten amperes or 15 amperes or whatever we may fix upon, and this commutator of his is not one of those commutating engines which we have seen here, but is simply a commutator which is not absorbing power to a large extent in an armature like the other machines. It is a simple commutator and it is working well, and I have the greatest hopes that that may be developed in the near future.

While telling you what we are doing at Niagara Falls, I have only felt that it was right that I should put before you these possibilities of the future, because it is only right that we should consider most carefully what developments are likely to take place in the next few years, and we ought to provide that the machinery which we put down shall never be obsolete. In the meantime, for reasons which I mentioned to you yesterday, we saw a decided preference among the different systems of polyphase transmission and transformers in favor of a system in which the lines are not interconnected. That system when most simply produced is the two-phase system with two independent circuits, one for each phase. We are going to have dynamos made in two phases, not only because we want to avail ourselves of all developments in this line of working that manufacturers can offer us, but also because we get our single-phase circuits cheaper than if we built the machine with one phase instead of two phases. If we use only single-phase motors then we get a larger output from the same machine by building it of two phases than building with one phase. This was appreciated so early as 1879 by a man whose name we all honor so much in connection with the development of electric work, M. Gramme. M. Gramme's first alternating current dynamos were in two phases, eight poles and two phases with a revolving field and a fixed armature.

As to the motors which we shall be using, we shall be using synchronizing motors of single phase, polyphase, and sometimes, no doubt, converting into continuous current and using continuous current for street railways.

The paper of Mr. Pollak which has been referred to involves what I consider the most important point for electrical engineers to attend to that can be thought of at the present moment, the commutating of the alternating current to give us a continuous current. Every advocate of the continuous current that there ever has been, and there have been bigoted advocates, would have been convinced in favor of the alternating current dynamo, alternating current and transmission, if you could have told him that you would put a commutator at the far end instead of at the place where you generated your power. That is the proper place to put a generator if you are going to put one anywhere at all.

There was a good many special features in connection with the Niagara project which rendered special features in the design of dynamo desirable, and which naturally will differentiate the dynamo which is to be used there from those which have been in more ordinary practice, but I venture to say that there will be no serious departure in the dynamos which are put down from the ordinary lines which we have found to be perfectly satisfactory in the past. One of the features is that we have a vertical shaft instead of a horizontal shaft. As you are all aware, the water of the Niagara River is taken off one mile above the Falls by a large canal which has been built. It is then taken by tunnels into the wheelpits and sent down on pen stocks to a depth of 140 feet to the turbines below. These turbines have been constructed by the I. P. Morris Company in Philadelphia, and will be delivered very shortly. The water, after passing through the turbines, is carried down through the great tunnel which has been built and which is an engineering work to be proud of. On the top of the turbines they have a vertical shaft coming to the surface of the ground, and that shaft rotating at 250 revolutions a minute causes the large dynamo to revolve directly on the same shaft without any gearing whatever at the same speed.

It has been proposed in many cases to generate the current at low voltage and use a step-up transformer to create a higher voltage. There are two objections to this. The first is that we have the cost of the transformer. The second is that we have the extra losses in the transformer. If it is possible to create the whole voltage that we require in the dynamo instead of in a transformer, we save the cost of a transformer, which is approximately, roughly speaking, about the cost of the dynamo, and we are saving some three per cent. of efficiency. Now, three per cent. of efficiency—I do not know if every man realizes that until he begins to count out what it is. It means 150 H. P. in each of our units. Our units are 5,000 H. P. Three per cent. of efficiency saved would be 150 H. P. That means so much more earning capacity to our plant. That means so much more rental to be taken in. Suppose you put that at $20 per annum, and 150 H. P., that is, $3,000 per annum is saved by saving that little three per cent. Three thousand dollars per annum capitalized at five per cent. would be $60,000. By saving that three per cent. you save more than the whole plant and the station connected with that work, the dynamo and the whole thing. When we reduce these things down to figures we see what value a high efficiency is to us. Now, I maintain that by following the example set by Gramme, of having the armature fixed, it may be a little extra expense, but nothing like the expense of putting in an extra transformer. You can build that dynamo to the same voltage that you are going to use with a transformer. The fixed armature becomes a thing as easy to handle and as safe to handle as the transformer itself, and you can introduce your very high pressure into that armature with the same safety that you can introduce it into the transformer.

Now, I will not say more about the general arrangement. I think I have said enough for the present, and I felt that it was only right to say this much before so distinguished a congress at this particular stage of the work. I will say one or two words, if the chairman will allow me, on the question of the means of transmission.

It has been an anxious consideration as to whether the transmission ought to take place by overhead conductors or by means of a subway; also the question of laying underground cable in a conduit has been considered. I distinguish, gentlemen, between a subway and a conduit thus: I consider that a conduit is a place for putting cables in. I consider that a subway is a place for putting cables in where a man can walk along and inspect them. Obviously the most complete and satisfactory method would be to put a subway wherever you want to carry these high tension mains, and the cheapest way is obviously to put a pole line all the distance, and the intermediate way is, as often happens when we try to strike a mean course, disastrous. One of the greatest troubles which is likely to come to this work unless it is watched against with the greatest care, is the trouble arising from the capacity of the line. It was said of the high tension transmission at 10,000 volts between Deptford and London, which was for a long time an experiment, that there were two things to consider in connection with the cables: first their capacity, and secondly their incapacity. Their latter defect has, I am glad to say, according to the latest advices, disappeared entirely, from knowledge acquired as to how to deal with the first defect. Now that the capacity of these cables is handled in a proper manner, in a scientific way, there is no trouble. But capacity is always apt to lead to trouble and ought to be avoided in this case in the cables, and for that reason it is undesirable to have insulated cables acting in this manner; consequently the the work will be done either by overhead conductors, bare wires, or by bare wires carried in a subway. Naturally the cost of a subway to Buffalo is a very serious thing. The first place which we have to supply with power is the Pittsburg Reduction Company in the manufacture of their aluminium, which is at a distance of 2,500 feet from the power house, and we have also to proceed almost immediately to Buffalo. Later on we have to meet the agreements which have been made to supply places situated along the Erie Canal; and since the State of New York has taken up experiments on the possibility of having their towage on the Erie Canal conducted by means of electricity, we have to consider the question of transmitting electricity over the whole of that distance. I may express as a purely personal opinion that the action of the State of New York in this direction is an action of the very highest importance; that it is likely to revolutionize traffic in the State of New York; that the volume of transportation over the Erie Canal will be such as to benefit manufacturers in all parts of the State, and more especially those in the neighborhood of Buffalo and the Falls. This work takes us ultimately to a distance of 350 miles. This involves high electric pressures and it involves the consideration of the expense of laying our line.

I have lately had occasion to deal with a similar problem in India. The Indian Government has lately been irrigating the eastern side of the Nilgharry (?) Hills by means of the rivers on the western side of these Hills, and driving a tunnel through the mountains to carry water to irrigate land. They found that when the water was carried through the tunnel at an elevation of 1,200 feet, within a mile and a half before they wanted to begin to use that water for irrigating purposes, they had sufficient water to develop 50,000 H. P. They have been considering the question of generating electricity, and I have had to look into the electrical question. In that case the greatest development of electrical power and lighting would be at the town of Madras, which is 350 miles from this place, but still, according to the best information that we are able to collect on what has been done at high voltage, it seems almost certain that this power can be carried that distance and delivered at Madras as one of the cheapest forms of power in the world, because all the hydraulic works are already created and their sluice gates and everything prepared, and they are simply putting in the transmission plant.

The transmission from Niagara Falls to Albany is almost identical with this. The distance is the same, and when we come to supply this canal we shall have to consider the question whether overhead poles are possible. In the meantime it will be desirable to have some experiments made upon overhead construction, but in this climate there are very great difficulties. The two most serious difficulties that have to be contended with in connection with transmission for an overhead line are, first, those due to lightning, and second, those due to sleet. The sleet trouble is a very serious one, especially in the northern climate. Broadly speaking, the conclusion which it seems we must arrive at is that a transmission by overhead conductors must in the nature of things in that climate be liable to occasional interruptions, and that the electrical subway is almost certain to be carried out without interruptions, giving a continuous service. This makes one naturally favor the subway system. But experiments will be carried out with the pole system undoubtedly, and I have to conclude by making one statement which I think ought to be a matter of congratulation to all of us who are interested in seeing such a scheme successful, and that is that a subway, at any rate part of the way, has been begun. Last Friday the first sod was turned for a subway which is going to carry the conductors from the power station at least so far as the Pittsburg Reduction Works, which is half a mile distant from the power house.

New Method of Producing Steel.

A new method of producing steel has been suggested to M. Jules Garnier by M. Moissan's diamond making experiments. He claims that it is successful. The steel is instantaneously made by placing a bar of iron and a stick of charcoal together in a parallel direction in an electrical fire-brick furnace of a temperature of 1,000 degrees and subjecting them to a strong current. M. Jules Garnier expects that his discovery will revolutionize the steel industry.

On the Swinburne-Thompson Unit of Light.

BY SILVANUS P. THOMPSON, D.SC., F.R.S.*

In the spring of 1892 it was independently proposed by Mr. James Swinburne and by the author of this note to adopt as a unit of light of standard quality the light emitted from a unit of area of the positive or crater surface of the electric arc formed between electrodes of pure carbon.

The advantages of this source of standard of illumination over all flame standards hitherto proposed are so obvious as scarce to need mention.

The advantages over the platinum or Violle unit are also considerable. The carbon arc is much more easily managed, and if a pure carbon is employed, it is much more reliable as a standard than the mass of molten platinum.

The light of the electric arc is emitted, as is well known, chiefly from the end of the positive carbon, very little proceeding from the flame itself, and not much from the negative tip. The positive carbon is in fact heated intensely hot over a patch from which the column of conducting vapor or flame (called by Davy the "arc") is projected across to the tip of the negative carbon. This luminous patch becomes hollowed out into a crater, white hot all over its surface except at the edges, which are duller and redder, and which volatilize much less, but consume slowly by oxidation when the arc is produced in air. Except at these edge parts the light of the crater surface is of uniform lightness at every part if the carbon be pure. The reason of this circumstance is, as pointed out years ago by the writer, that carbon has a fixed temperature of volatilization. The arc cannot be formed at all unless this temperature is reached at least at some portion of the surface; and the temperature cannot be exceeded at any point, simply because the volatilization of the carbon keeps it down. The temperature of the crater surface, that is to say, the temperature of the volatilization of carbon, is as definite (if the material is pure and the external pressure constant) as is the temperature of the melting point of ice, or as that of the boiling point of water. It appears to be about 3,500 C. All arcs made with a pure carbon emit from the crater (save as regards the marginal parts) a light of equal whiteness, irrespective of the strength of current, or of the voltage, or of the length of the arc. Any variations that are noticed in the apparent colors of arc lamps arise either from the semi-incandescent parts around the edge of the crater, or from the tip of the negative carbon, or from the flame itself. If an arc has been burning for some time with a certain current—say six amperes—its crater will have assumed a certain shape or size. If we now increase the current to twelve amperes, the incandescent surface of the positive carbon will be at once increased in proportion, save for a slight discrepancy arising from the marginal effect of the duller parts, and the enlarged crater will settle down to a new shape. (These remarks relate to the steady arc; the phenomenon of the hissing arc being still very obscure.) If then by proper shielding there can be cut off all the stray light of uncertain quality emitted by the red hot margin of the crater, that emitted by the negative tip and by the flame, so that only the true crater surface is visible, its whiteness, as so viewed through a hole in a suitable diaphragm will always be of the same unvarying quality. This was the discovery of Captain Abney, F.R.S., in 1878; and it forms the basis of all the splendid work done by him in conjunction with Major-General Ferting, F.R.S., on the photometry of color.

Increasing the current merely increases the size of the crater, but does not alter its intrinsic brilliancy or its color. Increasing the voltage of the arc has no effect on the intrinsic brilliancy or color of the true crater surface. Increasing the length of the arc has no effect on the intrinsic brilliancy or color of the true crater. The amount of light emitted from a square millimeter of crater surface is a fixed quantity, no matter how the current, or the voltage, or the length, may be varied; and not only is the total amount of light emitted from a square millimeter constant, but its composition is constant. That is to say, the proportion relatively of red waves to blue waves is the same always, independent of current, voltage or length of arc.

It was in consequence of the recognition of these physical properties of the true crater surface that the writer and Mr. Swinburne each made the proposition for the establishment of a new unit to supersede the Violle standard.

Since that suggestion was placed before the scientific world, some work has been done toward its realization in France. M. Blondel has described under the term *arc nomal* an apparatus closely resembling that used by Abney in his photometric researches, consisting of an electric arc furnished with a metallic diaphragm pierced with an aperture of known dimensions, but with the addition of a water-cooling arrangement. More recently, M. Violle has taken up the subject of the electric arc, and has redetermined the temperature of the crater. He adopts and confirms the author's view, that this temperature is determined by the volatilization of carbon. The author has also recently investigated the possible errors introduced by the thickness of the diaphragm and by its obliquity in its position; he has found these sources of error to be by no means negligible. He has also made some experiments on the purity of carbons, and finds that natural graphites always give a less light intrinsically than the artificially prepared hard carbons. Trotter in his original investigation of the distribution of light as emitted from the arc lamp, announced the different emissivity of the soft carbons used for cores. He also investigated the amount of light emitted (normally) from a square centimeter of hard carbon, and finds it to be something less than 70 candles. Doubtless the imperfections of the photometric methods until recent years were such that the production of an exact standard of white light was of less importance than is now the case, since photometry has become the art of precision. Professor Ayrton, adopting the periodic principle of photometry lately described by the author, and using a photometric screen of the Lummer-Brodhun pattern, finds no difficulty in measuring light with a precision of one part in 500. Now that such accuracy of measurement is possible, there is the more urgency for adopting a standard which is not only of entire trustworthiness, but is also easily reproduced.

A Useful Directory.

The "Directory of Street Railway Exhibits at the World's Fair" is the title of a very useful guide-book published by the *Street Railway Gazette* of Chicago. It contains information which will enable the visitor at the Fair interested in any branch of railway work to readily find every exhibit relating to the same, and the subjects included cover every branch of railway work both as to machinery and rolling stock. The subjects are classified under general heads, each of which directs the visitor to every exhibit pertaining to the heading.

Announcement is also made in this pamphlet of the addition of Mr. Clarence E. Stump and Mr. J. W. Dickerson to the staff of the *Street Railway Gazette*, the former in the capacity of business manager and the latter as a member of the editorial staff.

Both of these gentlemen are too well known in the field of electrical journalism to need introduction, and the *Gazette* is to be congratulated on the acquisition of two tried and successful members in this field.

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* Paper read at the International Electrical Congress, Chicago.

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Empiricism. Our usually accurate contemporary, the *Electrical World*, points out in an editorial discourse the danger of dogmatisms which are not uncommon in the literature of electrical science.

Taking as its text the remarks of Prof. Crocker at the International Congress on this subject, it says:

> "For many years the rule was laid down that the difference of potential between adjacent bars of commutators should not exceed 9 volts, yet Prof. Crocker describes two machines which worked successfully, one with a difference of 100 volts and the other with 150 volts. While the successful working of these machines was partly due to the use of carbon brushes . . . nevertheless the arbitrary dictum in regard to the limiting potential between the bars of commutators has been definitely disposed of and the way thus opened for a new advance."

While we heartily concur in the conclusions drawn by our contemporary, and in the justice of its comments on this subject, the figures actually given by Prof. Crocker are remarkably at variance with those imputed to him by the *Electrical World*, which are not nearly so striking an illustration of the case in point. The figure formerly laid down in regard to the maximum average difference of potential between commutator segments was 19 volts instead of 9.

Then of the two machines described, one having a 32 segment commutator generated a current of 5,500 volts, which would make the average difference approximately 350 volts, and the other, which generated 11,000 volts, had 108 segments, or a difference of over 200 volts.

By substituting the figures 200 and 350 for those quoted above, the uselessness and fallacy of the old arbitrary limit of 19 volts is made still more apparent.

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Mercurial Air Pumps. An entirely novel form of mercurial air pump is described in a paper by Mr. Schulze-Berge printed elsewhere, and the subject is one of great interest to electricians on account of the prominent part this machine plays in the manufacture of incandescent lamps.

In the older forms of pumps, which were made of glass, trouble has been experienced frequently by the breakage of the glass due to concussions, and another trouble lies in keeping the mercury clean. Besides avoiding these difficulties, Mr. Schulze-Berge's pump is capable of producing rapidly an unusually high degree of vacuum, so high, according to the author, as not to be measured by the McLeod gauge.

To avoid the risk of breakage, these pumps when manufactured in large sizes suitable for lamp factories are made with cold-drawn steel tubing which, contrary to the accepted theory, Mr. Schulze-Berge finds will stand any degree of vacuum he is able to produce. The joints in these tubes, instead of being connected by electric welding, are soldered on the outside after inserting a platinum washer between the ends of the tubes to prevent the mercury from affecting the solder.

A pump of this design is now being tested for an incandescent lamp manufactory which from the performance of the smaller models promises to be a considerable improvement over older styles of vacuum pumps both in the degree of vacuum produced and speed with which the work is accomplished.

……o……

Electric Arc Lamps. The number of papers in regard to arc lamps read at the Electrical Congress would appear to indicate that considerable study is being given to this now almost universal means of outdoor illumination, yet it is probably a fact that notwithstanding the extent of the use of arc lamps they have received less attention from electrical engineers than has any other important piece of electrical apparatus.

This condition arose at first, perhaps, from the very rapid introduction of arc lighting and the necessity of supplying some kind of a lamp for commercial purposes. Customers at first had very little idea of what constituted a good lamp, and so long as it continued to run without too much flickering and without going out too often the customer was satisfied. This led to the manufacture of a class of very cheap lamps, and in a good many cases everything possible was sacrificed to produce lamps with few parts and of low shop cost, without much regard to efficiency or reliability. The result of this was plainly evident in the numbers of lamps which could be seen out almost any night.

In some cases the shop cost of lamps was reduced to about five dollars, but very few of these are to be found to-day. The tendency is now in the direction of improving the mechanism which even in the best of lamps is a delicate and somewhat uncertain point, and complaints about lamps going out are still familiar to central station men, although not nearly so common as formerly.

A good deal of the work in this line appears to have been done by people who had but little idea of the requirements of a good arc lamp, and this is particularly noticeable in the patent records. The number of lamps and devices upon which patents have been taken out is well up in the thousands, but as very few of these have found any practical application it is to be inferred that most of them are of but little value.

In fact, the different kinds of lamps in use to-day are limited to a very small number, and the most of these are turned out by half a dozen companies.

……o……

A RECENT issue of the Alton, Ill., *Sentinel* contains a somewhat lurid report of a mass-meeting in that town, held, pursuant to a call from the President of the Board of Trade, to consider what inducements can be offered to the Chicago-St. Louis Electric Road to secure the location of the company's shops at Alton. Mr. Fisher, for the road, explained how, for proper considerations, several deflections had been made in the proposed route, which was first announced as an air line. We gather that if sufficient "inducements" are offered, the road can be built as crooked as a Virginia worm fence without interfering seriously with the workings of Dr. Adams's "patented devices."

Citizen McPike inquired: "Has not Mr. Thos. A. Edison said that it is perfectly practical for you to operate your line at the intended speed of 100 or even 150 miles per hour ?"

Dr. Adams replied: "He has, I believe, made that statement, and we can certainly do it."

If Dr. Adams has a conscientious desire to inform the public what is thought of his plans by scientific men, he should distribute in pamphlet form the discussion at the meeting of the American Institute of Electrical Engineers which he addressed a year and a half ago ; to which might be added, as an appendix, the opinions published in these columns in regard to it.

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The idea that Mr. R. T. McDonald has withdrawn the Fort Wayne Company from the Trust out of sympathy for Mr. Coffin is the conception of no ordinary brain. Those who are putting it into print should read Electricity and acquire a clearer understanding of the situation.

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The report of the Blue Print case at Pittsburg did not appear in the *Western Electrician.* Did the office cat make a mistake and devour good matter, or is Mr. Sunny acting as assistant editor of our esteemed contemporary?

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It has been some time since any announcement has been made of the proposed absorption of the Westinghouse Company by the General Electric Company.

Edison Will be Again in the Field.

"Electricity's" Opinion Confirmed.

The following, which is believed to be based on direct statements from Mr. Edison, is printed in the New Brunswick *Daily Times:*

"An interview with Thomas A. Edison was recently published in the *Inter-Ocean* of Chicago, to the effect that he has retired from the electrical business. This is not so. Mr. Edison told the reporter that he had disposed of his stock in the organization of speculators which acquired a controlling interest in the Edison General Electric Company. Since that period he has not turned over any of his recent inventions to that organization, but in a short time it is said that a new Edison organization will be completed by the great inventor, who will equip it with several wonderful inventions which will make a complete revolution of the present methods of lighting. A majority of the pioneers of the lighting business who have declined employment with the so-called Electric Trust are to be associated with Mr. Edison, whose new factories will be located in New Jersey."

Responsibility for the Wreck.

A New York Paper Assumes to Believe the Boston Story.

(From the Evening Advertiser.)

"It was an unlucky day for the Thomson-Houston people when they became connected with Edison Electric. The methods which have made the General Electric Company a byword and a reproach are the result of the Edison interest in the management. Before consolidation the Edison interests were noted for their loose methods of business, and ever since the influence of the Thomson-Houston people has not been sufficient to prevent these identical methods from ruining what might be a very prosperous concern. If the present attempts to force out the Thomson-Houston interest from the management ever succeeds it will be a great misfortune for the already unfortunate stockholders in the General Electric. They will lose not merely the connection with the Fort Wayne Company, but every other company that is worth anything. That a concern like General Electric, which paid dividends at the rate of 8 per cent. less than three months ago, should be reduced to staving off all payments as long as possible, and even letting indorsed notes go to protest, only paying them when they are pressed on indorsement, is a public scandal. It is the result of, vulgarly speaking, 'sloshing around' in business. The General Electric Company has made scores of times all sorts of unbusinesslike concessions to secure business from its competitors, and the inevitable results of crippled resources and a forcibly contracted circle of trade have followed."

General Electric.

What is Said of it Nowadays.

From the "Wall Street Daily News."

The fight that is going on inside the General Electric Company between the Boston interests, represented by the Thomson-Houston people and President Coffin, on the one hand, and the New York interests, represented by Drexel, Morgan & Co. and Director H. McKay Twombly, is reported to have now reached the acute stage, and to have precipitated the withdrawal from the combination of the Fort Wayne Electric Company, which is one of the largest of the subsidiary companies. In Wall Street the withdrawal is taken as expressing sympathy with the Boston people in the present fight with the New York people, and it is perhaps prompted further by the fact that during the financial difficulties of July and August the General Company refused to honor a draft made on them by the Fort Wayne Company for $15,000.

Must Stand on Its Own Bottom.

Official Press Agent's Statement.

As to rumors concerning the Fort Wayne Company, it is understood that although the General Electric and its friends own a controlling interest in the stock, the Fort Wayne Company must hereafter rely upon its own resources, which resources are believed to be sufficient for its maintenance without drawing upon the General Electric Company.

The Boston View is Not Our View.

From the "Boston Advertiser."

The public announcement by the G. E. people that hereafter Ft. Wayne must look out for itself may be regarded as a practical announcement that its dividends will be cut off. The company has been carried along by G. E. for a considerable time as a left-over from the old T. H. The burden has become too heavy and hereafter Ft. Wayne stockholders need not be over-surprised to see their shares going the way of Detroit Electric.

The Effect in Detroit.

From the "Detroit News."

If the Fort Wayne Company withdraws it will affect the Detroit city lighting plant. The Fort Wayne Company controls the use of the Brush and Thomson-Houston patents in Wayne County. With the withdrawal of the Fort Wayne people they will naturally begin fighting the Brush and Thomson-Houston people, who will remain in the Trust, and the Fort Wayne Company would forbid the lighting commission to use the Brush or Thomson-Houston apparatus.

Mr. Coffin's Reported Resignation.

From the "Mail and Express."

There was a private dispatch received from Boston to-day which said that although President Coffin has not resigned he admits that he entertains an idea of doing so.

Who Would "Amalgamate" With a Wreck ?

From the "Evening Post."

General Electric was advanced early on the purchase of a few hundred shares by a trader, but fell back when he attempted to sell. Reports are current that some interests favor amalgamating the concern with opposition companies in the hope that the announcement of a new deal would create a buying movement in the stock.

Rotary Mercurial Air Pump.

BY DR. F. SCHULZE-BERGE.*

Of the different types of mercurial air pumps which have been devised so far two have been introduced into practice on a large scale, viz., the Geissler and the Sprengel pumps. Both are represented in numerous modifications, and have undergone manifold improvements in the course of time. They produce vacua of the highest grade, but compared with the mechanical piston pumps both of them are under the disadvantage of working only very slowly, so that they do not appear fit for evacuating receivers of large volume.

On the other hand, even the most perfect of the mechanical air pumps are far behind the mercury pumps so far as the degree of the vacuum produced is concerned.

To combine the advantages of both systems my brother Hermann and I have together constructed the rotary air pump described below, which allows the creation of extensive vacua of excellent quality in a very short space of time.

PRINCIPLE OF THE ROTARY AIR PUMP.

We have carried out the apparatus in a number of different forms, all of which are based on the same principle.

The pump vessel is formed by a curved tube returning into itself, which revolves in constant direction around a stationary axis of rotation. A mercury piston passing through the interior of the tube creates on the one hand the vacuum and expels on the other hand the evacuated air, while the connections required by the pump vessel with the receiver and the atmosphere are effected by stopcocks or suitable valves.

Of the numerous modifications which may be given to the apparatus on this principle, some will be shortly explained in this report, whereupon a more detailed description will be given of the one which has proved to be the most serviceable for practical use.

RING-SHAPED STOPCOCK PUMP.

The play of the machine is particularly conspicuous in the stopcock pump, Figs. 1 and 2. The hollow ring P has a diameter of one meter or somewhat more, and an inner width of some centimeters. It is revolvable around the horizontal axis A, which is hollow and closed at one end, while the other end is airtightly introduced through the stuffing box S into the stationary tube R. To the latter tube is connected the receiver to be evacuated. Within the ring there is a quantity of mercury Q, sufficient to equilibrate the pressure of the atmosphere if this pressure acts upon only one of the shanks of the mercury.

A three-way stopcock H, similar to the well known Grassmann stopcock, is inserted into the circumference of the ring. The seat of the stopcock is connected to the hollow axle A by the tube r.

The stopcock occupies three different positions during the rotation of the ring. In the first one it allows free passage to the mercury, as in Fig. 1. In the second one it prevents any communication between the parts of the ring P and tube r on the atmosphere. In the third position it connects the end E_1 of the ring, with the atmosphere, and the end E_2 with tube r and the hollow axle A.

Let the ring be rotated in the direction of the arrow (Fig. 1) until all mercury has passed the cock, and then let the stopcock be given its second position separating the ring from tube r and the atmosphere. If after this the rotation of the ring is continued, the mercury column will follow the upward motion of the stopcock until the difference of its levels corresponds to the atmospheric pressure. If then the stopcock is moved into its third position, air will rush into the ring from the receiver through the axle. The same occurs when the rotation of the ring proceeds, while at the same time the air above level N_1 is expelled into the atmosphere. When the stopcock reaches the mercury level N_2, it is brought into its original position again, and the play of the pump is repeated similarly as described.

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* Read before the International Electrical Congress, Chicago.

STOPCOCK PUMP WITH SPIRAL-PUMP VESSEL.

In the apparatus just explained the mercury only partly fills the volume of the pump vessel P in which the vacuum is created, and only a moderate quantity of mercury is required. A vacuum of very much larger volume may however be produced with the same quantity of mercury.

Suppose the pump vessel not to be formed of a single ring, as described above, but to have the shape of a double spiral, as in Fig. 3, the two ends of the spiral tube being joined by the stopcock H. If then the spiral is supplied with the same quantity of mercury as the ring in Fig. 1 the whole volume of the spiral may be evacuated by a continued rotation. While the play of the machine is in all essential respects identical with the one of the apparatus Fig. 1, the vacuum produced may be given an extent arbitrary within wide limits without increasing the quantity of mercury required.

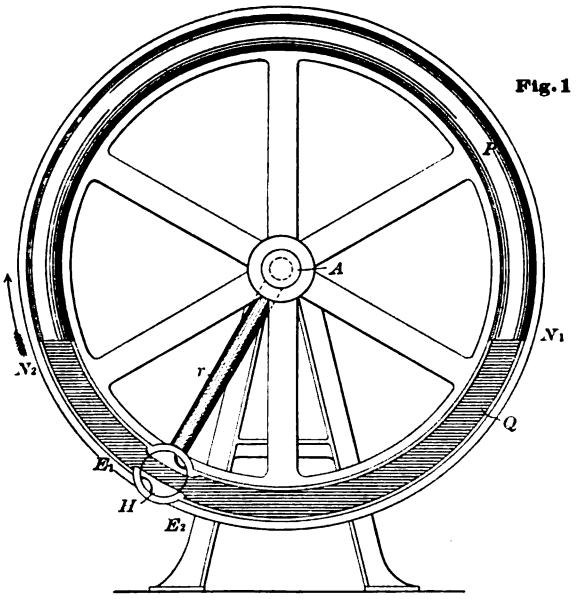


Fig. 1

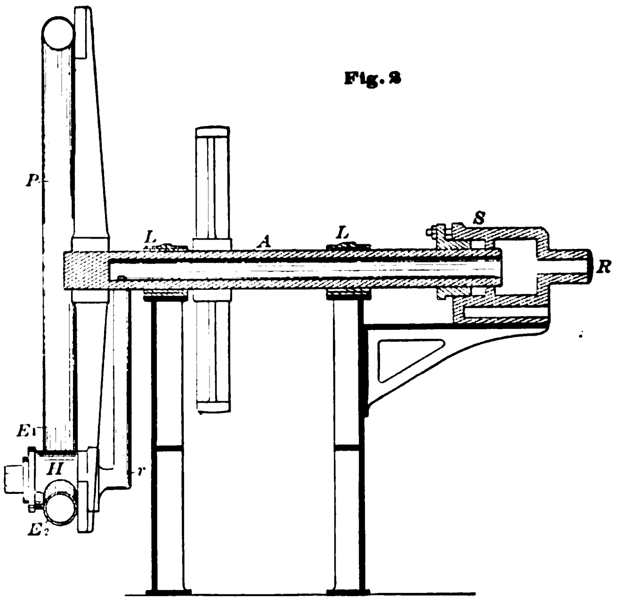


Fig. 2

RING-SHAPED VALVE PUMP.

The pump represented by Fig. 4 has, like the one in Fig. 1, a ring-like pump vessel on a horizontal axle. The apparatus is supposed to cooperate with an auxiliary pump (mechanical piston pump, water-jet air pump, etc.,) in such a way that the air exhausted from the receiver is not discharged by the ring into the atmosphere directly, but into a chamber in which a partial vacuum has been previously created by the auxiliary pump.

The place of the stopcock is here taken by the valve V, which is inserted into the circumference of the ring, and represents a spiral tube consisting of two convolutions. If the circumference of the ring be followed up in the direction of the hands of a watch it will be noticed that the convolutions of the spiral run from E_2 in the opposite direction until they return at E_1, into the ring P.

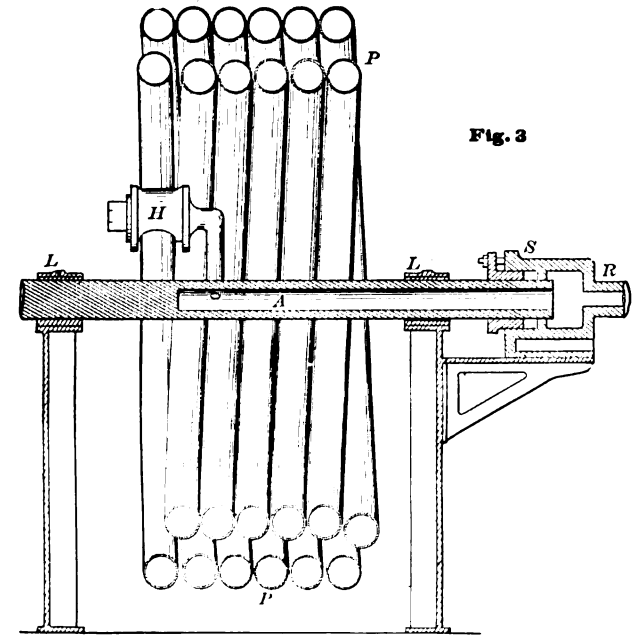


Fig. 3

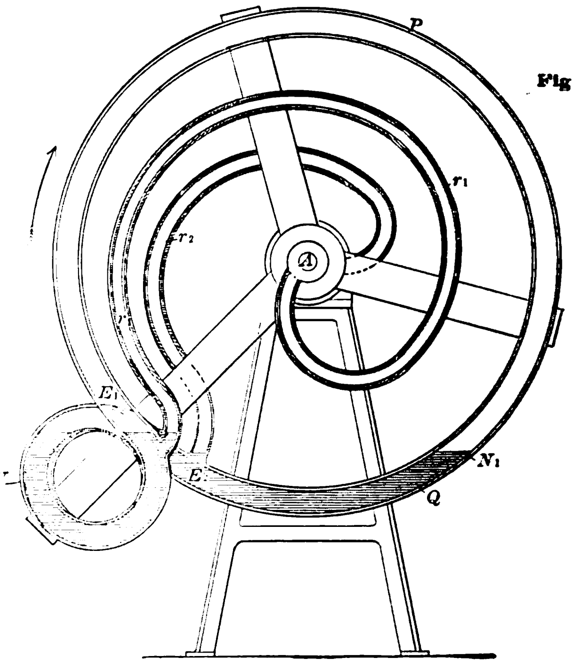


Fig. 4

The axle which in Fig. 4 is only shown in cross section projects as well in the front as in the back of the plane of the ring. It is hollow, and divided into two compartments by a vertical diaphragm in its middle.

Each end of the axle is connected airtightly through a stuffing box with a stationary tube in the same manner as the open end of the axle A in Fig. 2 is connected to R. The one in front of the ring leads to the auxiliary air pump, while the tube on the opposite side is connected to the receiver.

At E_2 the tube r_2 branches off from ring P and communicates with the receiver through the axial compartment situated at the back of the plane of the ring, while another tube r, starting from E_1, is connected to the auxiliary pump through the other compartments of the axle.

The spiral valve and a part of the ring are filled with mercury.

If the ring is rotated in the direction of the arrow, the air above it, level N_2, is expelled through r into the preliminary vacuum, whence it is removed by the auxiliary air pump. At the same time air is drawn from the receiver through tube r_2. This is repeated at each revolution of the ring.

The vacuum in the receiver is permanently separated from the one existing in the auxiliary air pump by the mercury contained in the spiral tube, provided that in the latter vacuum the pressure be kept so low that the difference of pressure of both vacua is equilibrated by the mercury of the valve. During every revolution a part of this mercury runs out into the tube r_1, but returns into the ring during the progress of the rotation. The width of r_1 therefore must be selected so great that the mercury running out of V never can fill the full cross section of this tube.

DOUBLE RING PUMP.

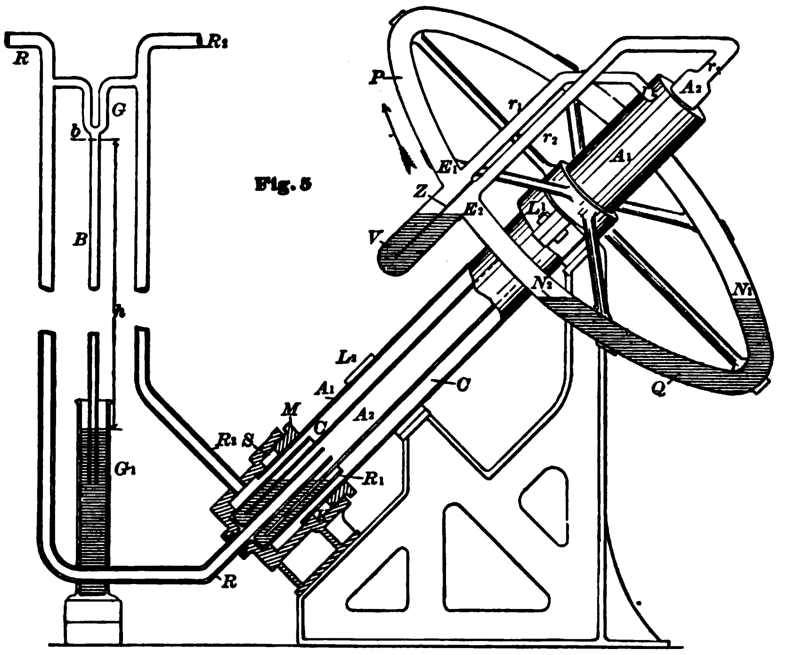
The greatest difficulty met with in the production of high vacua by rotary air pumps is caused by the necessity of establishing an absolutely and permanently air-tight joint between the rotary and the stationary parts of the pump. Without doubt this is the principal reason why the practical development and application of rotary pumps has not been carried out so far. It is impossible to create and maintain a high vacuum according to the notions of this day without a connection warranting perfect air-tightness between the receiver and the rotary parts of the apparatus. If, on the other hand, the receiver were to be rigidly connected with the pump, it would have to participate in the rotation of the latter, which only in rare cases would be practicable and recommendable.

While it is perfectly feasible to attain in the pumps described above the absolute air-tightness of the axle required, still we did not succeed so far in finding as simple a solution of the problem in those cases as the one embodied in the description of the apparatus illustrated by the Figures 5 and 6. This pump is distinguished by its easy manipulation, quickness of work and reliability of action, and appears equally adapted for laboratory work as for industrial purposes.

Also this apparatus is supposed to co-operate with an auxiliary pump which is used to create a moderate preliminary vacuum.

To facilitate the general view of the instrument, only one of the two ring-shaped pump vessels is shown in Fig. 5.

First, the arrangement of the axle is to be considered. It consists of the two concentric tubes A_1 and A_2. The larger tube, A_1, is mounted rotatably in the bearings L_1 and L_2, has an inclination of 40°, and projects with the lower end into the stationary stuffing-box, S. Through the bottom of S a tube, R, is introduced airtightly. The same is surrounded by the wider tube, R_1, as by a bell the mouth of which is turned upwards. The intermediate space be-



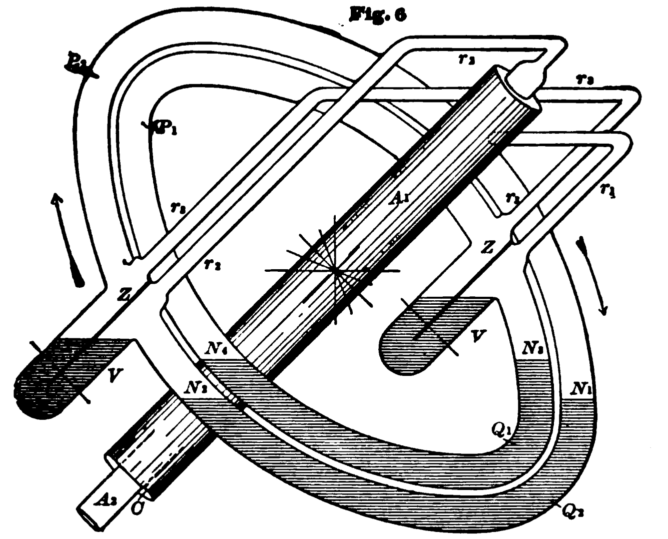
tween R and R_1 is provided with mercury. Into this space dips the inner axle tube, A_2, which passes air-tightly through the closed upper end of tube A_1, and rotates simultaneously with this tube. The tube R is to be connected with the receiver tube, R_2, with the auxiliary pump. These two tubes are connected by the forked tube G, which is so arranged that, after the vacuum is created, mercury may be introduced into the fork or withdrawn from the same by raising or lowering vessel, G_1.

The ring-like pump vessel, P, is fastened to the axle by six radial arms, and has an inclination of 45°. Into the circumference of the ring the valve, V, is inserted. It consists essentially of a cylindrical vessel closed at the bottom and parallel to the axis of rotation, which vessel is divided into two compartments by a tongue, Z, reaching nearly to the bottom of the valve. One of these compartments is connected to the middle tube, A_2, of the axle by tube r_2, while the second compartment communicates with the hollow space, C, contained between the walls of A_1 and A_2.

The valve, V, and about one-third of the circumference of the ring are filled with mercury, as illustrated in Fig. 5. If the ring is rotated in the direction of the arrow, the air contained above the mercury level, N_1, is expelled through tube r_1 and the channel C to tube R_2. At the same time air is drawn in the rear of level, N_2, through tubes r_2, A_2 and R into the pump vessel.

Let the receiver now be connected to R, and the ring vessel be placed into the position shown in Fig. 5, so that tube r_1 may freely communicate with the interior of the ring. Then the auxiliary pump is worked and the interior of the receiver and of the ring pump evacuated to such a degree as the auxiliary pump may be able to produce, say, for instance, to 10 millimeters of mercury pressure.

During this time the mercury rises up in the barometric tube, B, say to point b. Now vessel G_1 is raised so as to make the mercury enter the fork, G, thus interrupting the communication between R and R_2.



The level of the mercury contained between R_2 and R has not been changed by the preliminary evacuation, since so far the same pressure is acting within A_2 as in C.

If now the ring be rotated, air is drawn by the action of the mercury piston explained above, from the receiver into the ring through R, A_2 and r_2. On the other hand the air contained in the ring above N_1 is expelled towards the auxiliary pump through r_1, C and R_2, while the mercury contained in V permanently prevents a direct communication between the ends E_1 and E_2 of the ring.

The auxiliary pump now is only worked to the extent required for removing the air discharged from the ring, and to maintain in R_2 and the parts connecting with this tube the pressure originally created therein.

With each revolution of the ring the pressure decreases in A_2, while between A_2 and A_1 it remains essentially constant. Therefore the level of the mercury contained between A_2 and R will rise, while the level of the mercury between A_2 and R_1 must sink. The difference in level thus produced cannot become greater than the one corresponding to the difference of pressure between the preliminary vacuum created by the auxiliary pump and an absolute vacuum, i. e., not greater than 10 millimeters in the present case.

Of course the difference of pressure between the preliminary and the final vacuum is also manifested in the shanks of fork G, thus permitting the observer to watch the progress of the evacuation until the increase of the difference in level becomes inappreciable. For further observation a McLeod gauge is connected to R. We have used a modification of the same, shown in Fig. 9. The end of tube T connects with R. Raising and lowering the mercury in D is effected by the corresponding increase and decrease of air pressure in I. For that purpose the tube F is connected by a rubber tube to the auxiliary pump. A drying tube inserted into the rubber tube keeps the air in I free from moisture.

The stuffing box S only serves to protect the preliminary vacuum against access of atmospheric pressure so far as required. The purpose is attained by a number of greased leather washers K inserted into the stuffing box which can be compressed by the nut-screw M.

The separation of the final vacuum from the preliminary one is effected by the mercury contained between R_1 and R, and is accomplished thereby in a highly satisfactory manner. Even with the highest vacua attainable the seal proves absolutely reliable.

A seal based on the same principle may be used instead of the stuffing box S to separate the preliminary vacuum from the atmosphere. We have carried out this arrangement in several machines. It requires a somewhat greater length of the axle, but does away with the necessity of paying attention to a stuffing box, as in Fig. 5.

The pump which we found to be the best among the various apparatus constructed differs from the one represented by Fig. 5 in one point only, which, however, is of great practical importance. Instead of the single pump vessel, P, it contains two of them, viz., the concentric rings P_1 and P_2 (Fig. 6). They are so arranged that the air evacuated from the receiver during the rotation must pass through both rings in succession. First it enters through r_2 into the ring P_2 and is expelled during the next revolution by the piston Q_2 to r_3. Thus it enters the ring P_1 from which, during the following revolution, it is removed by piston Q_1 to r_2. Thence it is drawn off by the auxiliary pump in the same manner as in Fig. 5.

The vacuum created in P_1 in the rear of N_4 improves with each revolution. The consequence is that after the pump has been running for a short time the air withdrawn from the receiver by P_2 is discharged into a space already highly evacuated, viz., into the vacuum of ring P_1. The whole volume of ring P_2 and the mercury contained therein will therefore come into contact only with air of high rarefaction, which circumstance is of great importance if extreme evacuation is aimed at.

The pump does not require any manipulation except a single rotation. It therefore can be easily run by machinery. For that purpose there is space provided on the axle for a pulley, and for rotating the apparatus by hand wooden handles are used, forming prolongations of the six spokes of the frame.

By this pump vacua of so high a degree as to escape close measurement by the McLeod gauge have often been created. For that purpose of course it is necessary to provide for the absolute dryness of the mercury and of all parts of the pump and the receiver.

Fig. 7

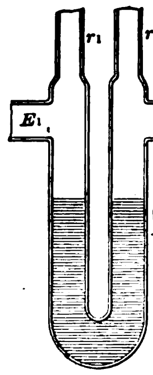


Fig. 9

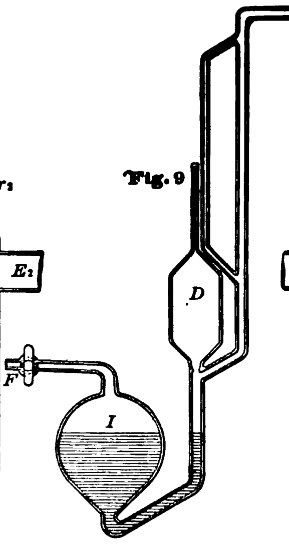
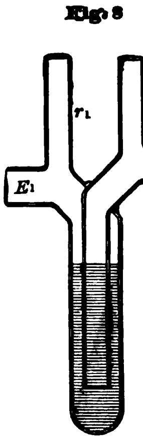


Fig. 8



As drying material in producing high evacuation we have used metallic sodium with good success. It eagerly absorbs humidity, and while giving off hydrogen is covered with a layer of caustic soda. As the latter is highly hygroscopical, it adds efficiently to the drying action of the metal.

The vessel containing the sodium was, as a rule, connected to the rest of the system by a tube susceptible of being closed by a mercury seal.

A pump of the kind described in which the outer ring had a diameter of 60 centimeters and a capacity of 0.9 liter, permitted 15 revolutions per minute when rotated by hand. At present a larger machine for industrial purposes is in course of construction, in which the volume of the outer ring amounts to 8.5 liter.

In conclusion I wish to remark that besides the apparatus described quite a number of different modifications of the pump have been worked out, every one having its peculiar merits or advantages.

I do not hesitate to say that although more than a hundred years have elapsed since the construction of the first mercury pump, still I think that we are far from having fully realized the possibilities of perfection contained in this apparatus, and that we may expect valuable fruit from further work in this line, especially on account of the close connection of modern electrical research with the nature of high vacua.

American Street Railway Association Convention.

The twelfth regular annual meeting of the American Street-Railway Association will be held in the Hall of the Exposition Building, Milwaukee, Wis., the third Wednesday in October (the 18th), 1893.

Special committees will report on the following subjects: "Best Method of Lighting and Heating Street-Railway Cars," "Can the T Rail be Satisfactorily Used in Paved Streets?" "Direct Driven Generators," "Power-House Engines," "Standard Form for Street-Railway Accounts," "Standards for Electric Street-Railways," and "Storage Batteries in Connection with Central Stations for Utilizing Surplus Energy for Lighting or Power." Notice has been received by the secretary that a special paper will be read on the following subject: "Some Practical Points in the Construction of Underground Feeders."

The Executive Committee has secured the Milwaukee Industrial Exposition Building for the exhibition of supplies and manufactures of every nature used in the street-railway business. It has been engaged for two entire weeks, beginning October 9 and ending October 23, thereby giving ample time for the setting up and removal of the largest and heaviest exhibits. The hall for the meeting is also in the same building, on the second floor, and delegates will therefore be enabled to examine the exhibits with much greater satisfaction than heretofore. The exposition will be in charge of the secretary, assisted by Mr. A. Trumpff, secretary of the Milwaukee Industrial Exposition Association.

Death of a Western Union Superintendent.

Charles O. Rowe, superintendent at Pittsburg of the Western Union Telegraph Company, died on the 12th inst. at Titusville, Pa. He was born at Harper's Ferry, September 10, 1840. He was appointed Superintendent of the Eighth District in 1884. It includes Western Pennsylvania, Eastern Ohio, West Virginia and Maryland. Deceased leaves a widow and four children.

Legal Notes.

Several citizens of Manchester, N. H., have entered suit against the city for the purpose of breaking the contract between the city and the Manchester Electric Light Company. In May last the city and the electric light company threw up the then existing three years contract between them and made a new one for a period of ten years. By the new contract the city reduced the price paid for light from $137 to $115 per annum, and secured other concessions. The petitioners claim that ten years is too long a time for which to make a contract, and deny the city its right so to do.

The State Electric Light Company has petitioned the Supreme Court of Kings County for an order permitting the company to carry on its business in the city of Brooklyn. The petition specifies that contracts have been made which cannot be fulfilled; that consents to furnish lights, etc., have been secured, but that the company is unable to do business by reason of the laxity of the Board of Aldermen and of the committees to which the applications have been referred.

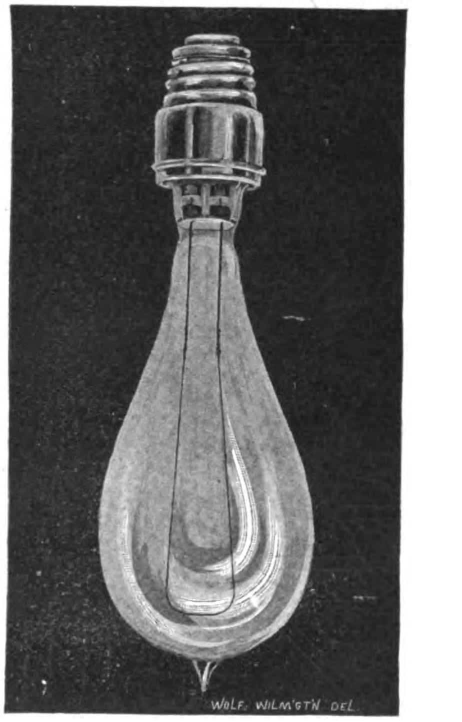
The "Maggie Murphy" Lamp.

Philadelphia's Aspirant for Popular Favor.

The accompanying cut is the fac-simile of the new "Maggie Murphy" lamp, which has just been brought before the public by the Pennsylvania Electric Engineering Company, Penn Mutual Building, Philadelphia.

The construction of the lamp, as shown by the illustrated cut, consists of a receiver made partly of glass and partly of cement. The cement is placed in the neck of the bulb, through which the leading-in wires pass. It was found in making the experiment with this cement that it was very difficult to overcome the softening of same, caused by the heat from the leading-in wires, two on each one, the same being insulated from each other by means of two mica plates, one above and one below. These discs radiate the heat from the leading-in wires to such an extent that disintegration of the cement stopper is impossible, and it is claimed the lamp is thus rendered the coolest burning lamp on the market.

The "Maggie Murphy" lamp is not identically the same lamp as was previously manufactured by this company, and does not infringe on the Edison patent, the special claims of which that were sustained being the combination of carbon, filamentary or threadlike in size and properly carbonized, used as an illuminant in an incandescent electric lamp, with the receiver made entirely of glass and the conductors passing through the glass, and from which receiver the air has been exhausted to such an extent that disintegration of the carbon, due to the air washing action of surrounding gases or to any other cause, is so far reduced as to leave the carbon practically stable.


WOLF. WILM'GTN DEL.

THE "MAGGIE MURPHY" LAMP.

In the "Maggie Murphy" lamp the receiver is not made entirely of glass, and the conductors do not pass through the glass. It is obvious, therefore, to anyone understanding what a patent means, that this new lamp does not infringe nor is it tributary to the Edison patent.

The appearance of a non-infringing lamp is a just cause for congratulation at this time, and the Pennsylvania Electric Engineering Company will have the best wishes of the entire trade.

Whatever the stagnation in general business, incandescent lamps must be bought, and it is a pleasure to announce further and effective opposition to the well-nigh established monopoly of the Electric Trust in this field.

Boston Notes.

The sudden death of Mr. F. L. Ames, Boston's wealthiest citizen, on board the Fall River steamer "Pilgrim" Tuesday night, caused somewhat of a flutter on the Boston Stock Exchange as soon as the news was known. Mr. Ames was a large holder of General Electric stock, and one of the heaviest underwriters in the new deal recently made with the Trust by the Traction and Illuminating Company. The stock sagged a point or two, as it was thought that his vast and varied holdings might, by the death of Mr. Ames, be divided up a good deal among the members of his family, but when it became known that such was not likely to be the flurry ceased. For a long time Mr. Ames's connection with the General Electric Company was a tower of strength to the moribund Trust, for not only was he at all times ready and willing to aid the directors when they found themselves in a tight place for ready money, by advancing it to them, but his splendid credit enabled the Trust managers to "raise the wind" at times when, but for the Ames credit, disaster, which has at last overtaken them, would have come upon them long ago.

For some time past the electric rail-welder built by the Thomson Electric Welding Company has been doing very satisfactory work on the tracks of the West End Railroad Company. Difficulties, however, have been encountered in the use of this machine, and it has been returned to the factory where it was built. It has been found that after being welded the rails break, not where they have been welded, but at other points, and this it is believed is the result of contraction. It is thought the difficulty will be overcome.

The Rockland and Abington Electric Railroad Company, which has become quite famous of late through its sanguinary conflicts with and victory over the Old Colony Railroad Company, is meeting with so great success that it has determined to double its capital and make it $120,000 so as to enable it to extend its system to South Weymouth. Thence it proposes to build to East Weymouth, and later it may push along to Hingham and beyond, to Nantasket Beach, Boston's most popular marine resort. There is a brisk demand for stock.

The handsome volume published under the title of "Armington & Sims Engine Company Catalogue, No. XVIII," is a work that every mechanical engineer ought to have in his possession and carefully study. As a book it is a work of art, being embellished with drawings of engines and separate parts superior to any we have ever seen before, while every page is replete with valuable data. Cuts are furnished of every type of engine designed and manufactured by this well-known firm. There is scarcely a use to which steam power is applicable but the Armington & Sims Co. have a special type of engine for. For electric light and power work these engines—single or double—have no superior and are in use in every part of the world. The makers claim for them the following advantages: extreme simplicity, the entire absence of parts requiring frequent adjustment, great regularity of speed, small cost, especially for the greater powers, small space required for engine and fly-wheel, a compact form and consequent rigidity in stationary and moving parts unattainable in engines of long stroke, the employment of short and nearly parallel belts in place of long converging ones, the avoidance of intermediate gearing to produce the speed required, the great saving in room, building and foundations. The large numbers of these engines now in use, both horizontal and vertical, the latter type being specially popular for running dynamos on shipboard, coupled with the extensive business now doing by the company is unmistakable evidence that the foregoing advantages are fully appreciated by users of steam engines the world over.

It is reported that the number of employees at the General Electric Company's factories in Lynn is being gradually increased, and that many of those who were laid off a few weeks ago are being notified to return to work. This will be welcome news to the work people themselves, many of whom have been reduced to great straits during the time they have been idle. Indications warrant the belief, however, that it will be a long time ere the factories are running full blast again, those now controlling the management of the Trust having determined that there shall be no more of the wildcat transactions such as were engaged in by the late management — transactions which largely brought about the present chaotic condition of the company's affairs.

It is a source of satisfaction to be able to report a gradual return of confidence in New England electrical circles and a better showing of business all round. Still trade is nothing like what it ought to be, and as we feel sure it soon will be, but after the serious depression of the last few weeks to be able to report any improvement whatever is a subject for congratulation.

The new electric power station that is being built by the Quincy and Boston Street Railroad Company at Quincy Point is now well under way. This company is one of the most prosperous outside of Boston. Since the introduction of electric light and railway, the quiet, conservative, sleepy, historic town of Quincy has taken on a new lease of existence.

Many of the Connecticut electric manufacturing companies are increasing their staff of men and running full time again.

At a recent meeting of stockholders in the Electric Gas Lighting Company of this city, Mr. W. W. Burnham, who for some time past has been assistant manager of that prosperous company, was appointed general manager in succession to his esteemed father, the late Mr. L. W. Burnham, who had by his untiring energy and push placed the firm in the very forefront of that class of trade. Mr. Burnham knows the business so thoroughly at home, and is so intimately acquainted with customers all over the country, that the same confidence will be felt by all in continuing their business relations with the company as heretofore. The same high grade goods only will continue to be manufactured and dealt in.

General News.

What is Going on in the Electrical World.

Staten Island.—Subscriptions are being solicited to defray the expense of extending the Prohibition Park electric road to Castleton Corners.

Los Angeles, Cal.—Bids for the franchise for an electric road between Los Angeles and Pasadena will be received by the Board of Supervisors up to October 4.

Detroit, Mich.—The Standard Electric Company of this city has just completed a storage battery system for F. W. Humphrey, clothier, of St. Louis, Mo., at a cost of $3,000.

Akron, Ohio.—R. J. Randolph, representing the Thomson-Houston interests, has been granted a franchise to construct a street railroad in this city and out to Cuyahoga Falls.

Lead, S. D.—The electric light plant of this city has been purchased by the Hulst & Price Lumber Company, who are already at work enlarging it to a considerable extent.

Utica, N. Y.—Extensive repairs are being made by the Central New York Telephone and Telegraph Company in the central office in this city with a view to bettering the service.

Meridian, Miss.—The directors of the Edison Electric Light and Power Company and those of the Meridian Street Railway Company have agreed to a consolidation of the two companies.

Rochester, Minn.—The council has definitely settled the contract for having electric lights here by approving the $5,000 bond of the Western Electric Company, which has the contract for the work.

Brooklyn, N. Y.—The Committee on County Farm has been authorized by the Board of Supervisors to advertise for proposals for the erection of electric light and kitchen fixtures for the four new buildings at Kings Park.

Fort Wayne.—The works of the Fort Wayne Electric Company, which have been closed for two weeks for repairs to machinery and buildings, have resumed operations with a full complement of workmen. The works employ 400 men

Philadelphia — The Hestonville Passenger Railway Company, who control twenty miles of track, are making arrangements to trolley their system and will begin work this month. About $500,000 will be needed to finish the work.

Pawtucket, R. I.—The Pawtucket Gas and Electric Lighting Company has closed a contract with the Union Railroad Company to furnish power for the operation of the electric car lines on Garden and Main streets between this city and Providence.

Sandusky, Ohio.—Indications point now to the speedy operation of the Sandusky, Huron and Milan Electric Road. At meetings of the stock and bond holders held lately, strong arguments were used and resolutions adopted in favor of the new enterprise.

Lynchburg, Va.—Conferences have been held lately between President Moon, of the Lynchburg Electric Company, and President Pettijohn, of the Rivermont Company, in regard to street railway extension in the city, and particularly to improving the transit facilities to Diamond Hill.

Manchester, Conn.—It is understood here that the Mather Electric Company, who have an extensive plant at North Manchester, will be able to compromise with their creditors, and that the works will be started up as soon as the demand for the goods will necessitate a resumption of work.

Baltimore. — The City Passenger Railway Company has awarded the contract for eight boilers for the equipment of the new electric power house on Light street to the Campbell-Zell Company. The contracts for the engines had previously been awarded to the Allis Company of Milwaukee.

Cincinnati.—President Kilgour, of the consolidated electric lines, has established a school for the instruction of applicants for employment on the lines in the mysteries of electricity, touching the various appliances on electric cars, how to use the machinery, and the best method of procedure in perplexing circumstances to avoid accidents.

Syracuse, N. Y.—Following the Salina street line, the Wolf street line will be the next to change its motive power to electricity. Other lines will be equipped as soon as the company can make arrangements for the work.—The Syracuse Railroad Company has lately mortgaged its property to the State Trust Company of New York for $2,500,000.

Millville, N. J.—The Millville Rapid Transit Company has succeeded in obtaining consent of council to construct a trolley road in this city. The road will be part of the system connecting Millville and Bridgeton, of which George Wood, president of the Millville Manufacturing Company, is the principal owner.

Newark, N. J.—The dispute between the Consolidated Traction Company and the Delaware, Lackawanna and Western Railroad Company as to the right of the traction company to string wires across the D. L. and W.'s tracks at Clinton avenue has been decided in court in favor of the traction company.

St John, N. B.—Col. W. S. Rogers, of Cleveland, Ohio, special agent of the Brush Electric Company, was in this city a few days ago. It is the intention of the company to locate a branch of their business somewhere in Canada, and Col. Rogers is to select a site. He will visit several other cities before making any arrangements.

Gloversville, N. Y.—The directors of the Gloversville Electric Company have elected the following officers: President, James Radford; vice-president, John Marsh; secretary, Edgar A. Spencer; corresponding secretary, Paul T. Brady; treasurer, Lee B. Crittenden; superintendent and manager, John Begley.

Cleveland, Ohio. — The Cleveland Electric Railway Company has filed a deed of trust in favor of the Central Trust Company of New York, including its 92½ miles of railway track, its buildings, etc. The mortgage is to secure the issuing of $1,900,000 of the $3,500,000 bonds authorized at a meeting of stock holders on August 31.

Ansonia, Conn.—The *Sentinel* says: "The resumption of work at Wallace & Sons lightens the feeling of depression which had fallen upon Ansonia. There is every probability that at the former shop the few departments yet idle will soon be started up again, and within a month or two at the most a greater activity will be brought back to us once more."

St. Louis.—The Belleville and St. Louis Railroad Company has brought suit in the Circuit Court, in the nature of a vender's lien, against the Belleville City Railroad Company for $80,484.88.—The General Electric Railway Company of Chicago will commence in October the laying of a double track electric railway in Belleville, and expect to have it completed and in operation by spring.

Hoboken, N. J.—The Paterson, Rutherford, Jersey City and Hoboken Electric Railroad is expected to be in operation by New Year's Day. Manager Debevoise of the North Hudson Elevated Railroad has, it is said, accepted a similar position on the new road. The Crimins syndicate will in all probability purchase the entire North Hudson system.

Trenton, N. J.—The Associated Electric Company of New Jersey at its last meeting declared a dividend of 2 per cent. on the paid up stock on the six months' earnings of the district telegraph service. J. Wallace Hoff, the present secretary and treasurer, was elected secretary and general manager, and Harry G. White, of the Trenton Light and Power Company, was made superintendent and treasurer, to look after the company's local interests.

Camden, N. J.—The trestle on the Timber Creek section of the Camden, Gloucester and Woodbury Electric Railway is 3,400 feet long, and is said to be the largest of the kind used by any electric railway in the world. The initial trip over the road was made a few days ago, and was enjoyed by a number of prominent men interested in the road and several Woodbury officials. The line is finished to Fancy Hill, within a few miles of Woodbury, where it is proposed to establish a beautiful pleasure resort.

Buffalo, N. Y.—The F. P. Little Electrical Supply and Construction Company of this city has been awarded the contract for enlarging the electric light plant of the St. Lawrence State Hospital at Ogdensburg. The contract amounts to about $13,000.—At a late meeting of the stockholders of the Buffalo, Kenmore and Tonawanda Electric Railroad Company, D. F. Calal an was elected president, Norman E. Mack vice-president, and John L. Donovan secretary. It was reported that the road would soon be finished and in operation.

Lawrence, Mass.—The aldermen have been discussing the question of installing a municipal lighting plant in Lawrence, and have turned the matter over to a special committee, including the mayor. At the last meeting of this committee the mayor read reports from various cities and towns throughout the country where municipal lighting plants have been established. The results in several places were unsatisfactory, and in others it was shown that a municipal plant was an expensive luxury. There were places, however, where municipal plants had proven a success and the citizens were enjoying the benefits of excellent service at low rates.

Albany, N. Y.—The day fixed for closing the filing of applications for experimenting in electrical propulsion on the canals (Sept. 8) has been extended to October 1. The promoters of the "Geer" device, the idea of a Rochester man, have applied for half of the $10,000 appropriation made by the Legislature, to be given to the inventor of this device, to enable him to give a public exhibition of it, and as there is a doubt as to the proper distribution of the appropriation, the Superintendent has determined to lay the matter before the Attorney-General for his decision.

New Haven, Conn.—The New Haven Street Railway Company has secured control of the State Street and Morris Cove Railroads, in pusuance of its purpose to consolidate the local street railway systems. The Saltonstall road, to be built next summer, is included in the scheme. All the roads will be electrically operated. The officers of the New Haven Company are: President, David Corey, of New Haven; vice-president, Charles A. Warren, of New Haven; secretary, treasurer and general manager, G. A. W. Dodge, of New Haven; directors, in addition to those named, Thomas Krutz, of New York; Thomas M. Waller, of New London; S. Harrison Wagner, James J. Lawton, William J. Atwater and Eli Whitney, Jr., of New Haven.

The Milwaukee Convention.

The exhibit of apparatus at the twelfth annual exposition of the American Street Railway Association at Milwaukee in October bids fair to surpass that at Cleveland last year. Thus far space has been secured by the following exhibitors :

- Standard Railway Supply Company, Chicago, Ill.
- American Fluoride Company, New York, N. Y.
- Baltimore Car Wheel Company, Baltimore. Md.
- New Process Raw Hide Company, Syracuse, N. Y.
- Dorner & Dutton, Cleveland, O.
- Short Electric Railway Company, Cleveland, O.
- Sperry Electric Railway Company, New York, N. Y.
- General Electric Company, New York, N. Y.
- Wadhame Oil and Grease Company, Milwaukee, Wis.
- Fitzgerald-Van Dorn Company, Lincoln, Neb
- Peckham Motor, Truck and Wheel Company, Kingston, N. Y.
- Eureka Tempered Copper Company, North East, Pa.
- Fulton Foundry Company, Cleveland, O.
- Steel Motor Company, Cleveland, O.
- Automatic Car Brake Company, Grand Rapids, Mich.
- J. G. Brill Company, Philadelphia, Pa.
- Siemens & Halske, Chicago, Ill.
- Stanwood Manufacturing Company, Chicago, Ill.
- Rochester Car Wheel Company, Rochester, N. Y.
- National Electric Manufacturing Company, Eau Claire, Wis.
- E. F. de Witt and Company, Lansingburgh, N. Y.
- Meaker Manufacturing Company, Chicago, Ill.
- Graham Equipment Company, Boston, Mass.
- Jewell Belting Company, Hartford, Conn.
- Sterling Supply Company, New York, N. Y.
- Time Transfer Printer Manufacturing Company, Pittsburg, Pa.
- International Register Company, Chicago, Ill.
- St. Louis Car Company, St. Louis, Mo.
- Lewis & Fowler Manufacturing Company.

The Western Electrical Supply Company of Omaha.

The Western Electrical Supply Company of Omaha, Neb., is a new concern which purchased the entire assets of the Western Electrical Supply Company, an Illinois incorporation, formerly doing business in Omaha. The officers are as follows : President, W. H. McKinlock ; secretary, John T. Burke ; treasurer, George W. Johnston. W. H. McKinlock was instrumental in the formation of the Central Electric Company of Chicago, and has been for years long and favorably known in the electrical fraternity. John T. Burke, the secretary, was very closely identified with the telephone interests in the early days. He was for eleven years with the Nebraska Telephone Company, and during that time had a very wide and diversified experience in this branch of the electrical work. Since that time for five years he was superintendent of construction for the old Midland Electric Company of Omaha, and in that capacity installed many of the central stations and isolated plants erected in that section of the country. For the past three years Mr. Burke has been an electrical engineer and contractor, with offices in Omaha, and has completed some very large contracts for the complete installation of electrical plants, and also for electric wiring. G. W. Johnston, treasurer of the company, has had a wide experience in the electrical supply business. He was one of the founders of the Gate City Electric Company of Kansas City, Mo., and held the position of secretary and treasurer of that company for several years, after which he accepted the position of general traveling representative of the Central Electric Company of Chicago. The Western Electrical Supply Company of Omaha is the Western agent for many well known electrical specialties, including the International Okonite Company, Interior Conduit and Insulation Company, Eddy Electric Manufacturing Company, American Electrical Manufacturing Company, Burke automatic lightning arresters, Hart switches and Meston alternating fan motors. The company is receiving orders from the South and East, and is constantly receiving orders from the far West, and it recently shipped an entire installation, including engine, dynamo, necessary wire, lamps, sockets, etc., to Chihuahua, Mexico. The company is very strong financially, and with the stockholders as active managers it is bound to succeed. It is always upon the lookout for new specialties, and is always glad to contract for anything of merit.

COMMERCIAL PARAGRAPHS.

The Model Dynamo-Motor made by the Elbridge Electrical Manufacturing Company, Elbridge, N. Y., is a very ingenious machine, and is specially adapted to the use of students and other experimenters. The price is moderate, and it ought to be a good line for any supply house to handle.

Whenever you see a switchboard which is really a work of art, the probabilities are that the marble came from the quarries of Mr. Edward Bonville at Fair Haven, Vt. He is the leader in this branch of the trade.

The United Electric Improvement Company of Philadelphia, who have been working for some time on new types of apparatus, will soon be ready to make announcements of interest to every one in the trade.

The Columbia Lamp Company of St. Louis, although running their factory night and day, are away behind with their orders and are building an addition to their factory which will double their capacity.

Many of the former users of the original Sunbeam lamp have availed themselves of the present opportunity to lay in a stock for the season. Both the old Sunbeam and the new Sunbeam lamps are now on sale.

Messrs. Palmer Bros., Mianus, Conn., whose fan motors are so well spoken of, make a specialty of motor attachments for sewing machines, etc.

The Riehle Bros. Testing Machine Company, of Philadelphia, have issued their Catalogue No. 8 in two volumes, which is a very good idea. The list of customers who are using these testing machines is a formidable one, and is proof positive of their reliability.

The Washington Carbon Company, of Pittsburg, which makes a specialty of motor brushes, reports a decided picking up in this branch of the business.

The Campbell & Zell Company of Baltimore report that they have closed within the past thirty days the following contracts for the Zell Improved Water Tube Safety Boilers, aggregating over 5,000 horse-power : The Illinois State Penitentiary, Joliet, Ill., 1.212 H. P.; the Illinois State Reformatory, Pontiac, Ill.; 600 H. P.; the new Stock Exchange, Chicago, 1,000 H. P.; the Bureau of Engraving and Printing at Washington, 516 H. P.; the Baltimore City Passenger Railway Company, 2,000 H. P.; and the Consolidated Gas Company, Baltimore, 250 H. P.

The Railway Equipment Company.

The Worcester (Mass.) Consolidated Street Railway Company, being equipped entirely with the type "G" and other material manufactured by the Railway Equipment Company, Chicago, writes to the latter company as follows:

Worcester, Sept. 3, 1893.

W. R. MASON, ESQ., General Manager,
Railway Equipment Co., Pullman Bldg., Chicago.

Dear Sir : We have about completed our overhead work and it ought to be a big advertisement for your company, as we have the most perfectly equipped road in the country. Every part is *first class.*

Truly,
JNO. N. AKARMAN,
General Manager Worcester Consolidated St. Ry. Co.

INCORPORATIONS.

The Bronx Gas and Electric Company, Westchester, N. Y.—to manufacture and sell gas and electricity for lighting purposes. Capital stock, $500,000. Promoters : Chas. H. Usher and James McGee, Brooklyn, N. Y.; Elias W. Taylor, Unionville, L. I.

The Elliott Electric Company of Cleveland, Ohio, has changed its name and will hereafter be known as the Elliott-Lincoln Electric Company. The capital stock of the company has been increased from $40,000 to $75,000.

In the U. S. Senate last week Mr. Cullom introduced a bill to incorporate the Washington Central Railway Company and to authorize them to use any motive power upon their line except steam. This authorizes the use of the trolley. The incorporators of the proposed road are M. I. Weller, T. H. N. McPherson, S. S. Yoder, Nathaniel McKay, John H. Knight, H. H. Rand, T. M. Ferrell and George W. Boyd.

The Universal Electric Pull Socket and Switch Company of New York City. Capital stock, $20,000. Directors : John M. Wellbrook, of Brooklyn : Louis Stirn and Maurice Sonborn, of New York City.

The Augusta Electric Company, Jersey City, N. J.—to build and maintain plant or plants for electric lighting, heat or power. Capital stock, $25,000. Promoters : F. B. Poor and L. C. Harris, Hackensack, N. J.; A. L. Furnald, Brooklyn, N. Y.

A charter has been filed with the Secretary of State, Kansas, for an electric railway, to run from Junction City to Fort Riley, the capital stock being $100,000. The directors are ex-Senator John K. Wright and A. L. Barnes, of Junction City, J. S. Gibson, E. S. McAnany and D. H. Irwin, of Kansas City, Kan. The same parties filed another charter for the Junction City Electric Light, Power and Milling Company.

The Cumberland Valley Electric Passenger Railway Company, capital $500,000, has been chartered at the State Department at Harrisburg. The line will traverse ten streets of Carlisle, and thence to Boiling Springs. The incorporators are Oliver H. Ormsby, S. Ritter Ickes, W. J. Ickes and S. H. Nigton, all of Altoona.

The Pall Mall Electric Association (incorporated in W. Va.), New York City—to manufacture, buy and sell electric curative and other goods worn upon the human body. Capital stock, $20,000. Promoters: Ruth E. Scott, Georgiana Scott, John H. Hawkins, all of New York City.

The Roseburg Electric Light and Power Company, Seattle, Wash.—to engage in public lighting and heating, and to furnish power by electricity, operate telephones, railways, etc. Capital stock, $20,000. Promoters : H. E. Clements, W. J. Grambs, Seattle ; S. Z. Mitchell, Portland, Ore.

The Electric Improvement Company, Jersey City, N. J. —to manufacture electric light, heat and power and electric supplies of all descriptions. Capital stock, $10,000. Promoters : R. Ashley, C. J. Shepard, Philadelphia ; F. Bell, Jersey City.

The Edinboro and Erie Railroad Company, Erie, Pa.—to construct and operate an electric railway in Erie. Capital stock, $200,000. Promoters: H. P. Van Dusen, Chas. S. Curtice, George W. Fuller.

The Morristown, Bridgeport and Conshohocken Traction Company, Norristown, Pa.—to construct and operate motors and cables and other machinery for supplying motive power to passenger railways. Capital stock, $10,000. Promoters: Edward S. Perot, Hiram R. Rhoades, Henry Freedly.

The Citizens' Electric Light, Heat and Power Company, Lykens, Pa.—to supply light, heat and power by electricity to the public in Lykens, Dauphin County. Capital stock, $10,000. Promoters: J. B. Whitney, F. J. Douden, J. J. Nutt.

The Scranton and Pittston Traction Company, Scranton, Pa.—to construct and operate motors and cables or other machinery for supplying motive power for passenger railways. Capital stock, $1,050,000. Promoters: W. F. Sadler, Lemuel Amerman, Chas. H. Mullen.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED AUGUST 29, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

504,042. Electric Circuit for Controlling Trains. Frank E. Kinsman, Plainfield, N. J. Filed Jan. 11, 1892.

504,104. Electric Conduit for Railways. Joseph I. Conklin, Brooklyn, N. Y. Filed May 2, 1892.

504,113. Electric-Railway Trolley. Alexander Pomroa, Lynn, Mass., assignor of one-half to Varna J. Peirce, Hudson, Me. Filed Sept. 1, 1892.

504,132. Means for Transmitting Power from Car-Axles to Dynamos. Morris Moskowitz and Samuel Young, Newark, N. J., assignors of one-half to Leon D. Adler and Joseph Loewenberg, same place. Filed April 29, 1893.

504.255. Electric-Railway Trolley. Frank J. Sprague and Patrick F. O'Shaughnessy, New York, N.Y., assignors to the Sprague Electric Railway and Motor Company, same place. Filed Jan. 19. 1889.

504 276. Crossing for Electric Railways Jay Nelson, St. Louis, Mo., assignor of one-half to Thomas C. White, same place. Filed May 18, 1893.

ELECTRIC LIGHTS AND APPLIANCES.

504 082. Hanger for Electric Lights. John P. Hebendahl, Weatherby, Pa. Filed Nov. 5, 1892.

504.105. Manufacture of Carbon Rods for Electric Arc Lamps. Ehrenfried Corleis and Hermann Renisch, Essen, Germany, assignors to the firm of Fried. Krupp, same place. Filed April 26. 1893.

504,271. Electric-Arc Lamp. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company of Connecticut. Filed June 9. 1893.

504,277. Electric-Arc Lamp. William A. Phillips, U. S. Army, assignor of one-half to Thomas J. Porter, Miles City, Mont. Filed June 3, 1893.

DYNAMOS, MOTORS, ETC.

504,177. Brush for Dynamos or Electric Motors. Frederick H. Sandherr, St. Louis, Mo. Filed Jan. 7, 1893.

504,216. Regulator for Dynamo-Electric Machines. John C. Henry, New York, N. Y. Filed April 29, 1892.

BATTERIES.

504,130 Electric Battery. Hosea W. Libbey, Boston, Mass. Filed Sept. 15, 1892.

TELEPHONE AND TELEGRAPH APPARATUS.

504,011. Automatic Telephone. Josef Wratitsch and Stefan Gergacsevics, Graz, Austria-Hungary. Filed April 18, 1892.

504,108. System of Telephonic Intercommunication, Frank R. Colvin, New York, N. Y. Filed Feb. 6, 1893.

504.250. Telephone-Exchange Testing Apparatus. Chas. E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed June 1, 1889.

504,251. Vibrating Circuit-Breaker, and Retardation-Coil for Test Systems. Chas. E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed March 4, 1891.

SWITCHES, SWITCHBOARDS, ETC.

504,123 Circuit-Switch. Charles E. Dey, Denver, Colo. Filed Dec. 13, 1892.

504,160. Rheostat. Albert B. Herrick, Schenectady, N.Y., assignor to the General Electric Company, Boston, Mass. Filed July 22, 1892.

504,219. Multiple Switchboard Keyboard Apparatus. Chas. E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Dec. 6, 1887.

MISCELLANEOUS.

503,981. Signaling Apparatus for Railways. John Orme, London, England. Filed Dec. 6, 1892.

504,059. Insulator. George W. Blackburn, Palmyra, N. J. Filed Aug. 30, 1892.

504,087. Electric Bowling-Alley. Pehr P. Nelson, New York, N. Y. Filed Sept. 21, 1892.

504,095. Electric Clock. Emil Schweizer, Sumiswald, Switzerland. Filed July 16, 1892.

504,148. Push-Button. William H. Berrigan, Jr., New York, N. Y. Filed April 7, 1892.

504,196. Electric Indicator. Jay L. Bradley, St. Louis, Mo. Filed Feb. 4, 1893.

504,200. Art of Concentrating Magnetic Iron Ores. Gurdon Conkling, Glens Falls, N. Y. Filed Sept. 30, 1891.

504,286. Dynamometer. Henry C. Stone, Kansas City, Mo., assignor to Olive A. Stone, South Evanston, Ill. Filed Dec. 27, 1892.

504,312. Coin-Controlled Race-Course. Charles Carroll, New Orleans, La., assignor to the Automatic Machine Company, Limited, same place. Filed Aug. 29, 1891.

ELECTRICITY.

VOL. V. NEW YORK. SEPTEMBER 27, 1893. CHICAGO. No. 11

ATTENDANTS AT THE ROCHESTER CONVENTION. (SEE PAGE 126.)

The Rochester Meeting.

The Eleventh Annual Meeting of the Street Railway Association of the State of New York was held in the rooms of the Chamber of Commerce, Rochester, N. Y., on September 19.

In the absence of the president, Mr. C. D. Wyman, who was detained at the World's Fair, Mr. D. C. Hasbrouck, the vice-president, took the chair and made the opening address.

The report of the Executive Committee was presented. The report showed that five companies had joined during the year. Three companies had been consolidated with a member company, leaving the present membership twenty-eight companies.

Reference was made to the subject of electric traction, in which the committee said: "We are glad to note the rapid development of the overhead system in Brooklyn. An object lesson as to the character of construction, equipment and operation by electricity is there being given to the country and the world at large that will do much to pave the way for the successful introduction of electric traction in those cities where it has not yet obtained a foothold."

The committee congratulated the fraternity that during the last session of the State Legislature not a single bill aimed at the successful operation and conduct of the business had become a law. All that was asked for the business was that the same consideration and fair treatment be extended to it as to any other business.

The business outlook was touched upon as follows: "The street-railway business is a delicate financial meter that indicates with certainty the financial condition of a people. In proportion to the prosperity of the people is our business successful; and the converse is equally true. Judged by this infallible test, therefore, we are assured that the worst of the country's financial troubles and business depression is passing away."

In closing the report, a fitting tribute was paid to the memory of the late John Stephenson.

The Treasurer's Report was presented and showed the financial transactions during the year:

Receipts	$902.49
Expenses	678.66
Balance on hand	$223.83

A report on "Recent Improvements in Cable Traction" was on the programme, to be presented by Mr. George W. McNulty, engineer of the Broadway cable road of New York City. The report was not ready, and Mr. McNulty sent a letter, in which he said:

"The 'improvements,' as you kindly call them, are yet practically not tried, or at least insufficiently so. It is true that the road has been running for several months, but with a view of meeting the public demand for better traveling facilities as soon as possible, and of experimenting a little with some devices before putting them in final shape, we really started before we were entirely ready. While the event has, I think, justified the wisdom of our course, it has naturally led our friends to assume that everything is done, and that we are sitting back in our chairs and contemplating the result of our labors with calm satisfaction. While we have no reason to be dissatisfied, we are certainly not done, and unfortunately for present purposes it is mainly our 'improvements' that are yet unfinished or at least untried. This of itself would make me reluctant to speak of what we have done as 'improvements' until they are proved to be so, but if further excuse were necessary, it would, I am sure, be sufficient to remind you of the multifarious and urgent matters that must engage the attention of one who has to get in complete running order a work of such magnitude and complexity to the exclusion of everything else, even so congenial a task as a contribution to the work of the Street Railway Association. I can safely promise a paper for next year."

The next business was the report of Mr. T. J. McTighe, "Return Circuit for Electric Railways," which was read by the secretary.

The vice-president appointed Messrs. Watson, Richardson, Sr., and Williams the Nominating Committee.

The committee recommended the following gentlemen as officers of the association for the ensuing year:

President, D. C. Hasbrouck, New York City.

1st Vice-President, G. Tracy Rogers, Binghamton.

2d Vice-President, James H. Moffat, Syracuse.

Secretary and Treasurer, W. J. Richardson, Brooklyn.

Executive Committee, John N. Beckley, Rochester; Daniel F. Lewis, Brooklyn; Charles Cleminshaw, Troy.

The association then adjourned to meet in Syracuse the third Tuesday in September, 1894.

The following delegates were present:

G. Tracy Rogers, president Binghamton Railroad Company, Binghamton; William Richardson, ex-president, and William J. Richardson, secretary, Atlantic Avenue Railroad Company, Brooklyn; Henry M. Watson, president Buffalo Railroad Company, Buffalo; W. W. Cole, general manager West Side Railroad Company, Elmira; H. Bergholz, secretary and treasurer Ithaca Street Railway Company, Ithaca; D. C. Hasbrouck, secretary Houston, West Street and Pavonia Ferry Railroad Company, New York; C. A. Williams, secretary, William Rosborough, superintendent, and Albert Green, electrician, Rochester Railway Company, Rochester; C. A. Durr, general superintendent Rochester Electric Railway Company, Rochester.

The Entertainment.

Rochester Treated Her Guests Royally.

After the close of the business sessions of the Association the visitors were well taken care of by the courtesy of the Rochester Railway Company.

There was an excursion to the lake over the new electric line on the east bank of the Genesee River, which involved a visit to the huge brewery of the Bartholomays, where an electric fluid of low potential was freely dispensed along with a substantial lunch.

LAF. HEIDELL.

Arrived at the lake the first thing on the programme was the taking of the photograph which is seen in our Frontispiece. Then came a magnificent banquet in the dining-room of the Cottage Grove Hotel. Many toasts were drank and responded to briefly by Mayor Curran, on behalf of the city of Rochester, and by Mr. W. J. Richardson and others of the guests. Songs were sung by the Tremont Quartette and good stories (also bad ones) were told by Mr. Laf. Heidell.

Major Evarts distinguished himself by bagging an order for six miles of Simplex wire, and others of the supply men were fortunate in a less degree.

Mr. Gregory, of the Yates, Syracuse, was on hand, and with the aid of General Harry Evans secured the Convention for next year. The choice was a wise one. Syracuse is a good town to visit, and the Yates is on a par with any hotel in the State.

Other than the regular delegates to the Convention, the attendants included the following gentlemen:

J. H. Stedmann, the "Transfer" man, Rochester.
R. Gerry, of Jones & Laughlins, Pittsburg.
H. W. Blake, *Street Railway Journal*.
F. R. Colvin, *Electrical Engineer*.
B. E. Greene, ELECTRICITY.
W. J. Clark, General Electric Company, New York.
J. S. Crider, Washington Carbon Company, Pittsburg, Pa.
Major H. C. Evans, Johnson Company, New York.
Major D. T. Evarts, General Manager Simplex Electric Company, Boston.
Thomas H. Fearey, General Electric Company, Buffalo.
Arthur W. Field, Peckham Motor Truck and Wheel Company, Kingston, N. Y.
R. Gerry, American Iron and Steel Company, New York.
H. J. McCormick, Schaffer Manufacturing Company, Rochester, N. Y.
Elmer P. Morris, General Electric Company, Indianapolis, Ind.
A. D. Newton, Eddy Manufacturing Company, Windsor, Conn.
J. F. Ostrom, Pennsylvania Steel Company, Philadelphia, Pa.
D. W. Pugh, John Stephenson Company, New York.
John S. Pugh, Baltimore Car Wheel Works, Baltimore.
F. C. Randall, J. G. Brill Company, Philadelphia.
F. D. Russell, Rochester Car Wheel Works, Rochester, N. Y.
John Taylor, Taylor Electric Truck Company, Troy, N. Y.
A. C. Vosburgh, Secretary New Process Raw Hide Company, Syracuse, N. Y.
H. W. Weller, General Electric Company, New York.
C. B. Wyman, Manager Central Electric Heating Company, New York.
Charles J. Bissell, Rochester, N. Y.
C. C. Woodworth, Rochester, N. Y.
Charles Benton, Sprague Electric Elevator Company, New York.
John D. McQueston, New York.

All Creditors Will Have an Equal Show.

A receiver has been appointed to take charge of the affairs of Alexander, Barney & Chapin, who were closed up a few weeks ago on an execution obtained by Patrick Gray on assigned claims of Luke A. Burke.

Edward E. Denniston.

Mr. Edward E. Denniston, whose death at his home in Philadelphia was announced last week, was greatly interested in street railroads and a stockholder in many. Manager Littell of the Buffalo Railway Company speaks of him as "a fine business man, broad minded and liberal and full of energy. He was the controlling spirit in purchasing, extending and improving the street railroads in Buffalo, Rochester, Louisville, Columbus, Ohio, Brooklyn, Paterson, N. J., New Orleans, Worcester, Lynn, Boston, Chelsea, Scranton and many other cities, and he was a director of the street railroads in all of these cities. He was of great service to Buffalo in helping to bring about the change and improvement in the street railway system here."

Forming an Electrical Society at Toledo.

At a meeting of the electricians of Toledo, held on the 18th inst., a committee was appointed to draught a constitution and by-laws for a proposed society for the study of electricity and for electrical research. The following were chosen as members of the committee: Messrs. Faben, James Robinson, J. W. Cherry, DeBree, Dodge, Cline, McNamar, Dr. North and Prof. Waite of the Manual Training School. After the appointment of the committee, Messrs. Seagrave, North, Battelle and Professor Waite spoke briefly on the advantages of an electrical society.

The Ferris wheel at the World's Fair has paid for itself and is now clearing about $8,000 daily for its owners.

Long Distance Transmission.

Multiphase Motors.*

Mr. Hasson.

I wish to say that it is a matter of great satisfaction to me to see that we have come down to the present time. I was very much afraid that I was going back to California with the idea that I had only been indulging in reminiscences of successful failures, but now we have got down to date.

We are now discussing a subject that is really of vital importance in electricity to-day. As a consulting engineer I represent a variety of companies in California who desire to transmit power electrically. The aggregate will amount to some 40,000 horse power, distances ranging from ten to forty miles Notwithstanding the fact that Mr. Scott has referred to the successful transmission of power for lighting purposes at San Antonio for twenty-eight miles, the transmission of power electrically long distances in California is a failure. Over a year ago the first contract for a definite transmission of power was closed. I see to-day an unhappy superintendent of a mine up in eastern California, up in the mountains, looking at his burnt-out field coils after this generator has been in operation for less than thirteen days. Although this whole plant is very beautiful upon paper, although it is all logical, the mere fact of the establishment of a small plant for operation in an exposition, as we have here, and saying that all this may be done, does not establish the commercial success of long distance transmission of power. The points that are necessary in this machinery are, first, that it shall from its inception and from its installation operate successfully; the second, that it shall continue to operate. The machinery must be so built that it will not run not only a day or an hour, but it shall run for weeks and months. It must be borne in mind that where this power transmission is necessary is almost invariably in countries where they are distant from railways, where repairs are impossible; and the machinery must be of such a nature, not only in its simplicity of construction but in its lasting qualities, that accidents will be something that is almost impossible to happen to it.

I believe in the transmission of power. I have been the apostle of it for a year in California, but I must definitely establish the fact that as far as California is concerned, as far as the investors, the men who make a success of long distance transmission, bearing in mind that no electric machine has any actual utility, that no transmission machine is of any use, unless it will stand high voltages only—we may overcome the list of defects and arrive at the correct manner of handling them—I wish to say definitely that to the investor in California to-day the successful machine for long distance transmission of power electrically exists only apparently in some special machine in the minds of the inventors and the promoters, or in some beautiful advertisement.

I wish further to state that some four or five months ago I was called upon to decide upon certain plans for the transmission of 3,000 horse power some twenty miles. Most elaborate, most beautiful detailed descriptions of the methods arriving at these results were put before me, but not a single working drawing of any kind was presented by any one of the three companies that were competing for this installation. I wish now and trust that the people who have been associated with the development of this long distance transmission machinery will discuss this question. It must be recognized that these experiments are so extensive that they can only be carried out by companies. I have waited and waited for information, and all that I can arrive at in that way is that one company says that 800 volts is the limit to multiphase generation, and another company says with equal positiveness, we do not hesitate to install 2,500 or 3,000 volts initially. Which is right? How are we to determine until these plants are installed and carefully operated. Again, we have been promised a long while a three-phase transmission in southern California. I understand that it is going out there now under special guard, and I trust that it will be taken care of and that it will arrive safely without any accident happening to it.

Dr. Bell.

My friend Dr. Scott has so well described the characteristics of a typical polyphase system that as regards the general characteristics of it I myself would have very little to say. I would only say that I am very glad that he has referred to the two-phase system as a polyphase system, because it gives us one word instead of two for the motor, and that all which applies to the two phase system applies in varying degrees to all other numbers of phases. The general methods in the apparatus are the same in principle, only differ in such details as inventors have found desirable to introduce, so that all the polyphase systems are capable of doing practically about the same work. The differences, it is only fair to state, are differences less in degree, far less, than the difference between the polyphase system and any other system of power transmission. There are in general three methods which are at present offered and proposed for power transmission: that of the direct current, which Prof. Crocker has been championing before us this morning; that of single phase currents, and that of polyphase currents. Of the first I have only to say that in this country at least it has not been altogether a shining success. The experiments have mostly resulted in failures. I hope that M. Thury will be able to give us a far more encouraging report from the other side of the water. The great difficulty seems to be that which was suggested by Prof. Crocker, that when your current goes up you begin to get into trouble. Voltages which are perfectly practicable on the five horse power machine, or on perhaps a 60 or 70 horse power arc machine, become difficult when you want to transform to say 500 kilowatts or more in single units, and the cases of power transmission are frequent where there is a call, and a very imperative call, for units as large as 1,000 horse power. I am afraid that for these big units we need even more experience than Mr. Hasson has thought necessary for the general problem before we get a successful direct current machine.

Second, we come to alternating currents, and we have to ask ourselves the very pertinent question, Why do we want them? We want them for the reason which has been very well set forth by Mr. Scott, that when we get an alternate current we can do something with it. We can twist it around in almost an infinite variety of ways, and set it to almost any application. Where we are dealing with a direct current, it is a direct current from start to finish, except as we transform it at the cost of more complication and an initial expense into alternate currents. Furthermore, we do not need the direct current for motors nowadays, and that is sufficient reason why we should consider the alternating current as the coming thing in power transmission. So long as the direct current had a grinding monopoly of all the motor service, it was direct current or nothing. To-day that is changed. The single phase system, with which we have all been familiar in lighting for some years, is, as we know now, largely through the experiments of our foreign friends, applicable to motor service as well; not as well, however, I am sorry to say, as the polyphase systems, nor is it as well adapted to the operation of the beautiful rotary transformers which have an essential feature, as Prof. Duncan has suggested, of the coming power transmission by polyphase currents. We know from experience that the single phase rotary transformer is not capable of quite so good a contact and is less desirable in other ways than the polyphase one. As for the single phase motor, such as has been exploited abroad, I can say as a result both of what we have heard from other experiments and from what I know myself from personal experiments, that the single phase motor in its present stage of development can be considered as nothing else than a rather poor polyphase motor. It starts on the polyphase principle every time, and with the objection that the rotary field established is not a circular rotary field, but an elliptical one, consequently less efficient as a rotary field, and giving less efficiency in the motor. When we are not driven to using a phase different motor, if we wish to start a single phase machine we have to use some variety of commutation running out through any synchronized motor, with its well-known limitations, or else into the non-synchronous motor of the type which we have recently been hearing about, which, as I have just stated, is not as good as a good polyphase motor. If you are building an induction motor of any kind, and set out to secure a single phase motor, you will have a most phenomenally good polyphase motor before you are through with the machine.

Then finally we come to the polyphase systems. Essentially they operate on the same principle. We may, however, divide them into two classes, polyphase systems having two wires per phase, that is, having an independent circuit, and polyphase systems having non-independent circuits. In this latter case we get some simplification in the wire. A two phased system with four wires one may fairly call practical. With three wires, combining two of the phases in that way and combining the two phases partially in that way, it is somewhat simpler. The three phase system operated on separate circuits, which would require six wires, I think we are all agreed is prohibited. Operated with combined circuits it requires but three wires, as few, in other words, as were required by any polyphase system. Furthermore, in all of the non-independent circuits, polyphase systems save copper as over the direct current, the simple alternating or the polyphase systems with separate circuits. They save copper in varying degrees, the two phase in about 72 or 73 per cent., the three phase about 25 per cent., and those systems which have more phases as a rule less than either of those mentioned, the saving lessening with the number of phases. We need not concern ourselves with that much, on account of the prohibitive number of wires required to install them, even with composite circuits. We therefore have, as distinguished from the independent circuit system, which is so well exemplified in these diagrams, a second kind of polyphase system with dependent circuits, interlocked circuits, which possess the valuable property of saving up to 25 per cent. of the copper, and also giving less self-induction and capacity on the line then alternating, so that for very long transmissions it saves both in the copper and that intolerable nuisance, line inductance. Line inductance I trust in the future will not be as serious a matter as it is now, or has been in the past, thanks to the suggestion of my friend, Mr. Steinmetz, in his paper yesterday.

As regards the general differences between the independent circuit polyphase and the dependent circuit polyphase system, one can only say that the independent circuit requires at least four wires. The dependent circuit requires at the least three wires. This in the question of installing lights is a comparatively slight difference, because you are going to split circuits anyhow in those cases. In the matter of motors, the three wires are somewhat more convenient than the four. The great objection which has been raised against the polyphase system with dependent circuits such as the two or three phase system with three circuits, is that it does not regulate well, and the principal thing that I wish to put before you is that that criticism is absolutely ill founded, as we know from positive experiments. In the first place, it is quite possible so to arrange a dependent circuit polyphase system that the difference between the different branches of the circuit, even under extreme conditions, will be almost intangible. That too was pointed out by Mr. Steinmetz in his paper yesterday. The means of doing this are not always simple, and it is therefore well to state as a result of positive experiments that without any complicated means of compensation whatever it is possible to obtain closely concordant voltages in all branches of a polyphase system, independent of their operations in the old branches. If you cut off all the branches but one you will obtain a perceptible variation. If you cut off one of the three branches of a three phased system you will obtain a variation which is scarcely visible to the eye.

With respect to the motors on the polyphase systems, I think we can readily appreciate from what Dr. Duncan has said that between 2, 3, 4 or M. phase motors there is not any very wide difference in principle, nor is there any very wide difference, or any perceptible difference one may say, in their operation on independent circuits or dependent circuits. The whole point of the matter is this, that if you are going to obtain equal results, whatever the number of phases, you must practically have a motor of about equal classification. In other words, for equally good results, the four phase motor would have to be just about the same sort of a machine as regards complication, binding, etc., as the three phase, and the two phase would have to be just about as complicated as the three phase. They would have to be practically nearly alike if you are going to get precisely the same results, but when these motors are properly designed I do not hesitate to say as the result of experience that they are decidedly superior to any direct current machine, and that is one of the strong reasons for using the polyphase systems instead of two currents. In the first place these machines have no commutators, and in the second place it is almost impossible to burn them out. I have been experimenting with motors of this type for a long time and I never yet succeeded, even under the strain of the toughest kind of experimentation in burning out a single machine in any way whatever, and I do not think that is a record that could be well made with any sort of direct current motor. If they are overloaded, they stop and will not burn out for a pretty long period. Under any ordinary circumstances they simply stand up to business without any commutation, without any complicated connections. They start quite well, as well as any ordinary direct current motor, and I beg leave to correct Dr. Duncan in his statement that eight or ten times the running current is needed to get a good start. The motors in respect to currents taken start just about as a shunt motor starts. Furthermore, the speed of these motors can be varied. It is non-synchronous, and when it is non-synchronous I do not mean to say that it is non-synchronous in the sense that a single phase motor is, but that it is non-synchronous in the sense that a series motor is. It is possible to run a polyphase motor at a widely varying range of speed, keeping up practically constant talk (?). The range of speed is practically varying from one-tenth speed up to full speed, keeping constant talk all the time. This, I think, escapes one of the objections which have been raised against polyphase motors.

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* Discussion held at the International Electrical Congress, Chicago.

One further thing I would say and then I am through. I want to defend the polyphase machine against the accusation of the lagging current, against the accusation that it will queer the regulation of every dynamo that the mind of man has found means to invent. It is simply not so. If a polyphase motor gives a big lagging current at or anywhere near full loaded, it is proof conclusive that the machine has been badly designed, that the man who made it did not know how to utilize his magnetic circuit intelligently. There is no necessity of having more than 10 per cent. lagging current in any polyphase motor, and, indeed, one that shows much more than this I should consider badly designed. As an example of what is perfectly feasible and practicable in the way of reducing lagging currents, I would say that I have experimented with motors of sizes up to twenty horse power, where the crossing the angle of lagging, I call it 5 here, is from 85 to 95 per cent. I only recently experimented with a five horse power motor, and I think this ought to satisfactorily dispose, once for all, of the statement that the polyphase motors require an enormous lagging current. And more than this, suppose the current does lag 5, 10 or 15 per cent. It is perfectly feasible to compensate the dynamo by very simple means against the lagging current, even where there is a considerable difference in phases. I recently tried such a compensating device of an exceedingly simple and practical description, with the result of holding the voltage of the dynamo practically constant from no load up to full load when the load itself was of the worst possible inductive character. The machine itself was a little experimental affair, one of 30 kilowatts, constructed out of an old alternator frame, it being the worst machine which I could pick for the purpose and selected intentionally, but the machine required two and one-quarter times the excited current at the full load that it did at no load. In other words, it is possible to automatically regulate the voltage of a polyphase generator in spite of even a severe lag in the line due to the operation of motors, and finally this lag due to the operation of motors becomes evanescent when the motor is properly designed. I am satisfied if I have been able to defend the polyphase motor against this false accusation, and the polyphase systems, whatever the number of phases, against the accusations of insufficient regulation.

Mr. Stillwell.

I have not come here with any paper, and have no speech prepared; in fact, I just arrived and have only listened to the remarks of the last two speakers, so that I should be afraid to go into any elaborate or detailed discussion of the polyphase systems as I see them for fear that I might be taking your time in simply repeating what has already been said.

I would like to call your attention, however, to the exhibit which has been described by Mr. Scott. I believe that that exhibit marks an advance in polyphase work, and I know that it will enable those who examine it to ascertain for themselves what is practicable by this system on a scale that has not hitherto been attempted. In preparing this exhibit of the Westinghouse Company we have not shown small machines. It is no exhibit of tops or models or drawings. We have simply shown there what we believe to be the best development of the polyphase system as we can build it, and look at it. Now, what have we accomplished in that system? We have one generator and one transmission circuit. At the receiving end of the line we have direct current and alternating current at various potentials, performing every kind of work to which electricity is applicable. I think that it is sufficient to show that the system is well worthy of careful examination and study. I have no doubt that further advances will be made, but we have here machines which mechanically are very excellent and electrically are capable of a very good performance. I think it would be interesting, if time permitted, to begin at the receiving end of the station and work back to the generating end from each kind of work that we perform, that is, from the incandescent lighting, how many lights and how many applications we have on the way. If you will work that out for yourselves you will find that the efficiency is in all cases very high, and that in all except as regards arc lighting we have introduced the minimum number of machines and of applications of energy.

We are aiming, of course, not at a partial solution of the problem of transmission, but at a broad and general solution, the door to which was opened by the invention of the polyphase system. There have been very many partial solutions, and we have as the result of such the direct current systems of limited applicability and the single phase systems. We have here a system which performs all kinds of service over a single transmission wire and from a single generator. Of course in a large station we would use several generators and as many circuits as might be demanded by the amount of power needed.

Now, I have one thing to say in regard to the evolution of this business. There are concerns in it—manufacturers, and those who propose to buy, users, and lately we have an intermediate class, consulting engineers, as yet less numerous on this side of the water than they are on the other. We are very glad to welcome them in their work, as they certainly have their place in protecting the interests of the customer, and also in explaining to the customer what the manufacturer is trying to sell him, to assist the manufacturer in convincing the customer that he is warranted in putting in his share of the necessary investment to carry the thing through.

Now, we have in this plant attempted to do this. We have spent a large amount of money in putting in a very large and expensive exhibit of our machine, and will be glad to exhibit it to those who may be interested and to whom we may properly extend that courtesy to make such tests as will, we think, satisfy them as to the performance of the apparatus. We have not attempted to show the insulation of our circuits for long distance transmission, although we might have run a circuit around the city of Chicago and come back to the switchboard, and carried our potential at 10,000 volts and operated it. That has been demonstrated in Germany over a longer distance and over a higher potential than our very high potentials are in commercial and successful operation in this country. Now, it seems to me that the consulting engineer is the man who must put two and two together and solve this problem for us. He is the man to stand up to the customer and to the world and say, this thing is practicable and it is a success. It is not for the manufacturer to pay for the apparatus and install it and operate it and guarantee dividends, as has sometimes been proposed.

The Chairman—I see a gentleman here who is familiar with long distance transmission, Mr. Freke of Munich, who is well known in connection with the subject of distant transmission. I will ask him to make a few remarks on the subject.

Mr. Freke.

I have heard here that some have recommended to you the polyphase and some the direct current. I should like to say that no system is the best. I think the direct current system is a very good one, the polyphase current system is a very good one, and the single phase current system is a very good one for the transmission of power. For the purpose of demonstration I should like to give you some instances from the other side of the water. I will not speak of Genoa, as I suppose M. Thury will tell you himself of the transmission of power there, where they are operating with 6,000 volts and a perfect system of dynamos.

We had in Germany two years ago a long transmission of 100 miles by circuit up to 30,000 volts, but people seem to be incredulous when I tell them of it. They said, well, it is very good for an experiment, but we should like to see some line working for a long time. Well, gentlemen, I can tell you I was at the works of Oerlikon two or three months ago, and I saw the transmission of power working, which had been in operation for, I suppose, 15 months, of 13,000 volts. It was a three phase current transmission on the same system as the transmission from Lauffen to Frankfort, the work being perfectly good all the time. Their motor was a 300 horse power motor constructed in the same manner as the generator.

Now, of the single phase system I said it was also good. I saw in Switzerland a 100 horse power transmission. I will tell you it was not a self starting 100 horse power motor, but had a very good device. It was for lighting a mill, and there is a small single phase motor of 2 horse power to put in motion the big one. As soon as the big one was in place the generator was coupled together and worked well as a motor. Now, this little single phase motor is now constructed by Messrs. Brown, Boveri & Co., the well-known builders, up to, I suppose, 10 horse power, as I have seen motors in perfect condition. They are put in action a two phase motor, and as soon as the motor is running and synchronized with a generator it is put on the main circuit as a single phase motor, and runs nearer synchronizing, and does not stop at an overloading of 50 to 100 per cent. These motors we have in use in a little town near Munich, and I can say that of the 15 motors they have there there is not one that has given any trouble and the people that use them are all very content with the work they are doing.

I might conclude by saying what I did before, that no system is the best. I do not think so. One system may be the best for some special work, but there is no only one best system.

Prof. Thompson.

May I first speak for M. Thury? He has asked me to place before you the following points: There is at Geneva a transmission of power at a constant potential of 1,200 volts, with a simple continuous current, the motors being shunt worked. There is another at Stanzerhorn working with a generator of 150 horse power at 1,500 volts and about 70 amperes. This works three motors each of about 60 horse power nominally. There is another case of distribution with continuous current, but with excitation with the generating plant, consisting of dynamos in series.

This is from Biberist to Rondchatel, a distance of 29 kilometers, about 20 miles. Two generators of 200 horse power each, current of 40 amperes, 3,500 volts, tried up to 4,500. A fourth installation is at Genoa in Italy. There is a continuous current having a constant flow of 45 amperes, eight dynamos as generators, all joined in series, each nominally about 1,000 volts, each about 60 horse power, these eight not running quite at 1,000 volts each, the line being at 6,000 volts in ordinary work, because if you keep the current constant the volts will vary according to the demand at the other end. There are two circuits feeding motors, varying from 5 horse power to 100 horse power, and from 100 volts to 2,000 volts, and these are all examples of practical installations for which M. Thury makes himself responsible.

Now, to speak for myself, first of all let me deal with the continuous current problem. Let me point out that for other purposes than the mere furnishing of arc lights, machines have been constructed, continuous current machines, to work out high voltages. In London Mr. Essen has designed various dynamos working at from 1,000 to 2,000 volts, using commutators of the ordinary kind, but when I say commutators of the ordinary kind I mean that they were the ordinary straight bars of hard copper or something of that kind, but they were specially insulated and they had to take special precautions against lapping over. In one machine they adopted the plan of wiping out any ordinary spark that might occur upon the commutator by imbedding the whole thing in a mass of asbestos which wiped out any spark which might be formed under the brush. It was a rough and ready device, but it "got there."

Again, in Germany, Mr. Lavier has carried out many examples of transmission of power with continuous currents at 1,000 volts. The difficulty does not seem to arise so much from the sparking of the commutator as from the inherent difficulty which is met with everywhere when you begin to apply with continuous currents any high voltage, namely, that of electrolysis of your insulating surfaces or insulating materials that may occur in any place exposed to moisture. We know that electrically caused fires from leaks in the mains more often occur with the continuous current than with the alternate, no doubt because the continuous current draws up electrolysis in the moisture and the alternating current does not do so, at least not in the same way.

May I point out that in the old-fashioned university town of Oxford, England—I must not claim for it that it is a long distance transmission of power but it is a transmission of power by continuous currents at high voltage. The town is supplied from a lighting station something like a mile and a third, over a mile and a quarter, and the current is brought in at something over 1,000 volts, while in the city of Oxford this current is transformed by continuous current transformers, that is to say, from motor dynamos, to the low pressure of 100 volts, and conveyed into the neighborhood all around, from house to house, and that installation has been going on now for many months and goes without any trouble. These rotating and continuous current transformers have a very high efficiency, and so far as my information goes there is no trouble from the sparking at the commutators.

Now, let us go to the alternate current work. I would invite every electrical engineer interested in this subject to study very carefully the installation at Rome, which is fed by the power of the waterfall 14 miles away, where there is a station, erected by the firm of Ganz of Buda-Pesth, where the water from the waterfall falls down turbines and drives alternate current machines which supply current at from 5,000 to 6,000 volts, carried across 14 miles over the Campagna until it arrives outside the gates of the city of Rome, where there is a transformer station which brings it down from 5,000 or 6,000 volts to something over 1,000 volts, from which again lines go into the city to be transformed down to 100 volts, being the low pressure for the work.

I have listened with great pleasure to the discussion originated by Dr. Duncan and carried on so ably by the engineers of the Westinghouse Company upon the question of the polyphase transmission. I have studied that polyphase transmission at Frankfort, where we had it in some 8 or 10 different systems, all rivals of one another, from the various houses of Germany. We had the great houses of Schuckert, Siemens & Halske, Lehmeyer and several others, each of them showing their own way of carrying out a polyphase system, and we could compare the one with the other, and it was very interesting to see how they all had solved in their own way that problem to which so much attention has been drawn here, namely, making a rotary transformer transform a continuous current into a simple alternate current. No doubt their rotary transformers will be of service in the industry, but I imagine they will be of service rather in particular instances than in any kind of general way. Let me entirely endorse the remarks of Mr. Freke, that there is no best system, that each system is the best for its own purpose. What would you think of an engineer who could stand on the platform here and say that he had invented, or that any man alive had invented, the best steam engine, and that there was no other? You would want to know what that steam engine was best for, whether it was suited for a mill or a threshing machine or a large factory or a steamboat or a locomotive. There is no best steam engine. There is no best dynamo, and there is no best motor, and there is no best system. They are all right. They are all best.

Well, then, what is the polyphase system composed of, and what is the simple alternate system composed of? I am not going to prophesy. I do not know what ten years may bring forth, but I will give you my own personal opinion as to how the thing stands at present. I do not love the complication of three phase transformers, and three phase switchboards, and three phase motors. I love the three phase or the two phase alternate current dynamo and motor. They are very beautiful. They can do a great many things with them, but I do not love the complications of switchboards and transformers. I do not love such a complication as that. It is very beautiful, it is extremely fine, it is costing a mint of money, but I do not love it because of its unnecessary complications. For all distribution systems—distribution, I say, not transmission systems—where you have not only to transmit but to distribute to this and that and the other consumer, I believe you will abandon all the complications of polyphase work, and that you will return to simple alternate current methods, and I believe you will find that the bugbears that have been raised, the ghosts that have been put up to frighten you off the simple alternate current system, will disappear in practical work, and that the motors can be made as highly efficient and as comfortable with simple alternate currents as with any polyphase system. As I said before, I do not desire to prophesy, but I venture to predict, not in the way of prophecy, but simply giving you my personal opinion, that the simple alternate current work will be the thing which ten years hence will be found to be effective for all long distance transmission where you want to distribute at the consumer's end.

One final word in conclusion. We in England are trying to get our stations—I am speaking mainly of lighting stations—whether they work by high voltage or low, down to the utmost simplicity of engineering. We shall have one type of engine suitable for its purpose, not half a dozen different scratch lots in the same station, and one type of generator. We have one simple bar, or at most three, if you are working on a three wire distribution. Everything is tending in the direction of simplicity, and the results are excellent.

If I had come over here expecting to go back to England and say the apparatus you are working with has got down to such a beautiful stage of simplicity in the States that you will have to give up everything you have got in the old country and adopt the polyphase system. I should think that I would have been very effectively disillusioned, but the complications of those two diagrams which I see before me, although they represent a most enormous amount of research, of invention, of instruction and of capital fearlessly placed at the disposal of the inventors, are sufficient evidence to my mind of the correctness of my views. I admire what has been done, but while admiring it I cannot help thinking that there is something simpler which will be the successful machine of the future.

Prof. Thompson's remarks were greeted with great applause, and at the conclusion the chairman introduced Prof. George Forbes, of London, who addressed the section as follows:

Prof. Forbes.

Nothing, Mr. Chairman and gentlemen, could give me greater pleasure than to be told that I am to be limited to five minutes. I have half an hour ago landed from the cars and I have only just been able to manage to come into the tail end of your discussion. I had expected to arrive early this morning and to be here on time, and I traveled in order to be present at this discussion. I labor under the disadvantage of not having heard the papers read, of not knowing what the subject under discussion is, of only having heard the last part of Prof. Thompson's remarks, and being suddenly called upon to address you on the subject under discussion. I know that the subject under discussion is the subject which has been continually occupying my mind for many years back, for which I have been making journeys to the United States year after year and to every part of Europe where I thought work in this direction was being done. It is a work which during the last year and a half has been the incessant occupant of my mind, and not one-quarter of my time, awake or asleep, has been taken away from this subject, and it is impossible to compress into five minutes all the things I would wish to say to you on this subject. Briefly let me take up the points which Prof. Thompson was alluding to, and say a few words on some of them.

The first question that arises in this matter is the relative importance of direct and alternating currents. Prof. Thompson has wisely said with regard to the different systems that each has its own sphere of action. He is perfectly right, and everybody who has gone thoroughly into the question will agree with him. The grandest work in connection with the use of the continuous current for transmission to distances is that which I have seen at Genoa. They have done a splendid work in putting that down, working at high voltage. They have worked even up to 6,000 or 8,000 volts. They are now doing other work in the same direction. The continuous current can be used for transmission to a distance, and in many ways it is extremely convenient, but it has none of the beauty, none of the diverse applications of the alternating current. The trouble which exists in the commutator is a very serious one, and I will not dilate upon it further as it has often been spoken of. The trouble in insulating the armature is a very serious one, largely because in continuous current machines the armature must be the revolving part. In the alternating current we may have the armature as the fixed part. In that case the armature is just as easy to insulate as the high tension side of a transformer. You may put oil into it if you wish to carry off the heat, but if you trust in any way, and it is dangerous to trust far, to its extra insulating properties, it is perfectly unmoved. You may place the wires so that they are not acted upon by the mechanical action of the magnetic field. Prof. Thompson has said to connect the generators in series and you get your best insulation. At the receiving end it is necessary to do the same. You cannot have a 5,000 or 10,000 horse power motor in every workshop, and you must put them in series and the complications are manifold. I will not go further into this question. I have stated the general points and I will now devote the remaining two minutes to another subject.

The great charm and beauty of the alternating current lie in the flexibility introduced by means of the transformers. It is impossible to overrate the advantages of the transformer. A continuous current introducing rotating transformers has no comparison with the simplicity and the practicability of the alternating current transformer. I was pleased to hear Prof. Thompson speak about the single phase. The single phase is a great thing at present and has great possibilities in the future. I have had a very long experience of synchronizing alternating machines used as motors, and I have the very highest opinion of it, but they are only applicable in such cases where the motive power is required constantly, day and night, from week's end to week's end. For electrical construction works the synchronous motor is admirably adapted, and also to motor mills, but for all appliances where we have to start, stop and reverse our motors, it is practically out of the question to put in the synchronizing system. I have watched in the workshops of the greatest practical electricians in the world the progress that they have been making in the last three or four years in the evolving of an alternating current motor which shall stop and reverse with facility. Until quite lately there were none of those which were thoroughly suitable and applicable to ordinary lighting circuits. Now, however, we are able to use, as Prof. Thompson has said, a polyphase system for starting the motor, and use it synchronously afterwards, or nearly synchronously. This is a very great advance and I personally have great hopes that the single phase is going to play a very important part in the future.

On the subject of the best means to adopt, my tongue has been considerably tied, and with regard to the relative advantages of the three phase and two phase systems, on a late occasion, at the Electrical Light Convention at St. Louis, when I was asked to speak, for reasons which were readily appreciated, I was not able to speak on that subject. Those reasons no longer exist. I beg to say that as far as I have studied the two, and I have given a great deal of personal and practical study to it, my opinion is that they are both very good, both very excellent, that the three phase is an attractive one from its theoretical beauty, but in practical execution the two phase is better. The reason why I have a dislike to using the three phase is, first, the complications caused by having three conductors, all interconnected. This introduces troubles in locating the circuit. It introduces troubles in testing, and it introduces troubles in correcting a fault which has arisen. I can imagine the perplexity of an ordinary central station attendant when he is told that there is a fault in the line, in his endeavors to find it; if it is a three wire system where that fault is, it increases the labor enormously, and with two phase the wires may be interconnected or they may be separated. I prefer to have a two phase system with separate independent circuits, and then they are more easily managed, and more easily regulated. Moreover, when the three circuits are interconnected each one has an influence on the other. If you overload one circuit and underload another circuit, the underloaded circuit has a pressure enormously higher than the overloaded circuit. That is a fact which is generally known. It is not generally known that if you have three circuits, A, B and C, on the three phase system, if A is overloaded and B and C are not loaded, then B may be a higher voltage than A, but C has a higher voltage than either of them. That is a fact that is not generally known, and has to be known to be appreciated. It is a very serious drawback to the use of the three phase system. For lighting purposes it condemns it. I have advised the officers of the Cataract Construction Company to reject the three phase and to build their first dynamos with two phases,

(*Continued on Page* 133.)

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GEORGE R. METCALFE, - - - EDITOR.
R. H. WILLOUGHBY, - - ASSOCIATE EDITOR.

B. E. GREENE, Publisher.

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Electrical Literature. The science of electricity, in spite of its youthfulness in comparison with most of the other branches of science, has been a subject for study by some of the most notable scientific men in the world, and possesses a considerable amount of literature in regard to pure theory and mathematical deductions, as well as treatises of a popular and historical character, but one branch of this subject, and the most important one, viz., the practical text-book, is yet almost entirely unknown in this class of literature.

The most prominent books treating of electrical subjects which we have to-day are almost purely theoretical, deal with machines already built and the mathematical demonstrations of general electrical laws. The other books are chiefly descriptive in character, and not infrequently contain much that is absolutely useless, including minute details of dynamos and electrical apparatus which pertain to ancient history and are practically obsolete in present times.

While these books collectively contain most all of the information extant in the electrical field, this information is so scattered, and is so often buried beneath a mass of complex formulæ, that it remains almost inaccessible to the grasp of the average beginner in the study of electricity.

In every other branch of mechanical science there are to be found text-books which give in concrete form practical data and rules for the guidance of practical workers, and while these books are in the line of memoranda and note books, and are not to be considered as substitutes for the more complete works from which they are compiled, they are nevertheless the most useful volumes in the library of the practical electrician.

Take for example the subject of dynamo or motor designing, with which the consulting engineer is often confronted, and assume any particular conditions of size, weight, speed, etc. A few men in the manufacturing business, and others who have become familiar with the subject through experience, are the only ones capable of undertaking this work, for the reason that no one outside of the few mentioned are in the possession of necessary data.

Such information, which is the most essential kind, is not to be found outside the private notebooks of a few men, and it is in just this respect that the literature of electricity is found wanting. A text-book could be readily compiled which would enable the student to design an efficient dynamo according to the conditions implied without even the use of higher mathematics, and it is doubtful if the calculus enters into the calculations of the most successful designers of dynamo machines. It is just as well to recognize the fact that there are too many factors entering into this problem to make its solution a definite one. In almost any case we have a variety of conditions which may be dealt with according to the special requirements, and which do not admit of any single absolute solution. Beginning with the armature, we have the diameter, speed, winding, section of core and degree of saturation, besides a number of other conditions, all of which may vary, and it is only by assuming values for certain of these factors that a general solution is possible. The problem, therefore, contains five or six independent variables which the most astute mathematician would at once pronounce incapable of solution.

We find then that in this branch of work the practical formulæ are largely empirical, and are based upon the result of experience. For this reason a handbook dealing with the subject of electrical machine design in the same manner that the numerous mechanical and civil engineers' handbooks treat their respective branches, would be not only a welcome addition to the literature of electricity, but a much-needed help to the practical workers in the science.

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The Situation of the Sham Trust. Boston people who are not insiders, and some New York people, are wondering at the apparent strength of General Electric stock. It looks to ELECTRICITY as if the "apparent strength" of an 8 per cent. stock still selling below 50 requires little comment.

Readers of this paper have been kept well posted from week to week on General Electric news. When there is news we have it, and have it straight.

But it should be remembered that the news of a battle is only news when the fight is going on or immediately after. The doings of the defeated and surrendered army are of slight interest. We have, therefore, paid little attention of late to the battered and defeated General Electric Company. Of news there has been none, and it is yet a little too early to write history.

Boston is still thoroughly imbued with the idea that all the troubles of the General Company are an inheritance from the Edison General Company, that the condition of the latter company was misrepresented at the time of the consolidation, and that an immense floating debt was hidden. Any one who knows anything whatever of the inside workings of the Edison Company knows that this was an impossibility. Either Mr. C. A. Coffin is a blockhead (which he is not) or else he knew exactly where the Edison Company stood. The information was within his reach.

The burden of misrepresentation is on the shoulders of no other man than Charles Ali Baba Coffin. He came to New York with the endorsement of Mr. F. L. Ames and other Boston capitalists of standing and high reputation, and it was this endorsement, rather than any special knowledge of the man himself, that Drexel, Morgan & Company accepted. They believed in him because they knew the character of his friends. It is now known, and susceptible of proof, that for once the house of Drexel, Morgan & Company were humbugged. It has been until now an unwritten fact (and it is a fact) that the late F. L. Ames had changed his opinion of Mr. Coffin absolutely, and that he was working in entire harmony with the Drexel-Morgan interest to rid the company of Coffin and his fellow gamblers who had wrecked the concern. With Mr. Ames gone, this result may be longer postponed.

The chief interest in the situation now centres in the question, Who is in control? This question is often asked, but has not yet been authoritatively answered, and for good reasons. Neither faction is to-day in full control, and when the returns are all in Electricity will be the first to announce the result. We feel at liberty to say that Mr. J. Pierpont Morgan is intensely interested in the stock, which was strongly recommended by his house as a purchase at par; and it is well known that Mr. Morgan's plans are not easily learned in Wall Street. We look for a radical change in personnel and in policy within a few weeks.

The financial condition of the company does not need to be discussed. Receivership papers were drawn up some five weeks ago, but the necessity for filing them has not yet arisen.

As to the withdrawal of the Fort Wayne Company, cool-headed men will suspend judgment. It is either *bona fide* or it is not. "There is an uncertainty in all human affairs," and two old campaigners like Mr. McDonald and Mr. Coffin need to be watched closely. Rumor has it that the Fort Wayne Company will be called the Western General Electric Company.

When the cat jumps Electricity will get a snap shot, and will duly record his landing place.

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Our Foreign Critics. Considerable has been said pro and con in regard to the results of the International Electrical Congress at Chicago, and while many of our contemporaries appear satisfied with the work transacted by that body, a few have criticised it without stint.

In regard to the work of the chamber of delegates there can be but little to criticise, as the views of the various representatives had previously been thoroughly discussed by them in the electrical press, long before the date of the congress, and for this reason nothing remained to be done during the limited session of the congress beyond ratifying the decisions which were at the time of the meetings almost foregone conclusions.

The criticism in regard to the discussions of papers, while in some respects justified, is also carried beyond the limit of reason. One of the critics laments the fact that "nothing new was disclosed"; and lamentable as this may be, it is entirely conceivable that even an International Electrical Congress may be insufficient as an incentive to new and brilliant discoveries. The criticisms on the character of the discussions, however, we feel are not unwarranted, but the failure in this respect cannot properly be charged to the congress as a body. Ample time was given to the authors of the papers to forward their manuscript and have it put in type before the meetings, but with a very few exceptions this notice was disregarded, and almost all of the papers were heard for the first time at the meetings, giving no opportunity for the members to study the subjects discussed or to prepare any careful consideration of them. Whatever is said upon this subject, it must be apparent that the failure in preparing advance copies of these papers, without which intelligent discussion was impossible, rests solely with their authors in not complying with the regulations laid down by the congress, which called for the papers in ample time for printing and distributing in advance.

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Is a man like Mr. C. A. Coffin, whose chief interest in life is stock gambling, who has encouraged all his intimate friends among his employees to follow the same bent, going so far at times as to carry their margins for them, the proper man to be at the head of a large manufacturing enterprise?

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Cleveland bankers will do well to consult—well, Mr. J. Pierpont Morgan, for instance, before they turn the money of their depositors over to Mr. Coffin to assist him in prolonging what has been from the first a disgraceful confidence game.

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A gentleman of high standing in the trade said to us last week that Mr. Coffin made the mistake of his life in not getting control of Electricity a year ago. Not so. He showed exquisite judgment in not making any such attempt.

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When the General Electric gambler employees get so low in pocket that they can't patronize a legitimate broker, they can still lose their fives and tens in the bucket shop which occupies a prominent place on the ground floor of the building at 44 Broad street.

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There is renewed gossip of a consolidation of Westinghouse and General Electric interests. It is all nonsense. Any such consolidation is an absolute impossibility.

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The men who are claiming that the Edison lamp patent runs till 1897 will know more in sixty days.

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It will be evident to those who read the communication on the "Fall of Babylon" in another column, that "Recapitulator" has been a close reader of Electricity.

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By a strange coincidence Mr. C. A. Coffin and Mr. B. E. Greene were both registered at the Hollender House, Cleveland, on Friday last.

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"I'll mine beneath their deepest schemes and blow them to the moon."

An electric street railway was built under somewhat unusual circumstances at the little Dutch town of Hanover, in Pennsylvania. A fair was to be held there during the third week of September. The residents were anxious to have the road in operation during the fair. The work not progressing fast enough for their satisfaction, they volunteered to help build the line gratuitously, and merchants, mechanics and professional men took up the pick and worked in turn on the street. A procession of about 100 men from a neighboring village entered the town one day, headed by a brass band. The men carried shovels and picks on their shoulders, and at the command of their leader set to work and made the dirt fly for several hours, during which time the band discoursed lively airs. When nightfall arrived the men formed into a solid phalanx, gave three cheers for the electric road, shouldered their tools and marched to their homes.

CORRESPONDENCE.

The Chicago District Office is Mr. Sunny's Private Snap.

To the Editor of Electricity.

My attention has been called to an article in Electricity of Sept. 6 in which you seem to express surprise "that Mr. B. E. Sunny, general manager of the Chicago office of the General Electric Company, should be called to New York to explain how the final balance sheet of his office should show a net loss of a quarter of a million dollars."

Allow me to say that "there are stranger things in this world than are dreamt of in thy philosophy, Horatio," but the strangest of them all is the management of the General Electric Company in this so-called Western District. To a business man it is surprising, patterned as it seems to be after the manner of politicians, who on the eve of a general election, to perpetuate their power, attempt to blind the eyes of the people by a so-called policy of retrenchment and reform. Permit me to give you a few facts to assist you in solving the problem.

Under Mr. Sunny's management the sales department of the Chicago office alone, aside from the large clerical force engaged, is divided into seven departments—railroad, central station, isolated, supply, meter, motor and mining—at the head of each a high salaried manager, particular cronies of his, educated in his peculiar methods of doing business. The several departments employ all told from 25 to 30 salesmen, or a manager to every four agents. The late "close the barn door after the horse is stolen policy" of Mr. B. E. Sunny is as ridiculous as any of his previous acts, discharging as he has many poor paid employees through whose labors the business has grown to its present large proportions, but still retaining all his high salaried managers, his particular friends. Is it a wonder that you or any business man would express surprise? Is there any business, however prosperous, that would not fall behind under such a policy? With such a showing the many stockholders cannot but look anxiously for the return of the next "dividend declaring day." Enough at present. If you wish, I may at some future time throw a little more light on the "ways that are dark and peculiar" in the Chicago office of the General Electric Company. Yours,

Chicago, Sept. 15, 1893. Stockholder.

THE FALL OF BABYLON.

A Recapitulation.

Below is given a summary of a few of the impartial items on the way that the Only Electric Company down in Lynn carry on their business, previously published in the popular electrical journal, Electricity.

How any company who depend on the commercial world for their livelihood could expect to exist when they have treated the "outs," as they term them, as they have, would be hard to answer.

The games of deception played and the fairy tales told by the company which formed the nucleus of the whole nefarious conspiracy will remain on history's pages as a "horrible example," as one of their engineers termed the direct current plans submitted to the Niagara Consolidated Company before they got an inkling of what some other company was doing.

Their contribution of $1,000 to the New York Press Club is where part of their next January dividend has gone.

Said a large contractor: "The days and doings of such a Trust are numbered." And he had cause to. Having signed a $200,000 contract, he was tendered in payment a check discounted to the tune of $12,000. When he insisted, they tried all the bluff games they knew, but the contractor was firm and was finally paid. Any business firm who can trade with such a deceiving company must be sorely in want.

Then came the Detroit episode. Detroit wanted municipal lighting by the vote of its people. The Only Company did not want that they should. At a Common Council meeting the mayor of the city produced $200 in bills, the paltry sum which had been given to one of the aldermen as a bribe. It is said that they were going to spend $25,000 in this way. Here's where the useless expenses count up.

How any city can negotiate with a company having such low, sneaking methods of procuring business is hard for one to see clearly.

While the Only Company have some smart engineers down in Lynn, they are not over ingenious or of the inventive nature, as their line of production shows.

They wait for the sun-Brown-ed engineer from Switzerland to design their four-pole generator, and a Western-house for its alternator, direct copy. But they are afraid that this Western-house will have something new, so they send one of their draughtsmen down there to enter their employ for the sole purpose of stealing all he can that is new and send it to the New York office. But this Western-house knew a thing or two, and while a little late, they had the whole gang of thieves and bulldozers arrested. True bills were found against them, and convicting letters were shown with their signature on them, but the jury disagreed. This shows that at least there was some ground for the charges, and that some jurymen could not be bribed, possibly.

From the lawsuits that they carry on, one is not surprised that they had to have another company formed to supply them with funds to pay debts and carry on their bluff games. Just what a share in the third company signifies it is hard to tell.

They try to shut up all competing lamp factories, but only encourage the Yankee inventive powers by so doing.

They make the flimsy misrepresentation that they own all the patent rights on the under-running trolley, which is really more comical than serious.

The Joliet Prison affair shows bribery and rottenness somewhere. The Illinois Legislature having appropriated $200,000 for an isolated plant, advertised for bids in the town paper, with a circulation of several thousand, more or less, so every engineering company could see it, and a Chicago weekly.

The plans and specifications submitted to the different bidders all bore the stamp of the Only Company, and were so worded that only their apparatus would answer all the specifications. Boilers were drawn in the plans which could only be furnished by one manufacturer, who of course stood in with the Only Company.

Stock of such a company has been a regular Wall Street football. When stock whose par value is $100 sells down to less than 50, and paying 8 per cent., which is of course at the present price more than 16 per cent. on the amount invested, is a drug on the market, there must be something rotten in Denmark.

Their latest known low-lived trick at which they have been caught is the stealing of signs from the exhibit of another Western concern's exhibit at the World's Fair.

It seems to be against their nature to conduct their business on an honorable basis, and the sooner they drop out of the commercial world the better it will be for all concerned.

RECAPITULATOR.

Bids Wanted.

Bids will be received up to October 2 next for apparatus for an electric light plant at the State Asylum at Wernersville, Pa. Specifications, etc., may be had of Mr. R. Meckle & Co., Drexel Building, Philadelphia.

W. A. Drysdale, 20 Hale Building, Philadelphia, will furnish specifications, etc., for a plant at the Norristown, Pa., Asylum. Bids will be received until October 25.

Iron for Transformers.

BY PROF. J. A. EWING, F. R. S.*

In selecting iron for use in the core of a transformer, the first consideration is smallness of hysteresis losses; high permeability is comparatively a secondary desideratum. These two good qualities do not necessarily go together; the curve of the B–H cycle may have a relatively easy slope, and yet inclose a relatively small area. In actual tests the author has noticed that the order of merit in a set of samples is not always the same if permeability be made the criterion as it is if smallness of hysteresis losses be the criterion.

Notwithstanding the obvious and well recognized importance of small hysteresis losses in transformer iron, the metal that is actually used is often of a very poor quality in this respect. The author has been much struck by this in the course of a recent experimental inquiry in which ten or a dozen specimens of iron were examined, most of which were supplied either as transformer iron or as specially pure metal prepared for the purpose of the experiment. In only one case were the hysteresis losses as low as they had been found to be in some wire which the author tested in 1881, in the laboratory in the University of Tokio, and in most cases the losses were much greater. In the Japanese tests which were made before the days of alternate-current engineering, when the word hysteresis was to be found nowhere but in the Greek Dictionary, wires were taken at random from the stock which the laboratory chanced to furnish. Two of them were about equally good; one of them was probably a piece of native iron, and the other was wire sent by an American manufacturer to an exhibition in Japan. Since then many observers have made tests, and, obtaining decidedly inferior results, have not unnaturally been led to express themselves in terms of politely veiled skepticism about the Japanese figures. It is therefore interesting to notice that one sample among those most recently tested by the author has given results which are substantially on a par with those given by the Japanese wires. Under strong magnetization it is not quite so good, but when the magnetization is moderate or weak there is practically no difference. The sample in question was thin sheet iron, used by a well-known English firm in the building of their transformers. But the corroboration of the old figures, interesting as it is, only serves to emphasize the contrast between the good and the bad. Other iron, also used by eminent makers of transformers, and also, like the last, carefully annealed before testing, turned out so markedly inferior that the author does not care to indicate the sources of his specimens by any more particular description. And the case was even worse with some iron supplied as specially soft and pure.

The following figures may be taken as representative. They give the value of $\int$ HdI, or the hysteresis loss incurred in a complete cycle of magnetic reversal, for various values of the magnetic induction B which is reversed. Column 1 states the results of one of the old Japanese tests, column 2 refers to the good sheet iron mentioned above, and column 3 refers to another specimen of transformer metal, where it will be seen the losses are about half as great again as in the other. Column 4, where the losses are much greater still, relates to a test of some wire which was furnished as a specimen of particularly fine Swedish charcoal iron.

TABLE OF HYSTERESIS LOSSES.

Values of $\int$ HdI.

B.	1.	2.	3.	4.
2000	400	420	600	1100
3000	780	800	1150	2150
4000	1200	1260	1780	3300
5000	1680	1770	2640	4700
6000	2300	2370	3360	6200
7000	2800	3150	4300	7800
8000	3430	3940	5300	9500
9000	4160	4800	6380	11400
10000	4920	5730	7520	13400
11000	5800	6800	8750	15600
12000	6700	8000	10070	

The figures given by Mr. C. P. Steinmetz in his paper on the Law of Hysteresis (Am. Inst. Elect. Engrs., 1892) give additional evidence of the wide variation which this quality is liable to exhibit in different specimens of nominally soft iron.

Chemical analysis is apparently an imperfect guide in the estimation of magnetic quality, and to some extent this is intelligible enough. Puddled iron, for instance, liberally streaked with slag, may seem on analysis less pure than specimens of ingot metal which have much higher hysteresis losses. It is not improbable that much of the inferiority of which most modern sheet and wire iron undoubtedly shows in this respect may be due to traces of foreign elements which have become chemically incorporated with the metal through the use of methods of manufacture which are ill adapted to yield a good product from the magnetic point of view, however successful they are in producing a mechanically good iron. Manganese, so essential to the strength and toughness of ingot iron, is well known to be deleterious magnetically.

The makers of transformers complain that they are unable to get metal of the quality they want except by a kind of happy accident, that the conditions which bring about a good result are so imperfectly understood that they cannot be reproduced with any certainty. Much the same thing was true in the early days of mild steel, and incessant testing contributed to put matters on a surer footing. Magnetic testing is now easy for makers as well as users of iron, and it may be expected that specifications of magnetic quality, and particularly of hysteresis losses, will soon become commoner than they are. From being a mere laboratory affair, interesting only to the curious physicist, the subject has in a few years advanced to the front rank of practical questions, and affects wide commercial interests.

The form and general design of transformers has received all possible attention at the hands of engineers, but of the material which mainly determines their efficiency we apparently know very little. It is scarcely satisfactory to reflect that good makers are turning out machines which waste twice as much power as they need waste.

The author brings these remarks before the Congress in the hope that some suggestions may be made which will lead to a better understanding, as between electricians and iron makers, of the conditions which govern the production of magnetically soft iron.

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[*] Paper read at the International Electrical Congress, Chicago.

because in so doing my honest conviction is that we are preparing the way to utilize those dynamos in every direction in which alternating current transmission is going to be developed in the next ten years. The two phase system has not only the advantage of being able to work the two phase motors, but it has the enormous advantage that it gives you two single phase circuits. You are able to work each of those with all the single phase machinery which is going to be invented in the next ten years, and at the same time you have all the advantages of the splendid work which is being done on the two phase system, and I wish that we should be able to have both of these advantages. The dynamos which are going to be put down at Niagara are capable of generating either single phases or two phases. A dynamo so constructed will give you the single phase cheaper than if it was constructed with one circuit; that is to say, there is a larger output from two single phase generators than from one single phase circuit from a single phased generator of the same dimensions.

Mr. Chairman and gentlemen, I feel that I have occupied a little more than five minutes, and in that time it is quite impossible to say one tithe of what I feel is due to the importance of the subject. I have tried briefly to summarize the results which have been arrived at by myself, and which I think all those who have been investigating with the same care have arrived at at the same time.

MR. STEINMETZ.

The chairman then introduced Mr. Steinmetz, stating that he would close the discussion. Mr. Steinmetz spoke as follows:

We have heard quite a number of able discussions on the different methods of power transmission and distribution. The largest amount of power which is distributed and used in the United States to-day is distributed by continuous current. I am speaking of the hundreds of thousands of horse power used to propel our street cars. That shows that the continuous current is not dead yet, and the very fact that their rotary transformers have recommended a machine to transform polyphase currents into continuous currents shows that even the advocates of the polyphase current still concede that they cannot get along without the old continuous current.

Now, with regard to the polyphase and single alternated current, it makes no difference how many phases you use, because any system of polyphase currents can be transformed into any other system of polyphase currents by using two transformers only. Furthermore, the motors of the different polyphase systems are essentially the same, worked by the same principles, and the differences which are found are rather mechanical in their nature, but not electrical. If I may be permitted to make an outlook into the future, although we do not know what to-morrow will bring, I think the system of the future will be the single phase system. Where the power is generated by a single or alternate current transmitted along a long distance wire by overhead wires the ground is perfect. There is no danger to life there, because one who touches a 20,000 volt line, whether it is grounded or not, has no chance to do it again, but if we use a single phase current in the power transmission of the future then we will have to learn many other things. We will not be troubled any more with self-induction, with capacity, but proper appliances will eliminate or abolish the effect of self-induction and capacity so that they are entirely annihilated in their effect on the line, and even the loss of energy and of resistance will not be carried any more by a less potential. In a continuous constant current for arc lighting or for any other use, perhaps we are nearer to this ideal condition than we all think.

Personal.

Mr. E. P. Roberts, of Cleveland, is about to open a school of Applied Electricity in that city, which will be conducted entirely on the correspondence method, which has lately come into very general and successful use. Mr. Roberts is well qualified to carry on this work, having graduated from Stevens Institute with the degree of Mechanical Engineer and held a number of important positions both in mechanical and electrical engineering work, as well as the associate professorship in electrical engineering at Cornell University. Mr. Roberts will still continue with his consulting firm of E. P. Roberts & Company, and has the best wishes of his friends in the electrical field for success in his new undertaking.

Legal Notes.

Attorney-General Olney in a petition filed in the Supreme Court, Washington, D. C., on behalf of the Government of the United States, asks that the franchises held by the Metropolitan Railroad Company of Washington be declared forfeited. The petition shows that on August 6, 1890, a law was enacted requiring certain street car companies operating in the District to discard horse power within two years from the passage of the bill, and to equip their lines with mechanical power, it being optional with them to choose either cable or underground electric power. July 22, 1892, the companies were by act of Congress granted an extension of time to August 6, 1893. The Metropolitan Railroad Company having neglected to comply with the law, the petitioner asks that they be brought into court and made to show cause why their charter, granted by the District government in July, 1864, should not be revoked.

Justice Hammond of the Massachusetts Superior Court has handed down his decision in the case of the Wightman Electric Manufacturing Company vs. the Union Street Railroad Company of New Bedford. This was a case brought by manufacturers in Scranton, Pennsylvania, for the price of certain car equipments furnished by contract, which the railroad company refused to use or pay for on various grounds, claiming there was fraud on the Wightman Company's part in making the contract, and on the ground that after the making of the contract the Wightman Company became insolvent and made an assignment. Judge Hammond now finds that there was no fraud, and gives a verdict for the Wightman Company in the amount of $8,239.94.

The State Electric Company of Clinton, Iowa, having discontinued their street cars and abandoned their line on North Third street, Clinton, have been sued for $15,900 for breach of contract by Pauline Williams, Amanda Gibbs and Josephine Cook, property owners affected by the abandonment of the line.

The Chattanooga Electric Light Company, which was incorporated in December, 1888, with a capital stock of $100,000, has filed a general creditors' bill in the United States Court for the benefit of the bondholders. The outstanding bonds amount to $150,000. D. J. O'Connell was named as receiver, and will take immediate charge and continue the operation of the plant.

Suit for $100,000 damages has been instituted by T. J. Preston & Company, oil manufacturers, of No. 80 River street, Newark, against the Newark Electric Light and Power Company, whose works adjoin Preston & Company's. The latter allege that their factory and stock have been damaged to the extent of $100,000 by the vibration of the electrical machinery used by the electric company.

E. W. Tolerton, attorney for the Electrical Supply Company, has filed nine answers to intervening petitions in the United States Court at Toledo in the case against the Put-in Bay Water Works, Light and Railway Company. Nearly all the petitions set up mechanics' liens for materials used in the construction of the road. Answering these, the complainant says that it is informed that a large part of the material furnished by the Cleveland Electrical Manufacturing Company, the Railway Equipment Company, Frank Hake, Bodefield Belting Company, Barbour & Starr, M. Haughton & Company, and Arbuckle, Ryan & Company was used in the construction of Hotel Victory, an organization entirely separate from the railroad company, and asks the court to order an investigation.

The Brooklyn Edison Company is Prosperous.

The Edison Electric Illuminating Company of Brooklyn have declared the quarterly dividend of 1¼ per cent. Secretary R. C. Peabody says that the outlook for the coming fall is far ahead of anything anticipated by the company. The business as compared with last year shows an increase of nearly $67,000 in business and an increase of nearly $35,000 in the surplus.

The Young Men's Institute.

On Tuesday evening, October 3, special exercises will be held in the hall of the Young Men's Institute, 222 and 224 Bowery, to formally open the educational work of the season of 1893-4.

This institution has for several years been doing a very valuable work in offering to young men engaged during the day exceptionally good evening classes in subjects bearing directly on their daily work.

Technical subjects assume a prominent place in the curriculum.

The school year continues until May, when prizes, diplomas and certificates are awarded.

The classes are open to all young men from 17 to 35 years of age.

Boston Notes.

Prof. Von Helmholtz, the eminent German savant, who has been present at the Electrical Congress in Chicago, spent a few days in Boston, where he found much to interest him. He took in the sights in and around the Hub, including visits to Harvard University, Institute of Technology, the General Electric Company's factories at Lynn, and other places. During his stay he was entertained in a manner befitting his distinguished reputation and eminence as one of the foremost scientists of the age, and expressed himself as deeply interested in all he saw.

The Newton, Mass., Street Railway Company whose system is operated by electricity and connects with the West End Railroad system of Boston, has declared a quarterly dividend of 2 per cent. besides adding $5,000 to the reserve fund. Its Watertown branch, which cost about $60,000 and was opened not long ago, is already about paying expenses.

The Thomson Scientific Club of Lynn, Mass., which was composed of employees of the Thomson-Houston Electric Company, after a most useful career is sharing in the ill effects of the general depression. For several winters series of most useful meetings at which scientific topics were introduced and discussed have been held, and gentlemen prominent in the electrical field have been the speakers. The club had a long roll of members and excellent quarters. Owing to the serious changes that have been made in the management and vacancies occurring in the ranks of the employees, the question has had to be brought up whether the club shall disband or not. At a meeting called for next week the matter will be thoroughly discussed and a decision arrived at. Some of the older members desire to see the club continue its useful work as heretofore.

It would appear as if the question as to whether an electric car track shall or shall not be laid through Brattle street, Cambridge, would never be settled. A few weeks ago there was a blockade in the city government caused by the mayor vetoing an aldermanic order authorizing the construction of such a road; then the mayor appears to have been induced to give way and sanction the order. This looked as if the work would go right ahead. But not so. President Eliot of Harvard University and Professor Charles Eliot Norton have now taken the matter up and addressed appeals to the Railroad Commissioners against granting the authority needed. Brattle street, the thoroughfare in dispute, is certainly very attractive and a desirable street on which to reside, but it is still more, according to the dictum of President Eliot, who declares "There is no other piece of road in the United States on which Washington lived for eight months, and which is also intimately associated with the lives of many American poets, orators and scholars. In fact it is a street unique, not only in Eastern Massachusetts but in the entire country. Moreover, as the result of its natural development, it is a mile of road handsome in itself because of its curves, trees and shrubberies. It is a Cambridge possession to be sure, but one held in trust for the whole country, and like Bunker Hill Monument or Independence Hall. The street will not remain a handsome one if an electric road is permitted there." Truly President Eliot waxes eloquent, yea, he almost ascends to the region of poetry, but it remains to be seen if the State Railroad Commissioners, who are hard-headed men of business, will respect these traditions of the past, or grant authority for the introduction of that modern innovation, which has no cerements of the past clinging about it, but is the very embodiment of progress.

The electric street railway business at the factories of the General Electric Company remains much the same as it has been for the past few weeks, reports to the contrary notwithstanding. A temporary slight improvement has occurred in one or two departments, but what workmen have not been laid off are working three days a week. On top of the wholesale discharging and short time, it has been determined to reduce wages from 12½ to 15 per cent. all round. Meantime the work of deporting the clerical staff from Boston to New York continues, the only alternative for declining to go to New York being voluntary dismissal. Truly it is a pathetic sight to see the thousands of unemployed with their wives and families beginning to feel the pinch of poverty, while the debilitated and decrepid Trust drags its emaciated form around and continues to keep above ground for apparently no other cogent reason than to save funeral expenses. The report of the possibility of a new Edison enterprise being organized is adding still more to the bitter pill the General Electric is at present being forced to swallow.

The first electric railway yet built in the State of Vermont was completed on Thursday last, having cost $125,000. It is the Burlington and Winooski Electric Railway. It is a single track line about five miles long and will have several branches in time. At present power is furnished for running the eight cars by the Consolidated Electric Company, but on completion of a new power station the Vermont Electric Company will supply current. The construction work was done by G. H. Gore & Company of Boston.

On Friday Judge Colt, in the United States Court at Boston, handed down his decision in which he enjoins the Milford and Hopedale Electric Company from using the Usher storage-battery, it being decided that the same is an infringement of a patent owned by the Brush Electric Company of Cleveland.

An effort is being made to bring about a consolidation between the Thomson Electric Welding Company and the American Projectile Company, the object being to place both enterprises under a single management and so reduce expenses. Should success attend the efforts of the proposers of this change a new company will be organized having a capital of $1,000,000, which would be $500,000 less than the two existing companies' combined capital. The Projectile Company holds some good contracts from the Federal Government for projectiles, but the Welding Company is not in a particularly healthy state, hence the project for consolidation.

Mr. George F. Porter, the genial and popular secretary of the National Electric Light Association, was a visitor to Boston the present week. He called at the office of ELECTRICITY, where he met with a very welcome reception. Mr. C. O. Baker, Jr., who prides himself on having a stray acquaintance here and there in New England, accompanied Mr. Porter to the Hub, and was no less welcome.

The Messrs. Thurnhauer Bros., of Paris and Berlin, one of whom represents the Thomson-Houston International Company in Europe, the other having recently identified himself with the General Electric Company in the factory at Lynn, were in Boston a few days ago, and besides calling on some old European acquaintances made several new American ones. While these gentlemen report business as being dull in Europe, it is in nothing like the state of utter demoralization that prevails on this side of the Atlantic.

"Our company has got the worst attack of the rattles I ever knew," said an officer of the General Electric Company a few days ago when speaking about the Trust and its current bedraggled plight.

The handsome new structure, to be known as the Union Depot, that is being erected by the Boston and Maine Railway Company, to accommodate all trains entering and leaving Boston for the north, is being rapidly pushed to completion, and is to be equipped throughout with electrical apparatus for illuminating and power purposes. A contract has been closed with the Westinghouse Electric Company for the entire equipment, the plant to have an aggregate capacity of 1,100 H. P. There are to be four Westinghouse generators coupled direct to compound condensing engines of 200 H. P. each. Two of these machines will supply current for 4,000 incandescent lights for the interior of the buildings, head house, etc. The other two will furnish power to the various motors which are to be installed for operating drawbridges, turntables, elevators, coal handling machinery, etc. In addition to these there will be two compound engines of 200 and 100 H. P. respectively, driving alternating current dynamos for lighting at what is called Prison Point and East Somerville, together with the track lighting and signal towers. All the engines will exhaust into an independent condenser, using sea water. A battery of twelve horizontal tubular boilers will supply steam. A striking feature of this plant will be the system of mechanical draft which will take the place of a chimney 200 feet high, which would otherwise be required. A steel stack rising only 55 feet above the ground level will deliver the flue gases at a height sufficient to clear the roof. Draft will be furnished by two large fans, each driven by a small independent engine and capable of doing the entire service when required. The hot flue gases will be drawn through economizers, and the heat thus extracted will be returned to the feed water, thus insuring corresponding economy in the consumption of fuel.

The immense express business that is done between Boston and the surrounding cities, towns and villages has assumed such proportions that it is with difficulty handled. In view of this fact, some of the capitalists who are interested in the Lynn and Boston and other electric railway systems which now extend from the various centres of population, have under consideration a plan for running freight cars over the roads for carrying express packages. The plan is meeting with the approval of many manufacturers and merchants, and when the project has been worked out in all its details it is expected promptly to be adopted. The freight cars would be run in between the passenger cars, the time schedule being so arranged that there would be no delays.

Canadian Notes.

The Department of Customs has granted the application of the Western Union Telegraph Company to land free of duty at Canso a portion of a cable which is to be used in repairing the Anglo-American Company's cable nine miles from the Nova Scotia shore.

It is reported that the directors of the Toronto Electric Light Company have obtained a controlling interest in the Hamilton Electric Light Company.

The Brantford Electric and Power Company have been awarded the contract for city public lighting for a series of five years.

Mr. John M. Goodell, editor of the *Engineering Record*, has written to City Engineer Haskins, of Hamilton, suggesting as a remedy for electrolysis that the water pipe, gas pipe or telephone cable be connected with heavy wires with the ground wire for the trolley road. In Hamilton, however, there is no ground wire, the rails being bonded and acting as a return.

The Brantford City Council has been considering proposals for the establishment in that city of a branch of the Gaynor Fire Alarm Company of Louisville, Ky. The proposals, however, were considered to be rather one sided, and the negotiations have come to naught.

The London City Council have referred back Col. Clark's application for an exclusive electric railway franchise, which virtually means throwing it overboard.

The trolley freight idea is about to have a practical application in Toronto and York township. The Toronto and Scarboro Electric Railway has made a contract with the Toronto Railway Company for right to run freight cars over the lines of the latter into the centre of the city. This will involve a rail connection being made between the lines of the railways at the Queen street and Kingston road junction.

Mr. F. W. Martin has been appointed to take charge of the plant of the Hamilton Electric Light Company. He has been for nine years in the Toronto Electric Light Company's power house under Mr. Wright, and goes to Hamilton equipped with a thorough knowledge of his business.

William Cox, of Hamilton, has invented a trolley fender. The frame of the apparatus is built of wood with a wire netting and projects in front of the car about 3 feet 6 inches, being the full width of the track. It can be raised or lowered according to the roadbed, by means of hinged eyebolts. The frame sets close to the rails and forms a wire bed on which the victim falls instead of going under the wheels.

The Finance Committee of Hamilton met on Tuesday evening to consider the offer of the Hamilton, Grey and Bruce Electric Railway Company to settle the dispute as to right of way through the city streets. The company offered to arrange with the Hamilton and Dundas Railway Company for the joint use of each other's track, the same to be free of mileage and other charges for ten years. If at the expiration of that period the company is able to pay a dividend of 8 per cent. per annum, the company will pay a rental of $200 a year until Dec. 13th, 1913, after which the rental shall be fixed by arbitration should the parties differ. Alderman Morris moved a resolution embodying the offer of the company, but fixing the mileage after ten years at $200 a mile. The motion was lost on a tie vote. Finally it was decided, on the request of the H. G. & B. solicitor, for the committee to make a report to the council, and leave the aldermen to settle the awkward question.

The electric railway service was inaugurated in Kingston last week, and everything seems in promising shape. Saturday was the last day for running horse cars for some time.

The General Electric Company intends removing its Hamilton lamp factory to Peterboro' in the course of a week or so.

A year ago Thursday the first electric car was run in Montreal, and in November the company will celebrate the thirty-second year of its existence.

General News.

What is Going on in the Electrical World.

Milwaukee, Wis.—The receiver's sale of the Milwaukee Lighting and Power Company's plant on the 11th having been declared illegal, the sale will be readvertised.

Omaha, Neb.—The Nebraska Telephone Company has completed its new metallic circuit between Omaha and Hastings, and also between Omaha and Walnut, Iowa.

Utica, N. Y.—The three years' contract of the Utica Electric Light Company with the city expires December 31. Much competition for the new contract is expected.

Atlanta, Ga.—The Atlanta Traction Company has purchased the Atlanta City Street Railway. T. B. Eelder, of the Traction Company, will continue president of the system.

Detroit, Mich.—It is stated that all the necessary financial backing for the Detroit-Toledo electric railway line has been secured, and that a company will shortly be formed to take hold of the project in earnest.

Elmira, N. Y.—An electric dynamo manufactory established here last winter by John L. Cooper and George H. Young, for the manufacture of dynamos of from one to six horse power, has had a good local trade.

Eau Claire, Wis.—M. H. Hewett, who obtained a franchise to operate an electric street railway at Eau Claire, has asked the council for an extension of time. He says he cannot commence the road until about May 1.

Salisbury, Md.—W. R. and W. T. Johnson of Milford, Del., have purchased the franchise and privileges of the Salisbury Electric Light and Power Company, whose plant was burned in April last, and will begin work at once to put in a new plant.

New York.—Corporation Counsel Clark has rendered an opinion that the Board of Electrical Control has no power to grant the Broadway cable road a franchise to lay a wire or wires in its cable conduits for the purpose of operating signals along the line.

Savannah, Ga.—There is a probability that the Tybee railroad, 18 miles long, will be equipped with electricity when the road is rebuilt.—The Brush Electric Light and Power Company has secured control of the People's Light and Power Company by purchase.

Muncie, Ind.—The Citizens' Street Railway Company and the Muncie Street Railway Company have been consolidated under the name of the first mentioned company. The work of changing the Muncie line (dummy) to an electric will begin as soon as possible.

San Francisco.—The Mid-winter Fair is receiving encouragement from all quarters. The Executive Committee received a check for $5,000 from Chicago last week in payment for the concession for the big electric tower, which the projectors desire to begin work on at once.

Plainfield, N. J.—The directors of the electric railway company have decided to extend the road down West Front street to Dunellen, and will begin work this fall. In the spring they hope to extend the road to Netherwood, when the entire city will be covered by rapid transit lines.

York, Pa.—The board of directors of the York and Dover Electric Railway Company, having approved of the surveys of the civil engineers, will take measures to ascertain the cost of the right of way, and as soon as this is settled will proceed with the construction of the road.

Elizabeth, N. J.—The New Jersey Consolidated Traction Company has applied to the board of freeholders for a franchise for an electric railway from Newark to this city. A special meeting of the board has been called for October 2, to give the applicants an opportunity of being heard.

Kingston, N. Y.—The new electric motor invented by Mr. Winkler of the United Columbian Electric Company, this city, was given a test here a few days ago which proved satisfactory to those interested. The Winkler motor works either way, necessitating only one motor to a car instead of two.

Red Bank, N. J.—The Gillett Electric Manufacturing Company, whose factory is located here, has elected these officers: Directors, Senator William J. Keyes of Somerville; Thomas Patton, Jr., of Long Branch; Joseph F. Bray, William T. Corlies and Thomas Davis, Jr., of Red Bank; president, Senator Keyes; secretary and treasurer, T. Davis.

Salt Lake City, Utah.—Col. W. J. Sutherland of London, Eng., recently visited Salt Lake. To a reporter he said: "We are delighted with Salt Lake. The street railways and electric light systems are as fine as any city can boast of. You know the electric light system is owned largely by Englishmen and we are proud of it."

Wilkesbarre, Pa.—The People's Electric Railway Company have begun work on their line from Nanticoke to Glen Lyon, Alden, and Wanamie. The officers of the new company are: President, K. M. Smith; vice-president, Henry Schappert; secretary, T. D. Garman; treasurer, John M. Garman; directors, the foregoing and George T. Morgan, Benjamin Bache and Joseph Schappert.

Montreal, Can.—The Montreal Street Railway Company, which holds an agreement extending until the year 1922 for the use of the streets of the city of Montreal, is now raising in England a loan of £140,000 on 4½ per cent. debentures £100 each. The money is required for the purpose of doubling the existing lines and for the necessary outlay required for working the system by electricity.

New Orleans.—The Great Southern Telephone and Telegraph Exchange has purchased a site for a new telephone exchange building in this city, paying $25,000 for the site. The company controls all the wires in the city and outlying districts used for telephonic purposes.—A petition signed by a number of leading citizens has been filed in the Civil District Court, enjoining the city from selling the franchise of the city and lake railroads.

Washington, D. C.—The project of building an electric railway between Baltimore and Washington, which has been lying dormant for some time on account of the monetary depression, has been revived and will now be pushed forward with energy. The syndicate which has control of the franchise is composed of Messrs. Elkins and Widener of Philadelphia, Hambleton of Baltimore, David Newbold, Charles E. Savage, Charles B. Calvert and Howard Munnikysen.

St. Paul, Minn.—F. H. Wheelock, engineer of the Franklin School, has just completed a model of a new electric fire engine, a patent for which will shortly be obtained, that seems destined to work a revolution in fire extinguishing apparatus. It does away with the use of coal, and can be put in action with one horse and one man less than the engines now in use. The engine weighs but 4,500 pounds, and is of 70 horse power. This makes the machine weigh 9,000 to 10,000 pounds less than the apparatus now in use while its efficiency is claimed to be much greater.

Terre Haute, Ind.—The *Express* states that "Fred Ray, chief engineer of the Terre Haute Street Railway Company, has perfected an improvement on the trolley wheel and harp. The one now in use makes it necessary to remove the entire pole when a trolley wheel is worn out. This causes considerable trouble, and Mr. Ray's improvement is to do away with the difficulty. Instead of the present device the improvement is made by making the harp, which holds the wheel, separate from the piece which fits in the hole. In this way a wheel can be removed by means of a set screw. Mr. Ray has also made several other improvements in the trolley."

Chicago.—One of the interesting incidents of Railway Day (16th inst.) at the World's Fair was a tug-of-war between a steam and an electric locomotive, the latter a 600 horse power machine built at the General Electric Company's works at Lynn, Mass. The steam machine was a modern Baltimore and Ohio locomotive. The contest was witnessed by a large crowd and resulted in a victory for steam. The victorious locomotive weighed 30 tons on the driving wheels, the electric 25. The former pulled and backed the latter all over the track.

Mt. Vernon, N. Y.—It is reported that the "Woolverton Glow-Arc Light Company" has purchased a site here for the erection of a factory, foundry, mills and laboratory, and intends commencing work at an early date. The company expects, it is said, to expend not less than $275,000, and employ not fewer than 200 hands for the first year, and also to make a like expenditure each succeeding year and increase the number of employees from year to year as the business may require. A portion of the capital stock of the company has been subscribed for, the remainder is now offered to public subscription. John E. Woolverton, the president, resides at No. 1,671 Third avenue, New York City.

Worcester, Mass.—The Consolidated Street Railway Company, since December 1, 1892, when John N. Akarman took charge as general manager, has expended $600,000 in various improvements in construction and equipment. Twenty-one miles of new track has been completed, the splendid new power house is nearly finished, and a car house with a capacity for 150 or 160 cars is nearing completion. The overhead construction for the whole system will soon be in working order. More than a hundred miles of overhead wire has been strung, the feed wire being the largest made by the Washburne & Moen Company and the longest used on any street railway in the State. $50,000 more will be expended before the road is completed.

Rochester, N. Y.—The Citizens' Light and Power Company is a new organization, capitalized at $150,000, now establishing a plant here to compete with the present lighting company whose service has not been altogether satisfactory. The company will at present supply light from two Westinghouse incandescent and two Western electric dynamos, but a large amount of special machinery, including dynamos for a multiphase system, will be added. The officers of the new company are: President, Robert M. Myers; vice-president, H. Wheeler Davis; secretary, E. M. Higgins; treasurer, P. V. Crittenden. J. A. Olmstead will be superintendent.—Another new electric company, the Central Light and Power Company, has been established here with a capital of $25,000. Its officers are: President, I. W. Butts; vice-president, H. L. Barker; secretary, F. S. Macomber; superintendent, G. A. Clark.

The New Factory of the Electrical Storage Company of Philadelphia.

The Electrical Storage Company of Philadelphia has begun the erection of a new factory for the manufacture of its storage-battery cells. The location of the building is near the Germantown Junction on Allegheny avenue Philadelphia. The present factory of the company, at Gloucester, proved too limited for the fast-growing business of the concern and a more commodious structure having better shipping facilities, became a necessity.

The company manufactures what is known as the chloride accumulator, a modified form of the Laurent-Cely storage cells, which is widely used in France and on the continent of Europe. These cells are used in more than twenty sub-stations in Paris and supply the electricity which lights a large part of the French metropolis and propels a number of the street cars. The electrical current is generated at a distance, is brought into the city at a high potential, and is used to supply the storage cells of the sub-stations. From the cells thus charged the current is conveyed at a pressure of 110 volts to the motor and lights in the immediate vicinity. The advantages claimed for this arrangement are numerous, not the least being the saving of copper wire and costly underground service. The electrical generators are situated at convenient points as regards low cost of real estate and facility in procuring coal. A single line of conductors supplies all the sub-stations and it is unnecessary to keep the machinery in motion night and day to supply occasional calls for the current at unusual times. On one occasion the Government inspector ordered all work at the central power station to cease for 72 hours while an inspection of the boilers was being made. During this period the surplus energy stored at the sub-stations was called on, and no diminution of the amount of electricity supplied to the customers was necessary. For three days the storage cells supplied all the current used in the portions of Paris supplied by this service through the energy stored in the accumulators. The Germantown electric lighting station has used the chloride accumulator with great economy, due chiefly to the fact that it was necessary to run only a part of each day of 24 hours, instead of maintaining a continuous service of engineers and firemen.

The principal officers of the company are W. W. Gibbs president, Herbert Lloyd general manager, with offices in the Drexel Building, Philadelphia.

Incandescent Lamp Cord Adjuster.

The accompanying cuts show the design and shape of a very cheap and efficient adjuster for incandescent lamp cords, the same being a device for which there has long been a demand. To secure public recognition a device of this kind requires to be both cheap and capable of easy attachment. There are two points of excellency about this invention which recommend it to all, for it is so cheap that no one can afford to be without one, while by its aid an incandescent light can be instantly adjusted to any position within its range, the cord being held firmly without the slightest wear or tear.

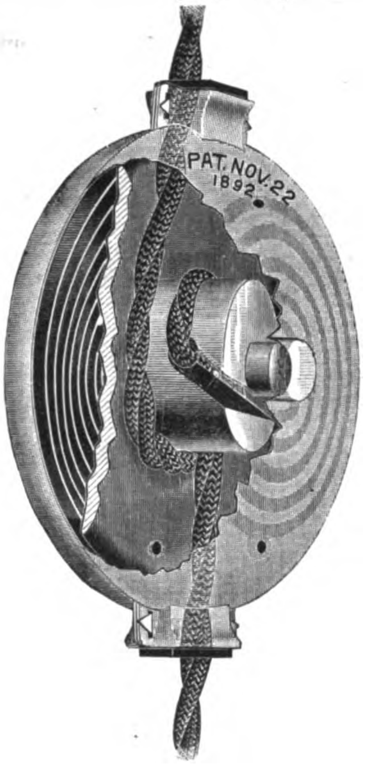


FIG. 1.

As may be seen from the cuts, this device, unlike others on the market, can be placed in position almost instantly without detaching the cord from lamp socket or rosette, thus saving time and annoyance. It is made in unique design, very light and compact, there being no heavy weight for the cord to support, and is guaranteed to fill every claim made for it.

In describing this apparatus, we would refer to the cuts Fig. 1, showing the adjuster attached in position on a cord, with a part of the brass shell removed to show the wood spindle with the cord slot through which it passes, with the cord in position, one flange on the wood spindle being partly broken away to show a position of the regulating spring. Fig. 2 shows the adjuster with one-half the brass removed, these shells being made of brass and stamped into shape. The two halves have small slots and points conforming the one to the other so that when the inner spring and wood spindle all have been placed in position the two brasses are placed together and secured. When placing the cord in position on the wood spindle the latter is held in position by a brass pin, the cord is pressed to back of the slot in spindle, the two brass shells are then pressed together and made secure, the pin is withdrawn and the adjuster is ready for use. The exact tension required is secured by regulating the spring with the hand before closing the apparatus, which can be placed at any point on the cord by simply being raised or lowered by the hand, the cord slipping through the slot without injury. This device is made in two sizes, No. 1 adjusting from 0 to 30 inches, No. 2, from 0 to 9 feet, and can be had from Stephen Porter & Company, 384 Atlantic avenue, Boston.

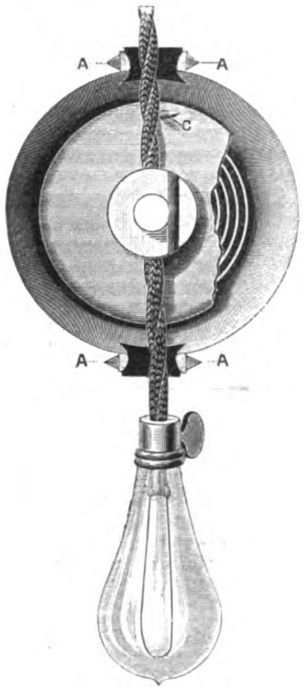


FIG. 2.

Important Notice.

Owing to the assignment of the Ansonia Electric Company and the pending settlement of their affairs, the Stanley Electric Manufacturing Company have decided for the present to sell their goods direct to users, and for this purpose have established an office in the building, 102 Michigan avenue, Chicago, and put same in charge of Mr. John H. Noble. They are prepared to furnish transformers, delivered in Chicago as heretofore, if preferred. They will carry a full stock of transformers of all standard voltages, and orders sent to the Chicago office will receive prompt and intelligent attention. Address all communications to the Stanley Electric Manufacturing Company, 102 Michigan avenue, Chicago, Ill.

COMMERCIAL PARAGRAPHS.

Queen & Company, Incorporated, recently secured an order for the testing outfit to be used by the Philadelphia Traction Company in its new power house at Thirteenth and Mount Vernon streets. This is a very satisfactory testimonial for the Queen apparatus, as a similar contract was executed between the same parties last year.

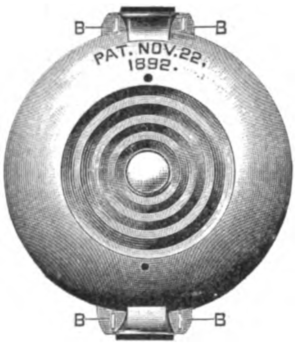
The Beacon Vacuum Pump and Electrical Company, owners and manufacturers of the "New Beacon" lamp, not only have no reason for complaining of depression in trade, but are jubilant over the prosperity they are enjoying. Though their new lamp has been before the public for only a few weeks, the demand has grown so great that the company has had to increase its factory facilities to a capacity of 8,000 lamps per diem, and even then finds difficulty in keeping up with its orders. When introducing the "New Beacon," the Beacon Company declared its intention of licensing at most six outside companies to manufacture the new lamp under royalty. Such an arrangement has been so promptly availed of that the last of these prospective licensees is now being negotiated with, which means when the negotiations are completed that there will be a tremendous daily output of the new lamp.

INCORPORATIONS.

The Natchez Light, Power and Transit Company, Natchez, Miss.—to manufacture and sell electricity for light, heat, power or any other purpose, and to distribute the same either in storage batteries or by poles and overhead wires, etc. Capital stock, $200,000. Incorporators: Maurice Moses and Abraham Moses, Natchez.

The Consumers' Electrical Supply Company, New York City—to manufacture electrical supplies. Capital stock, $1,000. Directors: Harold G. Martin, Elbert Brussel and Julian A. Moses, of New York City.

The Electric Experimental and Developing Company, of New York City—to acquire inventions having relation to the various parts of a system of electric light and power. Capital stock, $100,000. Directors: William E. Mandelick, W. B. Vandewater and Alick G. Macandrew, of New York City.



The North Scranton Transit Company, Scranton, Pa.—to build and operate an electric railway. Capital stock, $50,000. President, John H. Fellows. Directors: A. Weinschenk, J. George Eisele, Louis Morel, Jacob K. Johler and Hanson Carpenter, Scranton.

The Canton, Sparrow's Point and North Point Railroad Company, Baltimore, Md.—to build and operate an electric railway from Canton to Sparrow's Point. Capital stock, $500,000. Incorporators: Frederick W. Wood, president of the Maryland Steel Company; Joseph R. Foard, of the Joseph R. Foard Transportation Company; T. Wallis Blakistone, counsel for the Central Passenger Railway Company; and Walter B. Brooks, Jr., all of Baltimore City; and Major Luther S. Bent, president of the Pennsylvania Steel Company, of Steelton, Pa.

The Gladstone Electric Lighting and Power Company, Gladstone, Mich. Capital stock, $50,000. Incorporators: John W. Kendrick and John Woods, of Minneapolis; Edwin S. Tice, of Gladstone, and Richard H. Ralph, of St. Paul, Minn.

The Leroy Electric Light, Power and Heating Company, Leroy, Ill.—to supply electric light, heat and power. Capital stock, $10,000. Incorporators: L. A. Crumbaugh, A. J. Keenan, L. A. Reynolds, Amos Rutledge and S. D. Vandeventer.

The Royal Columbian Electric Company, Chicago, Ill.—to deal in electrical machinery and appliances for heat, light and power. Capital stock, $50,000. Promoters: H. H. Natwick, J. I. Stene, H. R. Fish, Jr.

The Des Moines Rapids Power Company, Hamilton, Ill.—to acquire water power, erect and operate street railways, electric lights, etc. Capital stock, $500,000. Incorporators: Lewis W. Cass, James Anthony, Charles B. Holmes and H. C. Reiner, of Keokuk, Iowa.

The Atlantic Electric Manufacturing Company, of Brooklyn, N. Y.—to sell and manufacture electrical apparatus. Capital stock, $100,000. Directors: Warren P. Freeman, Albert T. Schlichting, Julius Smith, all of Brooklyn.

The West Side Electric Light Company, Scranton, Pa. Capital stock, $10,000. Incorporators: John C. Haddock, C. W. Haddock, George W. Shonk, T. R. Phillips, Richard Clark and J. B. Davis, of Scranton.

The Capitol Electric Company, Hartford, Conn., to deal in electrical supplies, etc. Capital stock, $2,000. Incorporators: Ernest C. Wilcox, Meriden; Lawrence F. Furlong, Joseph P. Tuttle, Hartford.

The Johnson Sub-Trolley Company, of New York City—to acquire inventions having relation to the various parts of systems of electric railway traction. Capital stock, $25,000. Directors: Edward H. Johnson, Eugene H. Lewis and Charles B. Coster, of New York City.

The C. H. Brown Electric Battery Company, Portland, Ore.—to conduct a general business for supplying light, heat and power by means of electricity. Capital stock, $100,000. Promoters: Chas. H. Brown, A. P. Armstrong, Thos. Walker, Louis Prager, Chas. E. Wilber, Jas. Posey, Thos. M. Rogers, Thos. R. Demarest, Portland.

The Bevier Electric Light Company, Bevier, Mo.—to erect an electric light plant. Capital stock, $15,000. Promoters: J. A. Bovard, J. H. Bovard, J. C. Stearns, Kansas City, Mo.

Hicks-Troy Electric Door Company, Chicago, Ill.—to manufacture and deal in electric doors and devices. Capital stock, $250,000. Promoters: Oliver H. Hicks, Robertus F. Troy, Robert McCurdy.

The Lewis Electric Company, Jersey City, N. J.—to manufacture, use and distribute electricity for light, heat and power. Capital stock, $1,000,000. Promoters: I. N. Lewis, Fort Wadsworth, S. I.; V. H. Bridgman, Fort Schuyler, N. Y.; W. S. Fanshawe, Westchester, N. Y.; H. E. Fanshawe, Morristown, N. J.

The Boughton Telephotos Company of Buffalo, N. Y.—to manufacture a device known as "the Boughton Telephotos," being an instrument designed to communicate by signal between long distances. Capital, $125,000. Directors: George B. Van Vleck, Claudius V. Boughton, George Sandrock, Albert J. Wheeler, Andrew F. West, Thomas N. Jarvis and William L. Marcy, of Buffalo.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED SEPTEMBER 5, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

504,405. Trolley-Wire Cleaner. Mahlon Shaaber, Reading, Pa., assignor of one-half to Jacob S. Ammon, same place. Filed June 19, 1893.

504,549. Conduit Electric Railway. Benson Bidwell, Philadelphia, Pa., assignor, by mesne assignments, of one-half to Benson Bidwell, trustee. Filed Sept. 4, 1884.

504,676. Conduit for Electric Railways. Samuel H. Flagg, Providence, R. I. Filed Aug. 24, 1892.

ELECTRIC LIGHTS AND APPLIANCES.

504,475. Pendent Incandescent Electric Light. William A. Johnson and John C. Davidson, Prince's Bay, N. Y., assignors to the S. S. White Dental Manufacturing Company, Philadelphia, Pa. Filed April 28, 1893.

504,578. Flash-Light Apparatus for Photographers' Use. Joseph N. Harrison and Henry J. Harrison, San Francisco, Cal. Filed June 8, 1891.

504,632. Electric-Arc-Lighting System. Thomas Spencer, Philadelphia, Pa. Filed Feb. 18, 1893.

504,681. Electric Car-Lighting System. Isaac N. Lewis, Fort Wadsworth, N. Y. Filed Sept. 17, 1892.

DYNAMOS, MOTORS, ETC.

504,379. Commutator for Dynamo-Electric Machines. Ernest P. Warner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Nov. 1, 1892.

504,401. Armature for Dynamo-Electric Machines. John T. Morrow, Lynn, assignor to the General Electric Company, Boston, Mass. Filed May 13, 1893.

504,484. Electric Locomotive. Augustin I. Ambler, Washington, D. C., assignor to Roseline N. Ambler, same place. Filed Sept. 16, 1892.

504,492. Electric Automatic Steam-Governor. Edgar A. Edwards, Cincinnati, Ohio. Filed Dec. 2, 1891.

504,497. Method of and Apparatus for Regulating Alternating-Current Dynamos. Hermann Lemp, Lynn, Mass., assignor to the Thomson Electric Welding Company, of Maine. Filed Jan. 19, 1891.

504,630. Method of Operating Electric Motors by Alternating Currents. Alexander Siemens, London, England, assignor to Siemens & Halske, Berlin, Germany. Filed Oct. 21, 1890.

BATTERIES.

504,370. Secondary Battery. William L. Silvey, Lima, Ohio. Filed July 8, 1892.

504,455. Storage-Battery. Charles J. Reed, Orange, N. J. Filed March 2, 1893.

TELEPHONE AND TELEGRAPH APPARATUS.

504,367. Condenser Telegraph System. Charles H. Rudd, Evanston, assignor to the Western Electric Company, Chicago, Ill. Filed Feb. 8, 1889.

504,454. Telephone-Tansmitter. Nathaniel Parks, Deansville, N. Y. Filed Dec. 6, 1892.

504,461. Switchboard for Telephoning Purposes. Upton H. Balsley, Philadelphia, Pa. Filed June 8, 1889.

504,636. Telephone Apparatus. Alfred Stromberg and Andrew Carlson, Chicago, Ill. Filed April 3, 1893.

SWITCHES, SWITCHBOARDS, ETC.

504,345. Multiple Switchboard Apparatus. William M. Goodridge, Highland Park, assignor to the Western Electric Company, Chicago, Ill. Filed Jan. 12, 1889.

504,523. Double Pole Switch. Charles W. Gartside and Robert E. Wood, Baltimore, Md. Filed June 29, 1893.

504,528. Electric Switch. Albert B. Herrick, Schenectady, N. Y., assignor to the General Electric Company, Boston, Mass. Filed July 21, 1892.

SIGNALS AND SIGNALING APPARATUS.

504,542. Electric Railway Signal. Frank E. Seagrave, Toledo, Ohio. Filed Jan. 26, 1892.

MISCELLANEOUS.

504,335. Temperature Indicator. Charles E. Egan and Fred M. Bailey, Chicago, Ill.; said Egan assignor to said Bailey. Filed March 13, 1893.

504,336. Electric Belt. William C. Ekholm, Joliet, Ill. Filed June 19, 1893.

504,344. Thermal Cut-Out. William M. Goodridge, Highland Park, assignor to the Western Electric Company, Chicago, Ill. Filed Nov. 19, 1887.

504,397. Electric Conductor. Joseph W. Marsh, Pittsburg, Pa. Filed Aug. 8, 1892.

504,398. Electric Conductor. Joseph W. Marsh, Pittsburg, Pa. Filed Aug. 8, 1892.

504,462. Electric Lock. Lemuel B. Tinkham, Quincy, Mass. Filed May 12, 1892.

504,496. Electric Welding Apparatus. Hermann Lemp, Lynn, Mass., assignor to the Thomson Electric Welding Company of Maine. Filed June 25, 1890.

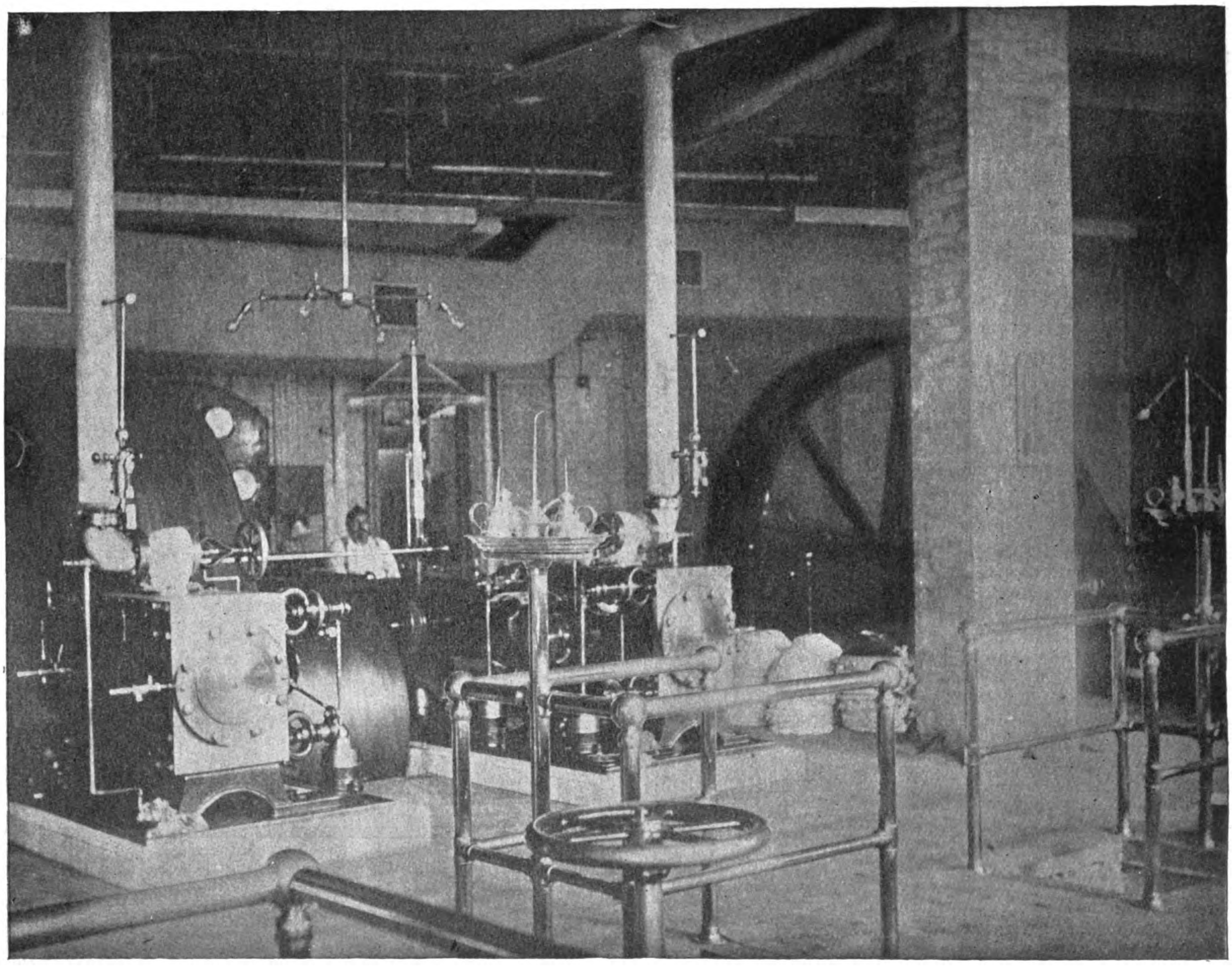
504,671. Musical Instrument. Constant Doriot, Philadelphia, Pa., assignor of one-half to John R. Painter, same place. Filed April 17, 1893.

RE-ISSUE.

11,364. Electrically-Heated Soldering Iron. George R. Meitzler, Cincinnati, Ohio, assignor of one-half to William H. Osborne, Prince's Bay, N. Y. Filed July 3, 1893. Original No. 490,256, dated Jan. 17, 1893.

ELECTRICITY.

VOL. V. NEW YORK. OCTOBER 4, 1893. CHICAGO. No. 12



DYNAMO ROOM.--"NEW YORK HERALD" BUILDING. (SEE PAGE 188.)

Electricity and Its Uses in a Modern Newspaper Office.

"The New York Herald" Building.

The New York *Herald*, following the uptown march of business, has been the first of the New York dailies to establish itself within the more modern centre of trade and to break away from the historical Newspaper Row. Its new home, at the junction of Broadway and Sixth avenue, at Thirty-fifth street, now almost completed, is one of the most ornamental structures in that neighborhood, and aside from its handsome exterior and finish it presents an equally well arranged and handsome interior very much at variance with the traditional newspaper office.

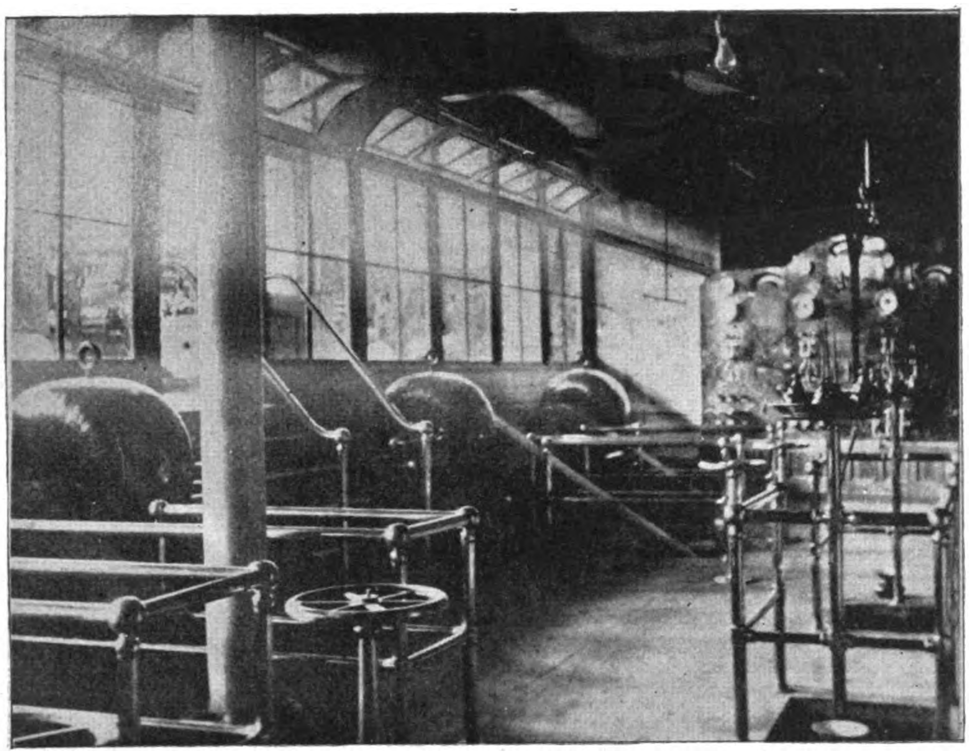


FIG. 1.

The building, which is occupied exclusively by the *Herald* and its allied branches, is a notable departure from the modern sky-scraping style of architecture, having but three stories, including the ground floor. Considering its large area and comparing it with the twelve and fifteen story office buildings which abound downtown, the *Herald* Building appears almost modest at first glance before the handsome details of the structure are appreciated.

The interior arrangements are designed entirely with reference to the requirements of the paper, and it is equipped with every kind of machinery and apparatus which enters into the work of turning out its large daily editions.

The electrical part of the plant, which will be of the most interest to our readers, forms quite a large proportion of the mechanical equipment of the building, and besides the lighting plant considerable use is made of electric power in almost all of the numerous departments of the paper.

The engine and dynamo room is situated on the Broadway side of the building, but separated from the street by the press rooms of the *Telegram*. Unlike the average engine room, it is well lighted, the partition on one side being entirely of glass. Facing the back of the room are four Watts-Campbell engines aggregating 700 horse power in capacity. The two central engines are connected on a common shaft carrying one driving wheel, and the outside ones have each a separate driver.

These engines are all belted backward to a countershaft in the basement below (see Frontispiece), and from this the belts run through the floor to the four Mather generators situated on the opposite side of the room from the engines, and shown in Fig. 1. The latter have a capacity of 55 kilowatts each, and are compound wound machines, running at 110 volts pressure.

The wiring is arranged to be used for either a two or three wire distribution, the middle wire being twice the section of the outside lines. The house plant is run on the two wire system, but in case of emergency the entire plant or any part of it can be thrown on to the street main from the Edison station. The method of changing from the house circuit to the street system is shown in Fig. 2. Each circuit in the building is connected at this switchboard to a double-throw switch, one side of which makes connection with the house plant and the other side with the street system.

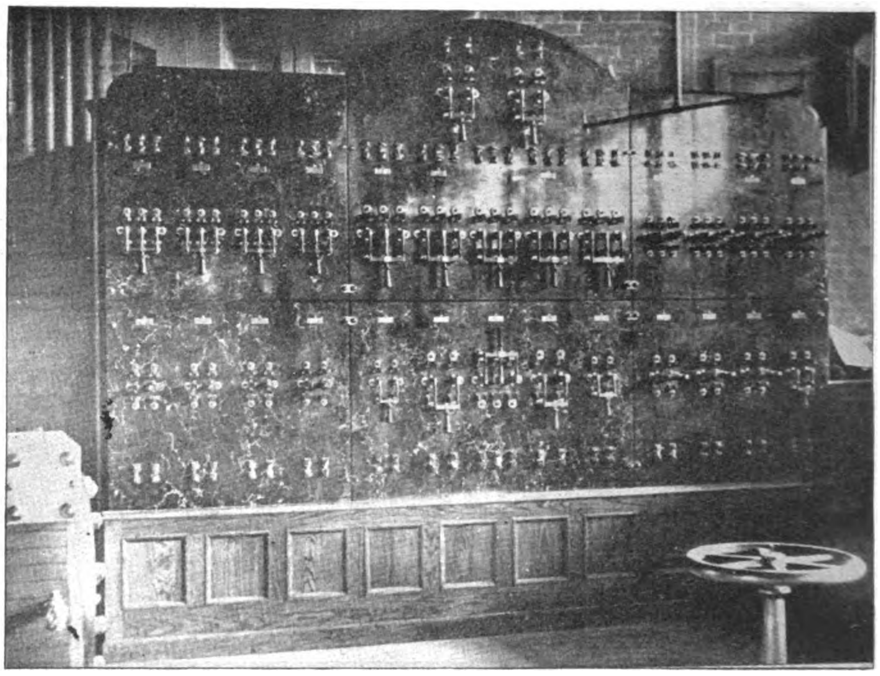


FIG. 2.

The room contains two switchboards, each 14 feet long by 7 feet 6 inches high. The one just mentioned contains 14 double-throw knife switches for the lighting circuits, and 14 of the same pattern for the motor circuits.

The other board, shown in Fig. 1, contains the generator switches and usual electrical apparatus. The instruments for the separate machines are of the Mather type, and those on the main circuit are Weston instruments. The circuits are all of Habershaw wire run in vulca duct.

The building is wired for about 2,600 lamps, a number of which will be used on the outside for ornamental purposes.

One feature will be a large sign composed of miniature lamps to be placed in front of the building, reading "New York Herald." Another novelty will consist of 26 bronze owls to be placed at equal distances around the cornice, their eyes being formed of incandescent lamps. These lamps are connected to an automatic switch, which is operated by a clock, partly shown at the right hand of the switchboard, Fig. 2. This clock runs in synchronism with the large clock on the building, and is so arranged that at every half hour after the lights are turned on the switch causes the owls' eyes to blink.

Outside of the dynamo room the electrical plant can hardly be said to be of any particular system, as the machines of at least half a dozen different manufacturers may be found throughout the building.

An interesting application of electricity is also to be found in the photo-engraving department, shown in Fig. 3. In copying drawings for illustrations the arc lights shown in the cut are used exclusively, and in this way this department is entirely independent of the state of the weather. The same lamps are also used for printing sensitized paper.

Throughout the building electric motors are provided for running all the machinery, although the three 40 horse power motors for running the three large presses are held in reserve and only used in case of emergency. On account of the absolute necessity of putting the operation of these presses beyond accident three independent sources of power are provided. They are run ordinarily by steam power, but in case of any accident to that the electric motors can be connected and run from the house plant, and as a third resource the motors can be switched on to the street system independent of any power in the building. These motors are of the Mather type, as is also a 15 horse power one which is used to run a color press.

The Detroit Company are represented by two 10 horse power motors used in the stereotype room and two 5 horse power motors in the matrix room. These are used to run the machines which first take an impression on a specially prepared paper from the type after being set and which is then used as a mould in which the type metal is cast, producing cylindrical plates from which the paper is printed.

The photo-engraving department uses one 10 h. p. motor for running a circular saw and drills, and two 5 h. p. motors are used to run five linotype machines, by means of which an operator sets type by manipulating a keyboard similar to that of an ordinary typewriter.

A 10 h. p. Waddell-Entz machine is used to run a paper wetting machine through which the paper passes before going to the press.

All the above machines are used specially in connection with the work of getting out an edition of the paper, but besides these a number of other electric motors are in use for various purposes.

The passenger elevator and three Otis lifts for handling the large rolls of paper are run by electricity.

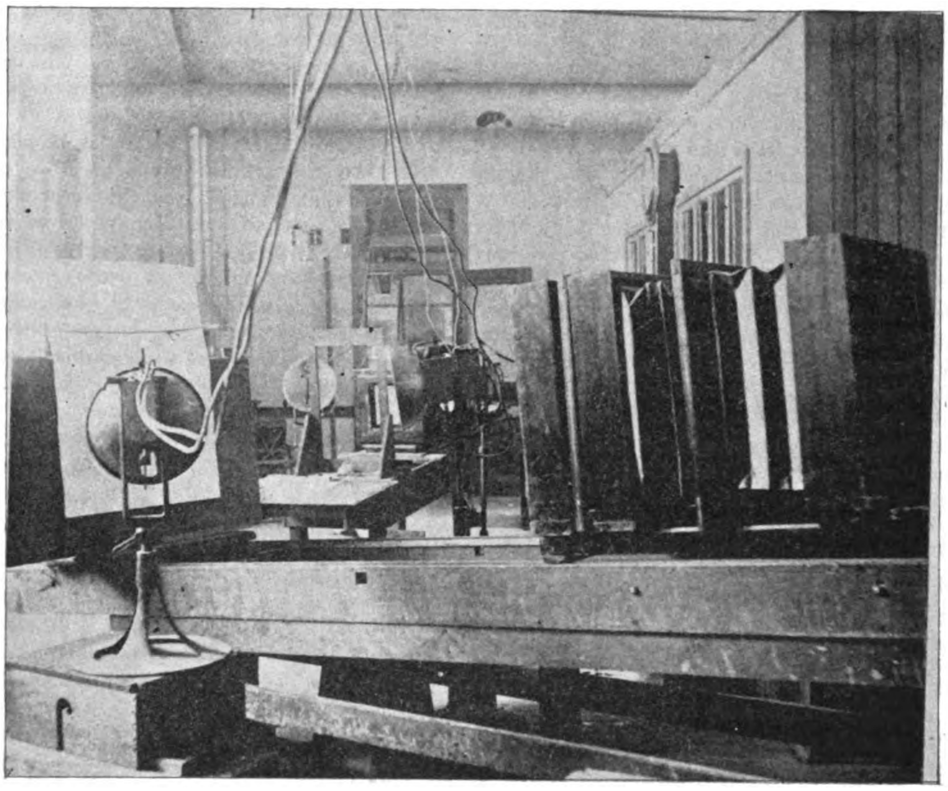


FIG. 3.

The ventilating plant is a system of exhaust pipes run with three 10 h. p. C. & C. exhaust fans and motors, and there are besides three Crocker-Wheeler motors and a Lundell motor in service.

The entire electrical equipment was installed by Hatzel & Buehler, of New York.

Altogether the motors installed aggregate 275 horse power in capacity, which is evidence of the important part that electricity plays in the mechanical work of producing a great newspaper.

Some years ago an attempt was made under the auspices of the Duc de Feltre and M. L. Vigreux to drive the dynamos at the Pointe de la Hève Lighthouse by wind power. The wind, however, as is its custom, blew when and where it listed, and ended one fine, or rather one stormy, day by overthrowing the ungainly apparatus installed on the exposed headland. M. Max de Nansouty, in alluding to this attempt to "harness" the wind, suggests that next time a similar attempt is made it would be as well to try the effect of surrounding the "atmospheric turbines" by strong towers, and directing the wind on to the vanes by nozzles in much the same way as the water is directed on to the buckets of a Pelton wheel. This idea of "canalizing" air currents is, it is said, actually engaging the attention of windmill experts.

Some of the Causes of Interruption to Telegraph Circuits.

BY F. C. ROBERTSON.*

A telegraph system, with its lines stretching over country in different directions, connecting cities, towns and villages, is to some extent at the mercy of the elements; with its batteries, instruments and wires, it is constantly subject to disturbance from various causes. The substance of this paper is a brief description of some of the common forms of interruption (usually called "troubles") which are experienced on telegraph circuits.

The troubles met with in the operation of telegraph circuits are of three kinds, and are known as "the break" (or open), "the ground," and "the cross." The circuit is said to be "open" when its continuity is broken and the current prevented from circulating, "grounded" when there is an abnormal electrical connection between the ground and the earth, and "crossed" when the line is in connection with another line upon which there is a current of electricity.

A circuit may be opened in various ways—for instance, by the breaking of the line, breaking of the magnet wire of a relay outside of bobbin, a loose connection at a binding post, displacement of plugs in switchboard, or by a key being accidentally left open. A break in the line wire generally occurs during very cold weather when the wire is contracted by the low temperature, causing a greater strain in it, and is often found at a point where the wire had been kinked, or at a joint which in making had been twisted so tightly as to cause the wire to be partially severed. Breaks are frequently caused by a tree falling on the line, which usually takes place during a violent wind storm, although sometimes through carelessness of woodmen in felling trees. Sleet storms are very destructive to the lines, owing to the excessive weight due to the ice adhering to the wires, which frequently causes them to break, or the alignment to become distorted. Poles carrying a large number of wires have frequently been known to break down under the extraordinary weight due to ice on the wires. Sleet storms general over a large area of country, of such severity as to damage lines, are fortunately of rare occurrence. The circuit is sometimes found to be open in an office, and might be traced to a broken connecting wire, broken relay wire, loose binding screw, but more frequently to an open key, or a plug out of position in switchboard. The circuit is sometimes found to be open in the battery due to a jar breaking and allowing its solution to escape, a zinc falling from its hanger to the bottom of the jar, or the wire connected to the copper element becoming detached. There is a kind of trouble which takes the form of an extraordinary and variable resistance in circuit, which is sometimes met with on old lines, the source of which is usually in a rusted joint, or a joint on a portion of the line in which there is no tensile strain. During dry weather these joints cause the resistance of the wire to be much increased, but during a rain the joints become wet, improving their conductivity.

Grounds on the wires are of more frequent occurrence than breaks or crosses. All ground faults contain more or less resistance; when the resistance of a fault is very small, the connection of the line with the earth caused thereby is comparatively perfect, practically dividing the line at that point into two circuits and preventing the current from the battery at either end of the line from passing further than the fault, but when the fault contains considerable resistance, the connection with the earth caused thereby is not sufficient to prevent a portion of the current from either battery from passing the point of fault, the working margin of current being that which finds its way past the point of fault. The circuit in such case is not totally interrupted, and signals may be exchanged between terminal offices on the circuit by properly adjusting the receiving instruments. Such a fault is called a "partial ground," or more commonly termed an "escape."

Although "single" (or simplex) circuits may be worked fairly well with a considerable and varying escape on the line (as the adjustment of receiving instruments can quickly be changed by the operator to correspond with the variations of the current), quadruplex circuits cannot be worked successfully under the same conditions; the varying escape causes the balance of the instruments to become disturbed, producing a mutilation of the signals on the receiving instruments.

A large percentage of the number of grounds which occur is found either on the lines in the towns through which they pass, or in the offices, only a small proportion being found on the lines in the country. The wire coming in contact with a foreign wire, such as a telephone, call bell, or guy wire, is a very frequent source of the trouble, though the circuit is very often grounded at the switchboard during a thunderstorm by lightning fusing the metal at the air-gap of the lightning arrester in passing over to ground. Partial grounds, or escapes, are often due to the wire touching the branches of trees, and are more susceptible during wet than dry weather, the effect of the moisture being to magnify the escape. Highway lines are more subject to escapes of this kind than lines located on the right of way of a railroad owing to the numerous shade trees which they encounter and the difficulty experienced in keeping them trimmed to clear the wires; owners of the trees as a rule object to any extensive cutting of limbs which would tend to disfigure the appearance of the trees, consequently to maintain a clearance the branches have to be frequently pruned. If this operation were neglected for a long time the effect would be manifested by the insulation of the line deteriorating. In cases where trimming cannot be done, in order to clear the line it becomes necessary either to replace the poles by higher ones, so that the wires will pass above the tops of the trees, or to divert the line by setting the poles out.

(*To be continued.*)

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* Read at the Convention of the Canadian Electrical Association.

The British Association.

[FROM OUR LONDON CORRESPONDENT.]

The British Association, which began its sittings at Nottingham on September 13, was attended by very few prominent electrical men; consequently few papers on electrical subjects were read. Their absence is partly accounted for by the Congress at Chicago, at which some of those who usually take part in the British Association meetings were present.

In Section "A" the president, Mr. R. T. Glazebrook, in delivering his address referred at some length to the "mechanical theory of light" and the "electro-magnetic field." Lord Kelvin read two papers, one on the "Piezo-Electric Property of Quartz" and the other on "A Piezo-Electric Pile." Mr. Gisbert Kapp read one on the "Relative Cost of Conductors with Different Systems," and Mr. Albion T. Snell also read one on the "Utilization of Waste Water Power by Electricity."

In Section "G" Mr. W. B. Sayers read a paper on "Self-Exciting Armatures for Continuous Current Dynamo-Electric Machines and Compensators for the Loss of Pressure in Feeders of Electric Supply Systems." In the same section Mr. W. Worby Beaumont, M. I. C. E., delivered one on a "New Form of Variable Power-Gear for Electric Railways and Tramways."

Relative Cost of Conductors with Different Systems of Electric Power Transmission.

BY GISBERT KAPP.

(*Read before Section G, September* 18.)

It is just twenty years ago that the reversibility of the dynamo-electric machine was discovered, and with it the transmission of electrical power. The machines then and until recently employed were of the continuous current type, but within the last few years transmission of power by some form of alternating current apparatus has come into use, chiefly because it enables us to carry power to a greater distance with a moderate rate, and therefore moderate cost of conductors. The reason for this enonomy lies in the fact that owing to the scheme of commutators, and the facility and certainty with which alternating current transformers can be insulated, the effective pressure at which the current is transmitted is much greater with alternating than with continuous currents. To put it in another way, with continuous current plant the voltage is limited by the difficulty of insulating the generating and receiving machinery. With alternating current plant there is no necessity of high insulation of generators or motors, but only of the step-up and step-down transformers, and since this type of apparatus can, by the use of oil or other means, be insulated to any desired extent, it is the difficulty of insulating the line rather than the machinery which limits the voltage that can be safely employed. In comparing the various systems of transmission as regards economy of material we must put all on the same basis, by so designing the plant that there shall be in each case the same stress on the insulation, or in other words, that the difference of potential between any two points in the circuit, or between any point and earth, shall not exceed the predetermined limit. The systems of transmission which have as yet been practically employed, and which alone even claim our attention here, are the following: single-phase alternating current transmitted by two wires; double-phase alternating current transmitted by four wires; double-phase transmitted by three wires; three-phase alternating current transmitted by three wires; continuous current transmitted by two wires. The last case, although practically impossible for extra high pressures, is here included because it gives us a financial standard of comparison for the other four methods of transmission. It is well known that in every circuit the different parts of which are equally well or equally badly insulated the electrical centre of gravity remains always at zero potential, and it follows from these reasons that if the circuit carry an alternating current, the absolute potential of any point undergoes cyclical change, bringing it in turn above and below the potential of the earth by an equal amount. Thus in a circuit carrying 10,000 effective volts, the greatest potential difference between two points will be 14,000 volts, and the greatest possible value of the absolute potential will be 7,000 volts, positive or negative. The insulation to earth will, therefore, be put under a stress not exceeding 7,000 volts; if, however, one point on the line were earthed, the stress at every point would immediately rise to 14,000 volts. We can now compare the continuous and single-phase alternating current as regards weight of copper required for the line, assuming in both cases the same total power and the same efficiency of transmission. Let us fix the greatest permissible stress at 7,000 volts from the earth, then it will be immediately clear that the effective voltage of transmission in the case of the alternating current is 10,000 volts and in the case of continuous current 14,000 volts, and since the weight of copper for equal efficiency conditions varies inversely as the square of the pressure, it follows that the transmission of power with alternating current requires twice as much copper as continuous. With two-phase currents and completely duplicated circuits, i. e., four wires in a line, the same holds good, as will be obvious on considering that each circuit half the power, but how does the case stand if we bunch two of the wires? In this case we have half the current in each of the external wires and about 70 per cent. of the current in the middle wires, resulting apparently in a saving of copper, but this is a fallacy; not only is there no saving of copper, but we require actually more copper than with a single-phase system, or the four-wire double-phase system; the reason being that if we tie two of the terminals together we forcibly displace the electrical centre of gravity of each circuit, causing the potential of the other terminals to vary between wide limits. To keep the stress on the insulation down to the given limit, we must therefore lower the voltage of each circuit, and this means that we must use more copper in the line. Similar investigations made for the three-phase system show that the effective voltage in each circuit must be lower than with a continuous current, but may be higher than with a single-phase alternating current. I shall not occupy time by giving the mathematical investigations of the various cases previously mentioned, but will simply state the practical result. If we put all the systems on the same footing as regards efficiency of insulation we find the following: If for the transmission of a certain power over a given distance by continuous current 100 tons of copper are required for the line, then the single-phase alternating and the two-phase four-wire system will require 200 tons, the two-phase three-wire system will require 290 tons, and the three-phase three-wire system only 150 tons. As far as the line is concerned there is thus a distinct advantage in the employment of the three-phase system.

On a Piezo-Electric Pile.

BY LORD KELVIN.

(*Communicated to Section A, September* 15, 1893.)

The application of pressure to a voltaic pile, dry or wet, has been suggested as an illustration of the piezo-electric properties of crystals, but no very satisfactory results have hitherto been obtained, whether by experiment or by theoretical considerations, so far as I know. Whatever effects of pressure have been observed have depended upon complex actions on the moist or semi-moist substances between the metals and electrolytic or semi-electrolytic and semi-metallic conductances of the substances. Clearing away everything but air from between the opposed metallic surfaces of different quality, I have made the piezo-electric pile which accompanies this communication. It consists of twenty-four double plates, each 8 centimetres square, of zinc and copper soldered together, zinc on one side and copper on the other. Half a square centimetre is cut from each corner of each zinc plate, so that the copper square is left uncovered by the zinc at each of its four corners. Thus each plate presents on one side an uninterrupted copper surface, and on the other side a zinc surface, except the four uncovered half square centimetres of copper. A pile of these plates is made, resting one over the other on four small pieces of indiarubber at the four copper corners. The air-space between the opposed zinc and copper surfaces may be of any thickness from half a millimetre to 3 or 4 millimetres. Care must be taken that there are no minute shreds of fibre or dust bridging the air space. In this respect so small an air-space as half a millimetre gives trouble, but with 3 or 4 millimetres no trouble is found.

The lowest and uppermost plates are connected by fine wires to the two pairs of quadrants of my quadrant electrometer, and it is generally convenient to allow the lowest to lie uninsulated on an ordinary table and to connect it metallically with the outer case of the electrometer.

To make an experiment (1) connect the two fine wires metallically, and let the electrometer needle settle to its metallic zero.

(2). Break the connection between the two fine wires, and let a weight of a few decigrammes or kilogrammes fall from a height of a few millimetres above the upper plate and rest on this plate. A startlingly great deflection of the electrometer needle is produced. The insulation of the indiarubber supports and of the quadrants in the electrometer ought to be so good as to allow the needle to come to rest, and the steady deflection to be observed, before there is any considerable loss. If, for example, the plates are placed with their zinc faces up, the application of the weight causes positive electricity to come from the lower face of the uppermost plate, and to deposit itself over the upper surface of plate and weight and on the electrode and pair of quadrants connected with it.

On a New Form of Variable Power-Gear for Electric Railways and Tramways.

BY W. WORBY BEAUMONT, M.I.C.E.

It is a matter of great importance on electrical railways and tramways that the maximum steam-engine power at work in the generating station should be as little above the mean load as possible.

It is found on electrical railways now at work that there is a great waste of power, and therefore of fuel, in consequence of the large consumption of current in getting the trains into motion by motors attached directly to the axles. On the South London Railway it is found that the power employed electrically in overcoming the inertia of the train is from 25 to 50 and 60 per cent. greater than that required to keep the train going.

Mr. J. H. Greathead, M.I.C.E., the engineer of this railway, has shown that if this could be avoided from 20 to 30 per cent of the engine power which must under present conditions be kept running might be shut down. The author shows this by diagrams representing the variation in the consumption of power in the working of this railway, as given by Mr. Greathead.

For several reasons the employment of geared locomotives is undesirable on railways, although single-reduction gearing is most generally adopted for tramways, and probably will remain best for that purpose. The noise made by high-speed gearing and the wear are both objectionable, otherwise a geared locomotive offers the means of overcoming to some extent the losses referred to.

In the paper the author shows how an intermediate course can be adopted which will entirely remove the loss of power at the generating station. The electric motor is placed directly on the driving axle, but is reduced in size and power to more nearly that of the mean horse-power required on the road. This for the greater part of the journey of a train from station to station drives the axle upon which it is placed at its own speed, just as those do which are now upon the South London Railway. The motor is, however, on a hollow spindle, which drives the axle, when starting a train, through the medium of a compact double clutch containing one pair of epicycloidal reducing wheels. The clutches are operated by electro-magnets or by fluid pressure.

The train or locomotive may by this means be started at from one-fourth to one-seventh of the speed of the motor. After a few seconds, the inertia of the train having been overcome, the motor, the clutch-gear, and the driving-axle are solidly coupled, and all move as one piece, the gearing only working during the starting of the train.

The motor may thus run idle upon the axle, or may drive the latter at one-seventh of its speed, or at its own speed. A breakdown leaves the locomotive in the condition of a gearless engine.

For tramcars similar apparatus is described in the paper, which will drive the car by a direct motor with starting ratio of gear of about six to one, or by single reduction gearing will drive the car either at the usual gear ratio of about four to one, or, for starting, at a ratio of about twenty-four to one.

Honorable Mention.

At a recent meeting of the directors of the Electric Gas Lighting Company, Boston, the following resolutions were adopted :

Whereas Louis W. Burnham, Vice-President and General Manager of the Electric Gas Lighting Company, departed this life August 9th, after a brief illness; and

Whereas the Board of Directors of the company desire to put on record their high appreciation of their deceased associate and deep sense of the great loss which the Board and the company has sustained; therefore,

Resolved, That in the decease of one who has been so constant, so able and so indefatigable in developing and advancing its interests this corporation has lost an officer whose strength, energy and integrity of character were invaluable; and the Board has lost a member for whose manly character his associates entertained a high personal regard, and upon whose aid in their common duties they have long and confidently relied.

Resolved, That the Directors hereby tender to the family of their late associate their heartfelt sympathy in their sudden bereavement.

Resolved, That these resolutions be extended upon the records of the corporation, and a copy of the same be sent to the family of the deceased.

His innumerable friends throughout the country will readily appreciate the appropriateness of this tribute to the memory of Col. Burnham, who stood deservedly high in the esteem of all who had been at any time,brought into personal contact with him, or were numbered among his acquaintances.

Materials for Wire Standards of Electrical Resistance.

BY DR. STEPHAN LINDECK.*

More than thirty years ago Werner von Siemens proposed to fix the practical unit of electrical resistance by such a definition that by referring back to the units of length and mass, and by the use of mercury, an element chemically and physically so well defined, the unit could always be reproduced with exact accuracy.

This proposition at the time was greatly opposed, but its correctness in the course of years has been proved more and more, and is demonstrated in the most striking manner by the fact that this proposition is suggested for International approval at the present Congress as a further development of the resolutions passed at the Congresses in Paris in 1881 and 1884.

The accurate reproduction of mercury resistances, as is well known, requires great care, and the use of the same is therefore limited to a few well arranged laboratories. The question still remains, which material according to modern experience is most suited for secondary wire standards, which are nearly exclusively used for practical measurements. This question was first considered by the Electrical Standards Committee of the British Association in the beginning of the sixties. The committee resolved to make copies of a German silver resistance, which has been absolutely determined out of various alloys, and to adjust therefrom ten unit coils, whereof two respectively consisted of platinum-silver, gold-silver, platinum-iridium, commercially pure platinum and mercury. It was expected by the choice of so many different materials to be assured that the result of the absolute determination could not be lost.

For the material used for the copies, which were distributed by the committee, the platinum-silver alloy was chosen. Dr. Matthiessen, to whom this work was entrusted, recommended the material on the strength of the investigation of several years, and it has been greatly used since for standard resistances in England and in this country; nevertheless it is not possible to rely absolutely upon the constancy of a resistance standard made of this material.

Entirely independent observations have proved that the value of a resistance made out of platinum-silver has constantly diminished in a period of two and one-half years. The changes remain, it is true, between the hundredths of one per cent., nevertheless they exceed the limits allowed for standards.

The question as to the most suitable material for wire standards was again taken up at the Congresses in Paris of 1881 and 1884. Dumas called attention to the alloy of platinum and iridium, of which material the standards of the meter and the kilogramme also consist.

In how far this alloy is appropriate for wire standards of resistance has been investigated by Dr. Klemenoii in an interesting paper published in 1888, which at the same time embraced the study of several other alloys, as German silver, nickelin and platinum-silver.

Of special interest are his researches on the influence of mechanical stress on the resistance of a wire. It is a known fact among the manufacturers of electrical resistances that during the winding up of the coil and in the time subsequent to the winding considerable changes occur which diminish but can be observed even after some years; that material, of course, will be most suitable of which the specific resistance is altered in the least degree. The following conclusions are arrived at by Dr. Klemenoii on the basis of his extensive researches, which cover the specific resistance, coefficient of temperature, thermo-electromotive force against copper, and the influence of mechanical deformation of the different alloys, namely, platinum-iridium, platinum-silver, nickelin and German silver. The first two are the most appropriate. The platinum-silver, however, must be preferred on account of its small coefficient of temperature (0.12 per cent. against 0.027 per cent). The next best would be nickelin. (It is to be regretted that chemical analysis of these materials has not been made). However, it is a matter of fact that the thermo-electromotive force of nickelin against copper is greatly higher than that of the other materials. Standards are always made of copper, and this is of great importance; for the connecting wires in resistance German silver is the least preferable, the alloy which has been almost exclusively used for standard resistances on the Continent; in England an alloy called platinoid is in common use, which does not differ much from German silver. For all alloys time variations were found, which consisted in an increase of resistance for German silver and in a decrease for platinum-silver and platinum-iridium.

Klemenoii further made the important observation that the rate of time variation is influenced in a high degree if the wire is heated to a temperature of 40 to 50 centigrade, in order to determine its coefficient of temperature. He says: Perhaps it would be preferable to expose a newly made standard resistance to a moderate rise of temperature during a longer time in order to terminate more quickly the variations of resistance produced by mechanical stress. Klemenoii did not, however, continue his work in this direction.

One of the duties of the Electro-Technical Laboratory of the Physikalisch-Technische Reichsanstalt, which was founded in 1887, principally by the liberal donation of Werner von Siemens, is to examine the correctness of electrical measuring apparatus, and to make such investigations as tend to improve them.

As to electrical resistances, the determinations of the absolute value of the ohm made some years ago by Kohlrausch and Himstedt have shown to what degree wire resistances can change in the course of time.

It is a matter of fact that Kohlrausch has observed for two German silver standards an increase almost equal in both to the amount of more than one-tenth per cent. in one and three-quarters of a year.

It was up to the present time very tedious to manufacture accurate standard resistances. It was necessary to take wire which had been made a long time before; to wind at the same time a large number of coils which were not to be disturbed for several months; then periodically the value of the resistance was determined and those were chosen for standards which proved to change in the least degree; nevertheless such resistances are not constant at all. During many years changes can be observed, as for instance Mr. Carpenter has shown; this was also proved with a carefully constructed resistance furnished by Carpenter to the Reichsanstalt. Such a resistance must be considered to be in an unstable state; a somewhat larger change of the outer temperature may effect considerable changes, as we have seen it before with a platinum-silver resistance.

Electric traction is being steadily developed in Germany, and is likely, within the next year or two, to make a good showing. There are roads running in Bremen, Halle, Gera, Breslau, Hanover, Dresden and Remscheid, besides the two old Siemens roads at Lichterfelde and Frankfort-Offenbach; and there are roads in course of construction or under contract in Breslau, Chemnitz, Dortmund, Essen, Lubeck, Nuremburg, Plauen, Hamburg, Gotha, Erfurt and Bochum.

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* Abstract of a paper read before the International Electrical Congress, Chicago.

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Grounded Railway Circuits.

The return circuits on electric railways, which according to the general practice are grounded circuits of which the tracks are a part, have been the cause of considerable trouble in a number of places because of the electrolytic action of the current on underground pipes, which have frequently been entirely destroyed in this way. In a number of cities this trouble has proved a matter of serious expense, especially where large currents are employed, and it has been seized upon by the deprecators of the "deadly trolley" for the most potent of their arguments.

This difficulty has heretofore been the most valid objection which has ever been raised against electric railway systems, and it cannot be denied that these complaints were in many cases well founded, but at present, thanks to the experience of a number of pioneer roads, this matter is better understood, and the means of providing against any destructive electrolytic action upon the rails or adjacent pipes is easily attained, though not without considerable expense.

The early roads using a rail return were at fault in depending upon the earth to a considerable extent for the return circuit. The error in this assumption is shown by the fact that to-day the ground circuit is not included in the calculations of the capacity of the return circuits. The ground has proved a very uncertain and a very variable quantity in this work as much depends on the character of the soil and the amount of moisture it contains, the latter being a large factor in the electrolytic action on pipes, etc. It appears to be well established that the return should contain sufficient metal to carry the necessary current without depending on the ground, and with a resistance not in excess of that on the overhead system. One of the first essentials in procuring a continuous circuit from the track to the generator is the bonding of the rails. A large number of patterns of rail-bonds have been placed on the market from time to time, but very few of these fully answer the purpose for which they were designed. The average rail on a well built electric road will run from sixty to ninety lbs. in weight, and where many cars are used the entire section of iron in a double-track road is insufficient to carry the current without supplementary ground wires. In such a case the bonding becomes a matter of the utmost importance, and it is evident that a single No. 4 iron wire bond connecting the track joints is entirely inadequate for the purpose. Neglecting the ground, which is not to be depended upon, this construction, which is to be found in a large number of roads, increases the resistance of the return to a very large extent, and is largely accountable for the electrolytic action of which there has been so much complaint. Besides the harm done to other underground systems, the high resistance of the track circuit is felt at the power house, and imposes a proportional additional load on the machinery which in time will largely overbalance the saving in material due to this cheap construction.

In reporting on this subject to the New York Street Railway Convention, Mr. McTighe sums up the requirements for a railway return circuit as follows:

1. Intrinsic resistance low enough to need no help from earth.
2. Utilization, to the utmost practical extent, of the rails as the return conductors.
3. Rail bonds of the heaviest practicable size.
4. Rail bonds of the shortest possible length consistent with due allowance for expansion and vibration.
5. Rail bonds made of a single piece of wire with integral rivets.
6. Rail bonds tightly riveted to the rails through holes freshly reamed immediately before bonding.
7. Rail bonds so placed as to permit convenient inspection.
8. Rail bonds protected against corrosion.
9. A very liberal use of heavy cross bonds from rail to rail direct, and in double track extra heavy cross bonds connecting the two inside rails.
10. An underground main or trunk return from power house to track, and there connected to each line of rails, and low enough in resistance to carry the maximum current with but a nominal drop in potential.

By fulfilling these conditions there is no doubt but that the saving at the power house would be more than sufficient to compensate for the extra cost of track work, and in addition the trouble from electrolysis would be avoided.

In some cases where the difference of potential on underground pipes has been measured, as much as forty or fifty volts difference has been found, and the electrolytic effect of such a current would obviously take but a short time to completely destroy the pipe. The remedy of supplying a larger metallic conductor for the return, and connecting the pipes with the station so as to avoid this action where the current leaves the pipes, has been found to obviate the trouble entirely.

It is therefore well settled that with proper care in construction of the grounded return there would be no foundation for the complaints which are now frequently heard.

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"Electricity" Is Ready.

The present condition of the General Electric Company would excite pity rather than animosity if there should be forthcoming from the Board of Directors an announcement of new executive officers to carry out a radically new policy. Few expressions of pity, however, will be heard until it is an assured fact that the company is to be conducted on new lines, by men who who will confine their attention to the business of the company and allow competitors the same privilege.

For something more than a year ELECTRICITY has waged relentless warfare. We began when the stock was selling above 115, and when a superficial view disclosed nothing of trouble ahead for the General Electric Company; when its officers possessed the esteem of their business associates, and when a word of criticism was looked upon as suicide for any electrical paper.

We had information even at that time upon which we believed a severe attack justifiable, and we have never wavered. The world was then against us; and it is now with us. But ELECTRICITY was just as surely right twelve months ago as it is to-day, when the rottenness and dishonesty of General Electric methods are common gossip and Charles A. Coffin is a discredited man among those who know him best.

Electricity's purpose has been fully accomplished. We have shown the General Electric Company under the mismanagement of Mr. Charles Ausgespielt Coffin to the trade in its true light. We have no animosity towards the company as an abstract thing, nor against the army of men who until recently earned an honest living in the service of the company. Our attack has been aimed at a proposed monopoly, and at corrupt and disgraceful business methods, and against the man who was chiefly responsible for their introduction into this trade.

As to monopoly, or anything approaching it, it is forever passed discussion in the electrical business. But as to the corrupt methods which have indelibly marked the present management of the General Electric Company we have no assurance that they are to be discarded. When we have such assurance, from men in whom the trade has confidence, and when Mr. C. A. Coffin's name is wiped out from all official connection with the company, Electricity will retire from the warpath, and will do all in its power to assist the reorganized company, to restore harmony and good feeling in the trade.

We will cease fighting when the occasion for fighting has been removed.

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Some very poorly informed person has written to ask us, "Who the deuce is Mr. Laf. Heidell, whose portrait you printed this week?" It is safe to say that our questioner has never travelled, does not know of Powers' Block, or even of the city of Rochester. He might as well ask, Who is Tom Ochiltree, or who is Abe Slupsky?

......o......

About six pages of the *Electrical World* last week were devoted to a report of the legal troubles of Messrs. Martin and Wetzler and W. J. Johnston. The matter was undoubtedly of interest to these three gentlemen, but to no one else. Few, however, are surprised to see the pioneer electrical journal prostitute itself by forcing upon its readers this expression of petty personal spite.

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Every day that Mr. C. A. Coffin is allowed to retain his position in the General Electric Company is an extension of time in his preparation for a future career of brigandage in the electrical trade. He should be forced to stand on his own bottom at once.

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The General Electric Company has been killed by the enemies it has made. Those enemies will not be friends under the present management and policy of the company.

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Mr. Joseph P. Ord, Controller of the General Electric Company, is in Chicago. We understand he has gone to pay his respects to Mr. Sunny.

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It is pleasant to call attention to the advertisement in this issue for sixty wiremen, etc. At least one job is going forward.

Monopolies Do Not Monopolize.

Savannah Will Have a Municipal Plant.

Owing to the recent combination of the commercial lighting companies, the city of Savannah, Ga., intends to erect a city plant. A bill will be introduced in the Legislature to secure the necessary authority. Mayor McDonough says:

"If the People's Electric Light Company had remained an independent institution, as it promised, the city would not have found it necessary to enter into the electricity business, because with two companies competing prices for lighting would have been so reasonable that it would have been a useless expenditure to erect another plant. But when the combination with the Brush Company was effected it was seen at once that competition had been throttled."

Electricity has already made sufficient comment on local combines. They can only be successful where they are in perfect harmony with the public and with the city. The cost of lighting should be decreased instead of increased; and any combination that proceeds on a different theory is sure to come to grief.

THOSE HAPPY DAYS.

"So Sad, so Fresh, the Days that Are no More."

(*Not written for "Electricity."*)

Oh! those were happy days, boys, just back in '91,
Before the Thomson-Houston and Edison were one,
Before the lion and the lamb each swallowed up their pride
And laid down in peace together, the lamb on the inside.

The grass upon the Common seemed softer then to all,
God knows that now it's pelted down and hardly grows at all!
And the boys upon the corner would on each Friday night
Blow in their stuff at Ames's—they're over that all right.

Each student had a typewriter, a draughtsman and a pull;
They took their damsels to the dance and after that got full.
Cigarettes were then the thing, and wine was never freer;
They're smoking T. D. pipes now, and drinking Uno beer.

Oh! those were happy days, you bet—when Saturday came round
'Twas off upon the bicycle or to the baseball ground,
And in the eve the Point of Pines would catch them by the thou';
They still go to the Point of Pines—they go to dig clams now.

Common stock was 96, preferred was rather more,
Until the General Electric took possession of the floor.
Stockholders, who were building high, each one as rich as mud,
Have felt their feet slip out from under with a dull and sickening thud.

Oh! those were happy days for clubs; prosperity was high,
And tennis, cricket and baseball, they all were flying high.
And now we're in the consomme, we haven't got a cent,
And even the Scientific Club can hardly pay its rent.

The pay came all in bills then, the envelopes were fat;
It comes in dimes and nickels now, and hard to get at that;
'Twas "quarter ante" in those days, and every man would stay,
Now every man is playing close to keep the wolf away.

Indeed, it's rather rocky now; we hardly get enough
To keep our board bills evened up and make a decent bluff.
Oh! will they ever come again, those happy days of yore?
Those bully days, those flush old days, those days that are no more.

Lynn, Sept. 1, 1893. F. S. H.

A Return to Old Tactics.

The following is a copy of a notice which is being distributed to the patrons of a local lighting company that is controlled from No. 44 Broad street, which needs no comment:

It has come to our notice that some of our *current* customers are using an inferior grade of incandescent lamps requiring a fraction over 5 watts per candle.

This company recommends only the Edison or Thomson-Houston incandescent lamps, which have an efficiency of 3.1 watts per candle. The difference in amount of energy required to operate lamps other than the Edison, or T.-H., is to us a costly and serious matter.

There are reasons of another nature that should cause prudent and careful patrons to discontinue using lamps not licensed by the General Electric Company, owners of the Edison lamp patent, No. 223,898, the United States Circuit Court of Appeals having confirmed the decision of Judge Wallace declaring Mr. Edison the sole inventor of the incandescent lamp. The Edison patent does not expire until January 27, 1897, and the owners are vigorously insisting on their legal and equitable rights in all portions of the country.

Restraining orders were recently issued against the Holland House and Hotel Imperial, New York City. As the owners of the Edison patent insist on an accounting for damages, we believe the wisest course is to discontinue the use of infringing lamps, and purchase none but those marked "Edison" or "Thomson-Houston," which fortunately are the best made. These lamps can be procured at our office, corner of Main and Field streets, at usual price. . . .

Legal Notes.

The Adams Electric Railroad Company's suit against the Lindell Railway Company at St. Louis is about ready for trial. It involves the right to use the propelling mechanism on every electric railroad car in the country. Evidence in the case, which has been accumulating for two years, already fills more than 1,000 printed pages.

The jury in the suit of Kahman Kosrael, of New York, against the New Jersey Traction Company, for $10,000, on account of the killing of his son Harry, at the corner of Springfield avenue and Bedford street, Newark, on May 9, brought in a verdict for the defendant.

Judge Lacombe, of the United States Circuit Court, has appointed Charles Batchelor receiver of the Electrical Development Company of New York. The company was organized in 1890 for the purpose of constructing street railways. It is understood to have practically gone out of business as a construction company. Its assets, consisting of stocks in other companies, have depreciated in value owing to the great shrinkage of values, and its inability to provide money to pay its debts necessitated a receivership.

In the United States Circuit Court, New York, on the 19th ult., Judge Lacombe granted a preliminary injunction restraining the Mount Morris Electric Light Company and the United Electric Light, Heat and Power Company from the further use of the incandescent lights now employed by the two companies in this city. The injunction was granted on the application of the Edison Company. The order is to go into effect after reasonable time has been given the defendants to adapt their fixtures to the use of other lamps which are not open to the objection. The case will be appealed to the Circuit Court of Appeals.

A bill of complaint asking for a receiver for the Citizens' Electric Light and Power Company of Manistee, Mich., has been filed. The complaint alleges that the company has never paid more than running expenses, and is wholly unable to meet its obligations.

The Falls Rivet and Machine Company has filed a mechanics' lien against the Toledo Electric Company for $1,735.

Suit has been begun against the new lighting company in York, Pa., using Westinghouse apparatus, to restrain them from using infringing lamp.

The Cleveland Electrical Manufacturing Company has filed a motion asking the court to order the discontinuance of the business of the Graves Electrical Company, claiming it is being conducted at a loss.

World's Fair Awards.

Following is the list of awards announced up to date. Some of the tests, viz., of wires, storage batteries, incandescent lamps, transformers and a few others, have not yet been completed :

Albert & J. M. Anderson, Boston, Mass.—1. Trolleys. 2. Railway insulators.

Brush Electric Co., Cleveland, Ohio—1. Direct current dynamos for series arc lighting. 2. Direct current dynamos for series arc lighting, coupled to engine, 125-2,000 C. P. lamps. 3. Alternating current dynamos, constant potential, 36-150 K.W. 4. Arc circuit switchboard. 5. Direct current dynamos, constant potential, 20-100 K.W. 6. Arc lamps, all types.

Bryant Electric Co., Bridgeport, Conn.—Snap switches.

W. R. Brixey, New York—Underground, aeria and submarine telegraph and telephone cables.

J. H. Bunnell & Co., New York—1. Standard dry batteries. 2. Telegraphic apparatus.

C. & C. Electric Motor Co., New York—1. Direct current motors, constant potential, 3-50 H. P. 2. Electric motor, fan and blower combination.

Cutter Mfg. Co., Philadelphia, Pa.—Pushsw es for electric lights.

Commercial Cable Co., New York—1. Ocean telegraphic apparatus operating through Muirhead's artificial resistances. 2. Cuttriss improved cable telegraph apparatus.

Crane Electric Co., Chicago, Ill. — Electric passenger elevator complete.

Carpenter Enamel Rheostat Co., Bridgeport, Conn.—Rheostats.

Copenhagen Fire Alarm Co., Chicago—Automatic fire alarm.

George Cutter, Chicago, Ill.—Lamp supporting pulley.

Electrical Forging Co., Boston, Mass.—Electric heating and welding apparatus.

Electric Heat Alarm Co., Boston, Mass.—Thermostat for automatic fire, hot journal and hot grain alarms.

Electrical Conduit Co., New York—Underground conduit for electrical wires.

Electric Launch and Navigation Co., New York —Electric launches.

Eddy Electric Mfg. Co., Windsor, Conn.—Direct current motors, constant potential.

Excelsior Electric Co., New York—1. Arc lamps series circuits. 2. Direct current dynamos for series arc lighting.

Elektron Mfg. Co., Springfield, Mass—1. Direct current motors, const't potential, multipolar, slow speed. 2. Automatic motor starter.

Electric Selector and Signal Co., New York—Electrical system for locking and unlocking.

Edison Mfg. Co., New York—Edison-LaLande primary battery.

Eureka Tempered Copper Co., North East, Pa.—Tempered copper for use in electrical construction.

Fort Wayne Electric Co., Fort Wayne, Ind.—1. Direct current "Wood" dynamo for series arc lighting. 2. Alternating current "Wood" dynamo, constant potential, compound wound, 150 K. W. 3. Arc lamp for constant current.

I. P. Frink, New York—Screen reflectors for incandescent lamps.

General Electric Co., New York—1. Electric locomotives for factory and switch service. 2. Electric elevated railway system. 3. Long distance power transmission, plant in operation, tri-phase. 4. Arc lamps for direct current series circuits. 5. Searchlights and focusing lamps. 6. Transformers 250-125,000 watts. 7. Engine dynamos. 8. Automatic overload switch. 9. Electrically illuminated fountains. 10. Thomson eccentric coil ammeters and voltmeters for alternating currents. 11. Pumping machinery driven by electric motor. 12. Electrically driven rock working machinery. 13. Mine locomotive. 14. Haskins astatic ammeter. 15. Arc lamps for constant potential circuits direct and alternating (Knowles). 16. Jaw switches, fuses, sockets and branch blocks. 17. Direct current dynamos for series arc lighting. 18. Alternating current dynamos for series arc lighting. Alternating current dynamos, constant potential, 30-300 K. W. 19. System of street railway service. 20. Direct current dynamos, constant potential (direct connected excepted), and direct current shunt wound motors, constant potential. 21. Edison feeder system for distribution of electricity. 22. Slate switchboard for arc light circuits. 23. Ventilating set, portable, Government standard. 24. Historical apparatus. 25. Edison three-wire system for distribution of electrical energy. 26. Exhibit of incandescent lamps all styles, ½ to 250 C. P. 27. Underground system complete in all details. 28. Hoisting apparatus driven by electric motors. 29. Integrating wattmeter.

The E. S. Greeley & Co., New York—1. Testing instruments. 2. Extra dry battery. 3. Telegraph apparatus.

Gamewell Fire Alarm Telegraph Co., New York—Automatic fire alarm telegraph system.

General Incandescent Arc Lamp Co., New York —Arc lamps for constant potential circuits.

Hart & Hegeman Mfg. Co., Hartford, Conn.—Snap switches.

Helios Electric Co., Philadelphia, Pa. — Arc lamps for alternating current.

The Hanson Battery Co., Washington, D. C.—Primary batteries.

Interior Conduit and Insulation Co., New York—1. System of interior insulating conduits. 2. Snap switches.

Jenny Electric Motor Co., Indianapolis, Ind.—Direct current dynamos and motors, constant potential.

H. W. Johns Mfg. Co., New York—Vulcabeston and molded mica insulating material worked into all kinds of insulations.

LeClanche Battery Co., New York—LeClanche batteries, especially the "Vole" and "Cylinder" cells.

Mather Electric Co., Manchester, Conn.—Direct current dynamo, constant potential, 500 volts.

McIntosh Battery and Optical Co., Chicago, Ill. —Electro-medical, dental and surgical apparatus.

National Carbon Co., Cleveland, Ohio—Carbons for arc lamps.

Nutting Electric Mfg. Co., Chicago—Nutting arc lamps.

Otis Bros., New York—1. Electric pump. 2. Electric motor and controlling devices for elevator and hoisting service.

H. T. Paiste, Philadelphia, Pa.—Snap switches.

Police and Signal Co., Chicago—System of police patrol telegraph.

Phœnix Glass Co., Chicago—Electric and glass globes and shades cut, etched and colored.

Queen & Co., Philadelphia, Pa.—1. Electrometer (Ryan). 2. Galvanometers. 3. Testing sets and resistances. 4. Portable medical induction apparatus for physicians' use. 5. Commercial ammeters and voltmeters.

J. A. Roebling's Sons Co., Trenton, N. J.—Bare copper and trolley wire.

F. A. Ringler & Co., New York—Half tone photo-electro type, steel faced.

Standard Electric Co., Chicago—1. Arc lamps for direct current series circuits. 2. Direct current dynamos for series arc lighting.

Stevenson-Hoggson Electric Co., St. Louis, Mo. —Automatic electric time stamp.

Sperry Electric Railway Co., Cleveland, Ohio—Electric railway system.

Short Electric Railway Co., Cleveland, Ohio—Short electric railway system.

Self-Winding Clock Co., New York—Special application of an iron-clad solenoid magnet.

Thomson Electric Welding Co., Boston, Mass.—Apparatus for electric welding and forging.

Union Electric Works, Chicago—Primary battery.

J. C. Vetter & Co., New York—1. Incandescent current adapter. 2. Dry LeClanche battery.

Western Electric Co., Chicago—1. Columbian street lamp post. 2. Telegraph apparatus. 3. Telephone cables, Paterson. 4. Annunciators and signalling apparatus. 5. Multiple switchboard for telephone service. 6. Direct current dynamos for series arc lighting. 7. Application of electric lights for the production of scenic effects in theatres and for the decoration of rooms, etc. 8. Arc lamps various styles for series circuits. 9. Arc lamps for constant potential circuits. 10. Direct current dynamos and motors, constant potential.

Waite & Bartlett Mfg. Co., New York—1. Holtz induction machines in air-tight case with 6 40 inch revolving plates. 2. Special faradic apparatus for varying the tension and strength of current (Engleman'apparatus).

Washington Carbon Co., Pittsburg, Pa.—Carbons for arc lamps, batteries and dynamos, and motor brushes.

Wm. Wallace, Ansonia, Conn.—Historical electric light exhibit.

Walworth Mfg. Co.—Poles for trolleys and arc lamps.

S. S. White Dental Mfg. Co., Philadelphia, Pa. —Acid gravity batteries, "Partz."

Westinghouse Electric and Mfg. Co., Pittsburg, Pa.—1. Engine dynamos. 2. Transformers, 250-12,500 K. W. 3. Direct current dynamos and motors, constant potential, bipolar and multipolar (except direct connected dynamos). 4. Alternating current dynamos, constant potential, 750 K. W. 5. Electric street railway system. 6. Alternating current dynamos for series arc lighting. 7. Long distance power transmission, plant in operation. 8. Two-phase alternating current motors (Tesla). 9. Incandescent system of street lighting. 10. Switches. 11. Complete switchboard for controlling 17 dynamos and 40 currents. 12. Lightning arresters.

Weston Electrical Instrument Company, Newark, N. J.—1. Alternating current instruments, including wattmeters. 2. Standard resistance and bridges. 3. Electrical measuring instruments for physicians' use. 4. Switchboard instruments. 5. Direct current ammeters and voltmeters, standard and portable.

Western Union Telegraph Co., New York—Instruments used in quadruplex telegraph, latest design.

Zucker & Leavett Chemical Co., New York—Collection of chemicals and appliances] for electroplating.

GERMAN.

Prof. Aron, Berlin—Electric meters.

J. Berliner, Hanover—Universal transmitter, long distance.

Geo. Carette & Co., Nuremburg—Optical, physical and mechanical instruments and toys.

Dr. Edelmann, Munich—Electro-medical apparatus

Felton & Guilleaume, Muhlhausen on Rhine—1. Electric cables with special armor. 2. Electric cables.

Gehmelzen, Nuremburg—Carbons for arc light.

Hartmann & Braun, Frankfort—1. Differential arc lamps. 2. Galvanometers. 3. Electrical measuring instruments, including instruments of precision. 4. Photometer, large universal. 5. Apparatus for testing iron and steel with respect to magnetic permeability. 6. Reading telescopes, mirrors and scales. 7. Portable measuring apparatus used in laying cable.

W. A. Hirshman, Berlin—Electro-medical apparatus.

Imperial German Postal Telegraph Dept., Berlin—1. Maps and drawings showing system of Government telegraph lines using armored underground cables. 2. Telegraphic apparatus of the German telegraph service.

Korting & Matthissen, Leipsig—Arc lamps for constant potential circuits.

H. Schomburg & Sons, Berlin—1. Insulators and insulating material. 2. Dry batteries.

Schuckert & Co., Nuremburg—1. Searchlights with parabolic glass mirrors. 2. Annunciators for vessels. 3. Arc lamps for constant potential circuits.

Siemens & Halske, Berlin, 1. Arc lamps for constant potential circuits. 2. Direct current dynamos, constant potential, 750 K. W. 3. Historical apparatus.

Schmidt & Haench, Berlin—Lummer-Brodham photometer with accessories.

J. Zacharias, Berlin—Dry batteries.

TURKEY.

Imperial Ottoman Government—Telegraphic apparatus.

GREAT BRITAIN.

British Government Postal Telegraph Dept.—1. Modern telegraph apparatus in operation. 2. Historical telegraph apparatus.

Corporation of Birmingham—Original Woolwich dynamo.

General Electric Co., Ltd., London—H. I. switches and other incandescent house fittings.

James White, Glasgow—Electro-magnetic balances, Kelvin.

AUSTRIA.

F. Hardtmuth & Co., Vienna—Carbons for arc lamps, etc.

RUSSIA.

Imperial Russian State Paper Manufactory, St. Petersburg—Collection of electrotypes.

Imperial Artillery Arsenal, St. Petersburg—Electrical registering attachment for testing machine (Prince Gagarian.)

ITALY.

Prof. Galileo Ferraris, Turin—Historical alternating current motors.

JAPAN.

Imperial University, Tokio—1. Seismographs and accessory apparatus. 2. Model of an earthquake.
Department of Engineering, Imperial University, Tokio—Automatic electric current recorder.

BRAZIL.

Directoria General dos Telegraphos, Rio de Janeiro—Telegraphic apparatus.

Bids Wanted.

Proposals will be received at the office of the village clerk, Plain City, Ohio, for the construction of a complete system of water-works and electric light plants. Specifications may be obtained from the engineer, Frank Snyder, Columbus, Ohio.

The Eddy Electrical and Manufacturing Company, at Windsor, Conn., which was working on reduced time in August, has been running full time for the past two weeks, and with a full complement of hands.

General News.

What is Going on in the Electrical World.

Baltimore.—The Lombard street division of the City and Suburban Railway is now operated by electricity.

Waterbury, Conn.—The Traction Company has received permission from the council to use electricity as a motive power on its lines.

McKeesport, Pa. — East McKeesport will shortly be lighted from the Wilmerding Light Company's plant. The wires are already in place.

Brooklyn, N. Y.—The State Railroad Commissioners have granted the Brooklyn City Railway permission to change from horse power to electricity.

Westchester, N. Y.—The Bronx Company of West Farms is about to put in a plant for the lighting of this town for which that company has a contract.

Hoboken, N. J.—The North Hudson County Railway Company have petitioned the Hoboken Council for permission to equip all their city lines with the trolley.

Smyrna, Del.—Charles E. White, of Philadelphia, has been awarded the contract for the erection of a complete electric light plant in this town to cost $9,430.

Windsor Locks, Conn.—The Electric Lighting Company of this town is about to put in a 150 horse power engine. The capacity of the dynamos will be increased from 750 to 1,200 lights each.

Detroit, Mich.—The manager of the Commercial Electric Company states that the chattel mortgage on the company's stock, recently effected, will not result in a suspension of the business.

Oakland, Cal.—W. E. and H. W. Meek and others have asked for permission to construct and operate a street railroad on the county road leading from Oakland to San Leandro, the motive power to be electricity.

Cincinnati.—The diminution of the smoke nuisance in this city is attributed in a large measure to the use of the new smokeless coal and the substitution of electricity for steam power in many small manufactories.

Leavenworth, Kan.—Newman Erb, receiver for the Leavenworth Electric Railway Company, intends, it is stated, as soon as the affairs of the electric company are settled, to equip the dummy and horse cars lines here with electricity.

Belair, Md.—An electric road between this place and Havre de Grace is under consideration, and the Hughes & Rigby Company, of Baltimore, who have the contract for lighting Belair, are making investigations in regard to the project.

Washington. — Telephone communication from the shore to vessels near shore by means of a cable has been demonstrated by the Light House Board to be practicable, and this new method will be put into operation as soon as funds are available for the purpose.

Middletown, N. Y.—The Eureka Electrical Company of New York has secured the contract for putting additional wire in the State Hospital and its new buildings, together with the cottages and barns. An electric cooking range is also to be added to the kitchen.

San Francisco.—The San Francisco and San Mateo Electric Railroad has arranged to carry funerals to the cemeteries in San Mateo County. On the 17th of September the first funeral was satisfactorily conducted over the road. The train was made up of the funeral car and two coaches for the mourners.

Buffalo, N. Y.—Work on the Buffalo, North Tonawanda and Sanborn Electric Railroad is expected to begin this week. The officers of the company are : L. F. W. Arend, president; Lewis T. Paine, of Tonawanda, vice-president; Lee R. Sanborn, secretary; Edward G. Reisterer, of Tonawanda, treasurer.

Albany, N. Y.—Electrical freight cars are about to be put on the line between this city and Troy. The cars are about the size of the ordinary passenger cars and resemble the baggage cars of steam railroads. Three of these cars already received here were built by the J. Y. Brill Car Company of Philadelphia.

Kingston, Ont.—A few days ago the electric railway on Princess street was opened for traffic to the delight of the citizens, who, as the first car was put in motion, ran up and down the streets cheering. A young lady christened the road by breaking a bottle of champagne over the dashboard of the car as it began to move.

Youngstown, Ohio. —The city commissioners and others of the committee appointed to consider the applications of the Youngstown Park and Falls Company and the Youngstown and Canfield Electric Railway Company for franchises have decided, after consultation, to advertise for proposals for electric railways over the routes.

Beverly, Mass.—The Beverly selectmen have granted the Lynn and Boston Street Railway Company an extension of the time allowed to equip their line from Gloucester crossing to the Wenham line with electricity from October 1. 1893. to July 1, 1894. The Danvers and Beverly line will also be equipped in the spring so as to be put to use next summer.

Kingston, N.Y.--The residents of Shanhaken, Lexington and Westkill are considering the advisability of building an electric road from Shanhaken through the Westkill Valley to Lexington, fourteen miles. The question has not yet been decided but there are a number of men in the three places who have signified their willingness to take stock in the proposed road.

Alton, Ill.—The proposed electric line to North Alton is being pushed by the new electric company, of which J. F. Porter is vice-president. Mr. Porter has advertised for sale seventy $1,000 six per cent. interest bearing bonds of the proposed road, with the St. Louis Trust Company as surety and trustee. The stock is presented to the citizens of Alton as an excellent investment.

Charlotte, N. C.—The *Observer* of a recent date says : "Mr. Cutler, of the General Electric Company of Boston, is in the city, and it is supposed that he is still considering the transmission of power from the Catawba River to Charlotte. It would be a big thing for the city if five to ten thousand horse-power could be transmitted here for sale in the shape of electric current or power."

Butte City, Mont.—The annual statement of the Northwest General Electric Company, whose Montana headquarters are at Helena, shows that the capital stock September 1 was $1,500.000, of which $856,500 had been paid in money and $643,500 in franchises, merchandise and accounts. The assets of the company are $3,234,227.53, in which is included the capital stock of $1,500,000 and a surplus and undivided profits amounting to $197,171.11.

Adrian, Mich.—The company that proposes to construct and operate an electric railway between here and Ypsilanti has purchased the electric line in this city and also controls the line connecting Ypsilanti and Ann Arbor, two important links in the proposed line, which is to connect Adrian, Tecumseh, Clinton, Macon, Saline, Ann Arbor and Ypsilanti, and cover sixty-two miles in length. To complete the line it will be necessary to build forty-two miles of new track. Samuel D. Nesmith, of Adrian, is the principal promoter of the proposed road.

Toledo, Ohio.—A number of Eastern capitalists are understood to have put up the money to secure the right of way for the projected electric railway between Toledo and Detroit. Toledo and Detroit capitalists are also taking an active part in the scheme, which seems now in a fair way to be carried out successfully. A stock company is to be organized with a capital of $1,000,000, one-fourth of which is to be paid in cash. The equipment of the line will be of the most approved kind, the motors to be of 100 horse power and the speed not less than thirty miles an hour. Passengers, express matter, and light freight will be carried on the trains. The local men interested in the enterprise are L. K. Parks, J. H. Ainsworth, Ellery Eaton and J. H. Dawson. H. J. Warner, of New York City, represents the Eastern capitalists.

Philadelphia. — "Rapid progress," says the *Ledger*, "is being made in many parts of the city in the construction of the new trolley roads. The work attracts a large amount of attention, especially in the centre of the city, where in many places the workmen are busy night and day laying conduits and putting down the heavy girder rails which are necessary to carry the electric cars. No expense is being spared by either of the two great companies, the Traction and the People's Traction, and each boasts and expects to have the finest electric railway plant in the world when the work is completed. As the Traction Company's lines are being erected on the Westinghouse system and the People's lines on that of the General Electric Company, the two great rivals in electric construction, the outcome is regarded with great interest by all who are conversant with electrical matters."

New Orleans.—The articles of agreement between the New Orleans Traction Company, limited, and the New Orleans City and Lake Railroad Company have been printed. Among other stipulations the Traction Company agrees to furnish the City and Lake Railroad Company at all times during the continuance of the contract an electric current of proper and sufficient electromotive force to supply light and motor power for the propulsion of all of their cars at the maximum rate of speed allowed, and at all times to keep the motors, cars and electrical and lighting apparatus in the said cars and connected with the operation of the said trolley system in good order and condition, and to make all renewals and repairs thereto made necessary by accident of wear and tear, and to keep said cars and electrical apparatus at all times in an efficient condition.

Boston Notes.

Though it is less than two years since the New England Telephone and Telegraph Company equipped and began to use their extensive exchange in the Bell Telephone Building, Milk street, the growth of the business has been such that it has become necessary to establish another Exchange in the western part of the city. This will be known as the "Haymarket" district. A block of property on Chardon street was secured some time ago and plans for the new Exchange have been completed. The building will be of four stories, with high basement. In the basement will be a workshop, linemen's room and heating apparatus. The first floor will contain a distributing department and store rooms. On the second floor will be a parlor in front, wardrobes, toilet and bath rooms in the rear. On the third and fourth floors will be the operating rooms for the new district.

For the month ending September 20 the total output of instruments by the Bell Telephone Company showed a net decrease of 11,932.

The Boston Electric Light Company, which does the city lighting, has declared a quarterly dividend of 2 per cent. payable October 14.

The citizens of Melrose, Mass., complain that they are being charged exorbitant rates for electricity by the Malden Electric Light Company which supplies current to its neighbors. These complaints have been embodied in a petition to the State Board of Gas and Electric Commissioners, who will give a public hearing on the subject in Melrose, October 12, when a lively discussion is expected.

October 9 is the date appointed for hearing the case of the Mather Electric Company vs. the Thomson-Houston Electric Company. This dispute arose out of what was considered by the plaintiff company to be unwarrantable interference with their business by the defendant when the matter of awarding the contract for lighting the State House Extension Building was under discussion. It is expected that this trial will settle the question as to the legality or illegality of the General Electric Company as a Trust. Should the General Electric Company be in existence at the above date, the trial is likely to prove, if anything, of even greater National importance than the now famous Beacon lamp case, which was tried last February.

Supplementary to our item in last week's issue, pertaining to the Thomson Scientific Club at Lynn, we may state that an adjourned meeting of members was held last Tuesday evening, to take steps for either winding up its affairs or continuing its existence on a more proscribed scale. After a long discussion, there was consensus of feeling that an effort should be made to continue under more economical management. It is sincerely to be hoped that an institution which has proved of inestimable social and intellectual value to its members may not have to be abandoned finally, for such institutions are none too plentiful, and it would be a distinct loss to the enterprising and talented young men identified with the General Electric Company. Our word to the executive board of the club is one of encouragement in their effort to preserve the institution intact until "the good time coming" gets here, as we feel sure it must ere long.

A CORNER IN THE SHOW ROOM OF THE HORN, BRANNEN & FORSYTH COMPANY.

Citizens residing in certain parts of Somerville are petitioning the West End Railway Company to extend its electric system in certain directions at once, so as to have additional cars running by January 1, 1894. They are also trying to secure a 5 cent transfer check on the different routes in the city.

Beginning with Monday a general reduction of wages will take place among the employees of the General Electric Company. About 300 men at the Lynn factories will be affected by the change. The salaries amounting to from $3,000 to $5,000 per annum will be reduced 10 per cent., and those of from $1.000 to $3.000 per annum will be reduced 5 per cent. No reduction will be made in the salaries of clerks and others who receive less than $1.000 per annum. These reductions will apply to men employed at Schenectady and all other works of the company.

The American Railway Improvement Company of this city has begun work on the electric road that is to connect Randolph and Braintree, Mass. This section will form the connecting link between the Brockton and Quincy systems, and unite the shoe city with Boston. They are twenty-two miles apart; the full length of the new section with branches will be fourteen miles.

Reports have been rife the past week as to what really is to be the outcome of the rapidly accumulating financial and managerial troubles that the General Electric Company is suffering from. Almost daily encouraging reports appear in some of the morning or evening newspapers as to the growing improvement in the company's affairs; but of late so much "bluff" of this kind has been thus retailed that no one believes these oft appearing paragraphs, and it were well that the fertile brain from which they emanate should appreciate this fact and act on the old but trite saying that "silence is golden." Public confidence, if there is a spark of it left, which is doubtful, might then in time be to some extent restored. Even the latest movement inaugurated for "raising the wind" wherewith to ward off the impending crash, under the title of the Electric Traction and Illuminating Company, which for the trifling bonus of $4,500,000 undertook to take care of $9,000,000 of assets, is now being discredited. Notwithstanding that the report has been published that 40 per cent. of the entire amount subscribed for has been actually received, financial circles are doubtful if that be so. The latest report is that this syndicate is willing to assume entire management of the company's affairs in the hope of being able to straighten them out. Should events prove the truth of that report, a pertinent question that will arise will be, how will the thousands of small stockholders fare at the hands of this syndicate of millionaires. The sudden death of Mr. F. L. Ames has without doubt raised a formidable obstacle in the way of perfecting a deal which many have regarded as "a consummation devoutly to be wished" in view of the tottering aspect of General Electric Company's affairs.

Where Electroliers are Made.

The Factory of the Horn, Brannen & Forsyth Company.

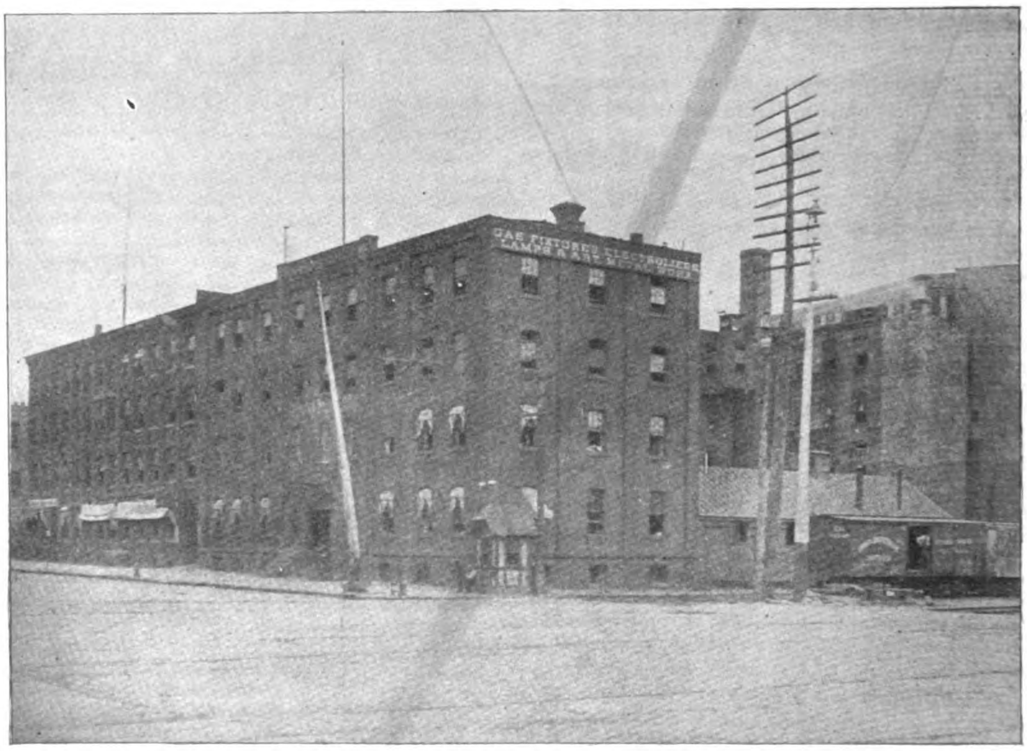
The city of Philadelphia contains one of the largest companies engaged in the manufacture of electric light fixtures, whose factory, situated on the corner of Broad street and Pennsylvania avenue, is illustrated below. In this building every operation in the manufacture of electric light and gas fixtures, from the foundry work to finishing and polishing, is carried on.

The building is a spacious one of four stories and occupies a ground space of 148 feet front by 90 feet. The first floor is occupied by the general offices of the company and the show rooms, a corner of which is illustrated herewith, and the remainder of the ground floor is devoted to a foundry in which all the brass castings used in the works are turned out.

The second story is used for some of the most interesting parts of the work and is divided into a number of different shops. Here the modeling and designing of the fixtures is carried on, as well as the dipping, plating, buffing and finishing of the fancy brass, bronze and other ornamental metal parts.

The third floor of the factory is devoted to laquering, fitting and finishing rooms and a general stock room; the upper floor contains the machine shops, where spinning and turning are done, and on this floor another department of this company's business, clock making, is also carried on. These shops, when working full, operate about 250 hands, but at present, being the usual dull season for this work, only 175 employees are required.

The class of goods manufactured here present too bewildering an assortment of sizes, shapes and patterns to fall within the scope of a brief description, but the elegance of the designs and finish of these fixtures has been increased year by year until to-day many of them are well entitled to rank as works of art.



FACTORY OF THE HORN, BRANNEN & FORSYTH COMPANY.

Coney Island Conduit Road Tests.

The following figures are given by Mr. E. W. Stevenson as the result of a test made by him on the electrical conduit road at Coney Island, which was described in a former issue of ELECTRICITY:

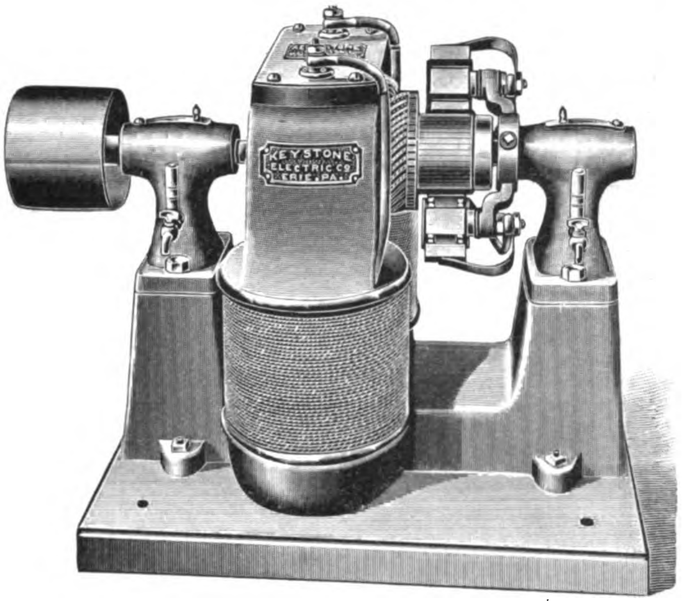
The insulation resistance of the whole line when the car is not in circuit equals 61,500 ohms.

The insulation resistance of line, with shoe of car and adjacent switch-boxes in contact with shoe submerged in water, equals 380 ohms.

E. M. F. of power circuit equals 353 volts; 353–380 equals .926 amp. loss.

Seventy-five feet of conduit was pumped up full of water previous to test.

With Weston ammeter the reading was hardly discernible.


KEYSTONE ELECTRIC CO ERIE, PA.

THE KEYSTONE DYNAMO.

The loss on boxes tested by Weston voltmeter showed nothing.

The resistance test was made with a Thomson tripod galvanometer and by comparison with standard resistances.

From the above figures the following result is arrived at:

As seventy-five feet of the conduit was submerged, this would include twelve boxes. Therefore it is safe to assume that the loss was only on those boxes. Several of the dry boxes showed no leakage.

Then, as the loss on the circuit, with boxes all open—that is, electrically—was .0058 ampere, equaling .0027 H. P., the loss on each box equals 1-12, which amounts to .000483 ampere, and which equals .000223 H. P. It therefore would take 4,484 boxes entirely submerged to give a loss of 2.113 amperes or 1 H. P., and as the boxes are six feet apart this equals 5.092 miles.

The car standing with the shoe entirely submerged and the two adjacent boxes with switches turned on showed a loss of .926 ampere, equaling .438 H. P. And as the car takes about 12 amperes, equal to 5.68 H. P. on ordinary track, this shows that it loses 7.69 per cent of its power when so placed; or, expressed differently, thirteen cars placed in the same condition would lose about the same amount of power which it takes to drive one car.

A progressive brick manufacturer in Auburn, Me., has arranged an electric motor to do the work of horses in grinding. In all yards where horses are used it is an established fact that one of the greatest troubles experienced in the windlass and treadmill is the rapid decline of the horses, as the strain upon their shoulders is so great that they succumb in a very short time. Other New England manufacturers are adopting the use of electricity in their plants, and with such excellent results as to premise the opinion that it will soon become universal.

Keystone Dynamos and Motors.

The general design of the dynamos of the Keystone Electric Company is shown in the accompanying illustration. They are built both for lighting and power, and are either shunt or compound wound, as the case requires. The Standard Constant Potential Dynamos are wound for 110, 220 and 500 volts. They also build machines of special voltage to order. A special winding is used where close regulation is required under great variations of load. Shunt dynamos are provided with hand regulator to adjust great changes of load. A substantial switch is used to open main circuit, also the field and armature connections, all of which are substantially made and in convenient position to operate. The commutator is of hard copper, made in a most substantial manner, insulated with mica, and will last for years with ordinary care. A high insulation test is made on all machines before leaving the factory, also a working test under full load. These are kept on file.

The mechanical construction is of the best throughout. skilled mechanics being employed, with the most improved machine tools, and the work is under the supervision of competent mechanical and electrical engineers. The armatures of these dynamos are wound to carry a greater volume of current than the nominal capacity of machines require, making them safe for the given load. Both dynamos and motors of this make have high efficiency. great solidity and strength and perfect regulation.

KEYSTONE ELEVATOR MOTOR.

Those who are paying for power to operate elevators, whether water or steam, would do well to look into the merits of the Keystone elevator motor.

With hydraulic elevators, where water is taken by measure, even at the lowest prices given, the system is expensive, as it requires the same number of gallons to raise 100 pounds as it would to raise a full load, while with the electric motor the amount of energy consumed is in proportion to the load to be raised, and where current can be paid for by measure through meter the cost of operating an elevator is much less than by water.

The Keystone Motor is a reversing motor which will run in either direction to raise or lower platform, and stops when elevator stops. This reduces the cost of power to the actual working time of elevator platform, and is in most cases 50 per cent. less than by either water or steam.

The company are furnishing these motors for passenger service where speed of platform is as high as 300 feet per minute. They have made a special study of this service, and are prepared to furnish, under a satisfactory guarantee, elevator motors.

A New Apparatus for Projection.

BY OSCAR KNIPE.

Although the advantages of screen projection for illustration of lectures and scientific experiments have been generally admitted, and the projector has been introduced in very many class rooms, the full extent of its usefulness for scientific projection could not until recently be realized, partly because the oxy-hydrogen light is not powerful enough, and the electric arc lamps were not perfect enough to obtain a steady light and satisfactory results. Within the last two years, however, a new style of electric arc lamp has appeared, and one of its principal recommendations is that it is adapted to a low potential [that is, the incandescent current], insuring perfect immunity from electric shock and an absolutely steady and continuous light. Every expert will be delighted to learn that he can let his electric light take care of itself so that he may devote all his attention to his lecture or experiments, as the case may be.

The object of this paper is to describe a new apparatus, the Paragon, Fig. 1, which the writer has employed for nearly two years in projection with the microscope, the polariscope, etc., with unparalleled success, so that professors in some of the foremost colleges highly commended the exhibition and declared it superior to anything seen by them.

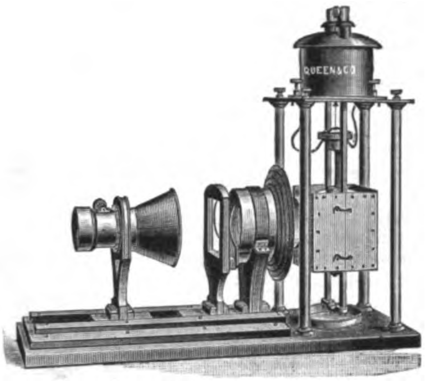


FIG. 1.

This new projector differs essentially from all former apparatus in construction. Advantage has been taken of the style of arc lamp to completely separate the optical system from the light. Here we have a complete slide base with a number of carriers disposed upon it similar to an optical bench, and by this arrangement the various lenses or other accessories can be located as desired and the whole set can be set at the proper distance from the light without interfering with its adjustment. A set of three differential condensing lenses. mounted in cells separately, enable the operator to select the most suitable for any special experiment to obtain the best results in illumination as well as in definition; this is not possible with the old style combined double or triple condenser fixed in the lantern.

For the projection of scenes and diagrams the Paragon is furnished with a special achromatic objective, supplemented with the patent multifocal lens; this lens placed behind the objective diminishes its magnifying power without interfering with its definition, so that the distance from the screen can be doubled and yet produce a picture of half the size that the objective alone would give.

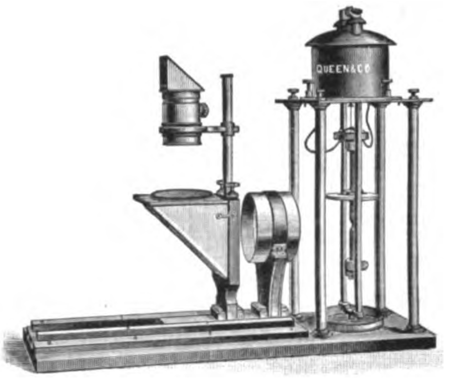


FIG. 2.

This constitutes the Paragon Projector for illustrating lectures on history, geography, etc., by views and diagrams; but its principal distinction consists in the accessories, and here we discover at once the advantages of the optical bench.

1. The vertical prism [Fig. 2] either attached or separate from the lantern has always been troublesome for proper adjustment, but no difficulty nor delay is experienced with the Paragon; here it is perfectly central and a correct performance can be effected in a moment. For the display of magnetic curves by iron filings, cohesion figures in the horizontal tank, etc., this apparatus is indispensable.

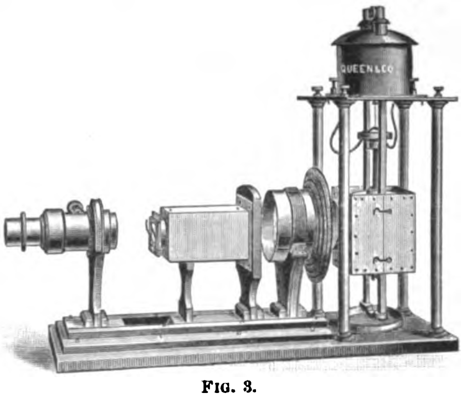


FIG. 3.

2. The polariscope [Fig. 3] is composed of a pile of thin

glass plates for polarizer mounted on a slide stand and provided with an object-holder which can be rotated. It is easily adjusted to the light, so that the refracted ray enters the analyzer and crosses at its centre. If desired, a silvered mirror can be attached over the pile to intercept the reflected ray, which may then be projected simultaneously with the refracted one and thus produce two images.

The analyzer is a 20 m. Nicol prism mounted on a rotating cell which is fitted in the objective. A complete disc of polarized light can be projected, alternating light and dark with the rotary motion of the analyzer. Among the objects suitable for this instrument may be named the following: Geometrical designs of mica and calcite, chilled glass shapes [verre trempe], chemical preparations, crystallization of acids while in progress.

3. The polariscope is also supplemented by a combination of converging and disperging lenses for the purpose of exhibiting the colored rings and crosses in crystals in general; for special scientific investigation in crystallography, the necessary graduated circles and verniers, goniometer, etc., can easily be added to complete it.

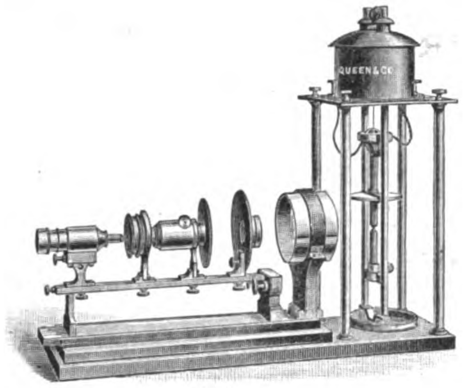


FIG. 4.

4. The projection microscope [Fig. 4]. The distinguishing feature of this is found in the application of an achromatic negative lens to convert the converging rays coming through the condensing lens into a cylinder passing to the secondary condenser; these are provided with rack and pinion, so that the illumination of the object can be adjusted with great nicety. Not only is the silvery whiteness of the arc light a great advantage, but as the radiant is comparatively a point the definition given by a good objective is superb. Abundant light is at hand to obtain a power of 1,000 to 3,000 diameters with perfect definition; a flea may be enlarged to 15 feet in length.

The Cutler-Hammer Manufacturing Company.

Messrs. Cutler & Hammer, of 313 South Canal street, Chicago, the well known dealers in superior electrical apparatus, in order to supply the demand for their high-grade specialties and electrical contract work have found it necessary to greatly increase their facilities and have purchased the factory of the Chicago Electric Manufacturing Company, 241 and 247 South Jefferson street, which they will operate as the Cutler-Hammer Manufacturing Company. Their present facilities are therefore unequalled by any factory in Chicago, while their long experience and the skilled workmen they employ enable them to produce the highest grade of special electrical apparatus, thereby sustaining their well-earned reputation for first-class and intelligent electrical work.

The firm will continue to carry a complete stock of their popular C. & H. Snap Knife Switch and Automatic Motor Starter, and are prepared to furnish on short notice any apparatus in their line.

Any inquiry made of them in reference to these goods will receive prompt and cheerful attention.

COMMERCIAL PARAGRAPHS.

The Electro-Chemical and Specialty Company of New York have lately placed on the market a Battery Compound which is worthy of investigation. It is said to be both cheaper and better than sal ammoniac.

The Keystone Electric Company of Erie are now comfortably installed in their new factory at Twelfth and Cranbury streets. The building is a fine two-story structure, 50 by 100.

The General Incandescent Arc Light Company have issued Circular No. 5, setting forth the advantages of their many styles both of direct and alternating current lamps. Prices and full information as to sending orders are given.

The Columbia Lamp Company of St. Louis report increasing sales and the most prosperous of all business in the history of the company.

Queen & Company, Incorporated, Philadelphia, have a new projection lantern, called the "Paragon," with which they claim to produce a perfectly steady white light, far superior to the oxy-hydrogen jet, and at the same time very much more convenient to operate. Already a number have been supplied to prominent schools where such apparatus is absolutely essential in the proper illustration of scientific lectures. The lamp is adapted for direct or alternating currents as desired.

Over 2,000,000 feet of tubing for inside wires of the well known and popular type made by the Interior Conduit and Insulation Company have been sold since January 1 of the present year by the Eastern Agents, the Pettingell-Andrews Company of Boston. Such a sale by one firm alone in the time above stated is evidence enough of the value of this conduit, which is in use everywhere, and still sells as actively as ever.

The Pettingell-Andrews Company of Boston, the largest electrical supply house in New England, report splendid results from a unique method of bringing special lines before the fraternity. Every month they mail a postal card addressed to each of their customers and the trade generally. On the obverse side their attention is called to some specialty in very few words. A fresh specialty is thus announced every month. These postals bring back quite a steady flow of good orders, for users are reminded of their needs by the announcement on the postal.

Hutchins, Longford & Hutchins, is the full title of a firm established recently in Providence, R. I., for the sale of every kind of gas and electric fixtures and for the execution of electrical contracts. The partners in this firm are all young, enterprising and competent men, who have had a varied experience in the business, and are in a position to undertake any and all kinds of electrical construction work. They carry a full line of supplies, are well known in Providence and surrounding towns and commence business under very encouraging auspices.

Albert and J. M. Anderson, the well-known manufacturers of Ætna Railway Insulators, Anderson Line Material, Ajax Switches and Switchboards, Pivotal Boston Trolleys and other useful electrical devices, have found it necessary to vacate their factory in Hamilton street, Boston, and have leased a much more extensive one, being Nos. 289 to 293 A street, Boston. The business done by this firm has increased so phenomenally, owing to the high grade character of all their goods, that a bigger factory became imperative, and the outlook for a yet still greater growth is most promising.

Riehle Bros.' Testing Machine Company, Philadelphia, are pleased to report indications of an improvement in business, and consider permanent prosperity near at hand—as soon as legislation at Washington reaches some definite policy. Among recent orders they report the following: 20,000 lb. Horizontal Testing Machine, 10,000 lb. Vertical Screw Power Testing Machine, Canvas Testing Machine for the U. S. Government, Warehouse and Railroad Trucks for export, 3,000 lb. Transverse Testing Machine, 1,000 lb. Cement Testing Machine with worm gear, "Star" Cement Testing Machine, 40,000 lb. Screw Power Testing Machine, two 1,000 lb. Cement Testing Machines, 100,000 lb. Testing Machine, six 20 ton Riehle-Roble Protected Ball Bearing Screw Jacks.

INCORPORATIONS.

The Progressive Power Company, Jersey City, N. J.—to manufacture engines, boilers, etc., and appliances, chemicals, etc., for the production of light, heat and power. Capital stock, $300,000. Promoters: Julius H. Batt, Montclair, N. J.; W. K. Lothrop, F. G. Wheeler, E. F. Leeds, Jas. P. Lowrey, New York City.

The Aurora Electric Light and Power Company, Aurora, Mo.—to furnish electricity for lighting streets, houses and running all kinds of machinery. Capital stock, $20,000. Promoters: E. L. Foster, Independence, Kan.; M. T. Davis, W. F. Branham, J. J. Rehm, Aurora.

Metropolitan Electric Company, at Chicago. Capital stock, $300,000. Incorporators: Edwards Elliott, John E. Campbell and Henry A. Ritter.

West Chicago Light and Power Company, at Chicago. Capital stock, $60,000. Incorporators: F. T. Barber, Grove E. Walter, Charles J. Bushy.

Chicago Electrorama Company, at Chicago. Capital stock, $25,000. Incorporators: William P. Sibley, Charles H. Hamill and William J. Louderbeck.

The E. Walley Jones & Son Company, Seattle, Wash.—to operate and maintain electric light and power plants, etc. Capital stock, $30,000. Promoters: E. Walley Jones, E. J. McKittrick, C. Winkley and others.

The Domestic Electric Power and Light Company, Baltimore, Md.—to manufacture the Hanson primary battery and carry on a general electric business. Capital stock, $50,000. Incorporators: Samuel Kimberly, of Norfolk, Va; John H. T. Jarome, Allen B. Howard, Jr., John C. Powell, George H. Dobson and Bruno R. Koering.

The Marlborough Electric Light Company, Marlborough Ulster County, N. Y.—to furnish electric light and power Directors: O. B. Whitney, Moses McMullen, E.E. McNamee A. A. Sudderly, E. Dayton, G. A. Bodner and W. A. Paltz.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED SEPTEMBER 12, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

504,734. Trolley-Head. Joshua P. Maddox, Westbrook, Me. Filed Oct. 7, 1892.

504,847. Conduit Electric Railway. Henry D. Oler, Paterson, N. J. Filed Aug. 23, 1892.

504,977. Supply System for Electric Railways. George F. Green, Kalamazoo, Mich., assignor of one-half to Oliver S. Kelly, Springfield, Ohio; Martha L. Green executrix of said George F. Green, deceased. Filed Feb. 13, 1892.

505,081. Conduit Electric Railway. Charles O. Ehlert, New York, N. Y. Filed Aug. 23, 1892.

ELECTRIC LIGHTS AND APPLIANCES.

504,743. Socket for Incandescent Electric Lamps. Charles G. Perkins, Hartford, Conn. Filed July 10, 1891.

504,751. Electrical Testing Apparatus. Charles H. Rudd, Evanston, assignor to the Western Electric Company, Chicago, Ill. Filed Jan. 14, 1888.

504,753. Electrical Testing Apparatus. Charles H. Rudd, Evanston, assignor to the Western Electric Company, Chicago, Ill. Filed Feb. 8, 1889.

504,760. Electric-Arc Lamp. Charles F. Snedekor, Worcester, Mass., assignor to the Washburn & Moen Manufacturing Company, same place. Filed March 20, 1893.

504,815. Carbon for Electric Arc Lamps. Robert McManus, Brooklyn, N. Y. Filed Oct. 27, 1892.

504,845. Carbon for Electric-Arc Lamps. Robert McManus, New York, assignor to William A. Powell, Brooklyn, N. Y. Filed July 8, 1892.

504,866. Electric-Light Fixture. Frank W. Davenport, Providence, R. I. Filed July 22, 1893.

505,051. Electric-Arc Lamp. William B. Luce, Brookline, Mass., assignor of one-third to Edward S. Ritchie & Sons, same place. Filed Dec. 5, 1892.

505,060. Portable Electric-Lamp Support. Norman T. Mills, Boston, Mass. Filed Oct. 15, 1892.

DYNAMOS, MOTORS, ETC.

504,740. Portable Static Electric Machine. Theodorus H. Patee, Chicago, Ill. Filed Dec. 9, 1892.

504,904. Multiphase Motor. Louis Bell, Boston, Mass., assignor to the General Electric Company of New York. Filed Nov. 4, 1892.

504,914. Dynamo-Electric Machine. Rolfe Eldridge, New York, N. Y. Filed May 13, 1891. Renewed June 3, 1892. Again renewed June 1, 1893.

505,063. Switch for Governing Electric Motors. Edgar F. Ramlen, Milwaukee, Wis., assignor, by direct and mesne assignments, to Horace Hobbs, Augustus W. Friese, and Henry W. Ramlen, same place. Filed April 8, 1893.

505,064. Switch for Controlling Electric Motors. Harry Sawyer, Muskegon, Mich., assignor to the Shaw Electric Crane Company, same place. Filed Feb. 20, 1893.

BATTERIES.

504,746. Galvanic Dry Battery. John von der Poppenburg, Charlottenburg, assignor to Carl Christian Lesenberg, Rostock, Germany. Filed Oct. 11, 1892.

TELEPHONE AND TELEGRAPH APPARATUS.

504,732. Printing-Telegraph. Samuel R. Linville, Philadelphia, Pa., and Louis F. Hettmansperger, Camden, N. J., assignors to the United States Printing Telegraph Company, Philadelphia, Pa. Filed Dec. 16, 1892.

504,797. Restoring System for Annunciators. Louis A. Berthon, Paris, France, assignor to the Societe-Generale des Telephones [Reseaux Telephoniques et Constructions Electriques]. Filed May 17, 1893.

504,801. Telephone-Transmitter. James A. Brown, Moline, Ill. Filed April 25, 1893.

505,070. Telephone-Switch. Josef Steiner, Brooklyn, N.Y., assignor to the Western Electric Company, Chicago, Ill. Filed Oct. 19, 1891.

SIGNALS AND SIGNALING APPARATUS.

504,745. Electric Signal Device. Charles R. Figgins, Racine, Wis. Filed April 4, 1893.

504,752. Electric Signal Device. Charles H. Rudd, Evanston, assignor to the Western Electric Company, Chicago, Ill. Filed Dec. 10, 1888.

MISCELLANEOUS.

504,703. Electrolytic Diaphragm. August Breuer, Iserlohn, Germany. Filed Jan. 4, 1892.

504,738. Electric Switchboard. Frederick W. Mount, St. John, Canada. Filed April 5, 1893.

504,741. Electric Door Register for Watchmen. William R. Patterson, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Jan. 31, 1889.

504,754. Electric Measuring Apparatus. Charles H. Rudd, Evanston, assignor to the Western Electric Company, Chicago, Ill. Filed Oct. 19, 1891.

504,774. Electrolytic Cell. Thomas Craney, Bay City, Mich. Filed Feb. 13, 1893.

504,827. Electro-Mechanical Gong. Franklin M. Dunn, Baltimore, Md. Filed June 23, 1892. Renewed June 9, 1893.

504,901. Commutator Brush Holder. Robert N. Bayles, New York, N. Y. Filed March 30, 1893.

504,938. Electric Cut-Out. Herbert N. Prentice, Stowmarket, England. Filed May 31, 1893.

504,980. Electrical Alarm System. Charles K. Hall and William B. Lillard, New Orleans, La. Filed Nov. 2, 1892.

505,025. Magnetic Clutch or Coupling. George A. Brown, Muskegon, Mich. Filed Feb. 11, 1893.

505,032. Automatic Safety Joint for Electric Conductors. James H. Curry, Wilkinsburg, Pa., assignor of eighty-three-one-hundred-and-twenty-eighths to Frank B. Tomb, same place, and Samuel J. Graham, A. H. Childs and Robert A. Gillespie, Pittsburg, Pa. Filed Nov. 18, 1892.

505,062. Electric Time Recorder. Charles E. Ongley, New York, N. Y., assignor, by direct and mesne assignments, to the Ongley Electric Company, same place. Filed Jan. 24, 1891. Renewed Nov. 16, 1892.

505,065. Hoisting Machinery. Alton J. Shaw, Muskegon, Mich., assignor to the Shaw Electric Crane Company, same place. Filed Nov. 15, 1892.

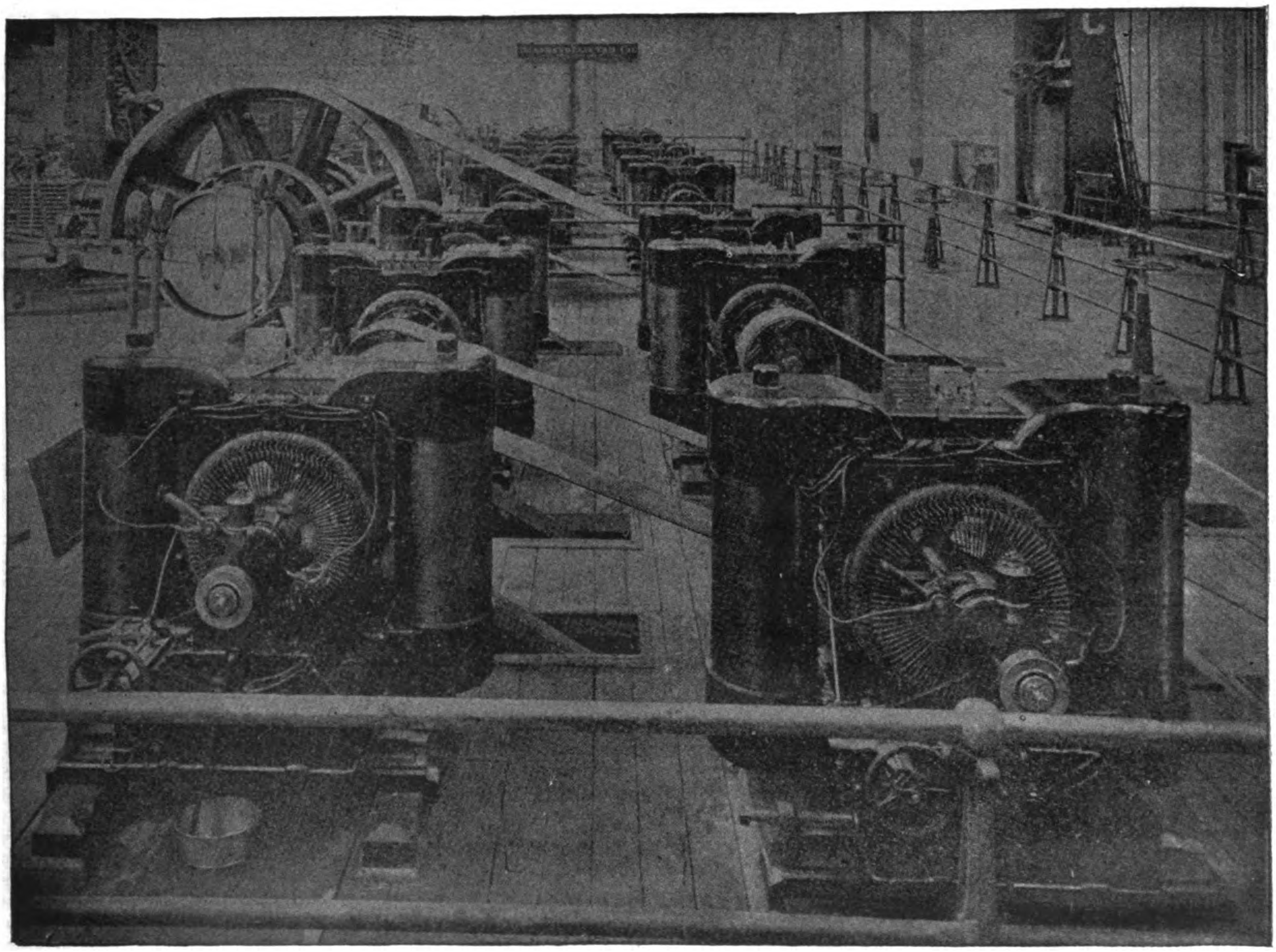
505,066. Hoisting Machinery. Alton J. Shaw, Muskegon, Mich., assignor to the Shaw Electric Crane Company, same place. Filed Feb. 11, 1893.

505,067. Hoisting Machinery. Alton J. Shaw, Muskegon, Mich., assignor to the Shaw Electric Crane Company, same place. Filed Feb. 17, 1893.

505,068. Hoisting Machinery. Alton J. Shaw, Muskegon, Mich., assignor to the Shaw Electric Crane Company, same place. Filed March 6, 1893.

ELECTRICITY.

VOL. V. NEW YORK. OCTOBER 11, 1893. CHICAGO. No. 13



STANDARD ELECTRIC COMPANY'S WORLD'S FAIR EXHIBIT. (SEE PAGE 150.)

The Standard Electric Company.

One of the largest arc lighting plants at the World's Fair is that of the Standard Electric Company, which is located in Section S, Machinery Hall. The plant contains 20 dynamos, each having a capacity of fifty 2,000 candle power lamps, besides two other machines, one of 50 and the other of 60 lights capacity in another part of the building. In all, these machines are capable of running over 1,100 arc lamps.

The two rows of dynamos, shown in the Frontispiece, are driven by three engines. The four further ones are directly belted to a 200 H. P. single cylinder Erie City engine. The next four are driven by a 210 H. P. Russel compound engine and the remainder by a double tandem compound Russel engine of 500 H. P. The latter engine runs a line shaft beneath the floor to which the dynamos are belted.

The lights from this plant are distributed through several buildings and about various parts of the Fair grounds. All the lamps run from this plant are of the Standard Company's make.

The dynamos in this plant are divided into blocks and a special switchboard is arranged so that any two circuits can be switched from one block to another in case of accident. These machines are of the Manchester type with cast iron pole pieces and wrought iron spool cores. The bearings are self-oiling and self-adjusting for alignment and their operation has been specially remarked by visitors on account of its smoothness and freedom from sparking.

A feature of the machine which also commends itself is the ease with which repairs may be made. The parts are easily separated and replaced and the bolts, screws, etc., are made of the standard commercial sizes.

Prof. von Helmholtz at Columbia College.

Prof. von Helmholtz Thursday afternoon delivered an address to the students of Columbia College in the lecture-room of the Law School building.

In addition to the students there were present Prof. Bell, Dr. Knapp, President Low, Profs. Van Amrinde, Rood, Ware, Butler, Rees, Keener and Jackson. President Low introduced Prof. von Helmholtz, who said that as his audience was composed of students from all the schools of the university he would deal with an abstract subject, "The Nature of Science and the Part that it Plays in Human Affairs." He said that the recognized method of scientific work now was collection of knowledge, retention of that knowledge and its communication to mankind. There has been more accomplished by science during the last two centuries than during 2,000 years previously.

Careful observation makes the artist and makes the brilliant scientist; trace the connection between events and the laws that govern that connection until doing so becomes intuitional. Train the mind so that the strongest impressions will be made by the most important events until this also becomes intuitional. Follow the advice of scientists of the last two centuries and go on by careful, accurate, complete observations to great discoveries and great successes.

Mr. Hurluf Petersen, of Milwaukee, has just patented a kind of electric railway which will do away with the overhead wires in the running of electric railway cars and make use of underground conductors by means of an opening between the rails similar to a cable line. Mr. Petersen is sanguine of the success of the invention. He says it is automatically and scientifically as nearly perfect as it can be made, and that it only needs a trial to prove its utility.

Direct Currents by Mathematical Methods.

BY LIEUT. F. JARVIS PATTEN.

The sometimes jocular vein of the editorial columns of the London *Electrician* threaten to make the inside pages of that sheet as bright as their lurid vermilion cover. Here is the latest, from the issue of September 1, which I reproduce for the benefit of this nation of inventors:

> Now and again we hear of the efforts of some inventor to produce a continuous current, such as may be used for charging storage cell from a simple periodic current. Various rectifying commutators have been tried, but these can only produce a humpy sort of current, the sole merit of which is that it is always in one direction; a current which must be clipped up into useful and useless portions before storage cells can be charged by it. Fourier's theorem, the refuge and strong tower of alternate current mathematicians, tells us, of course, that a certain combination of simple periodic currents *will* give an absolutely steady current; but, theoretically, at any rate, the desired result can be obtained in a much simpler manner. All that is necessary is to be able to produce a current which shall vary as the *square* of the sine of the time, instead of, as now, as the first power. Two such currents having equal periods, but superposed in quadrature, would give a perfectly steady current such as would make a battery man's mouth water. When we were at school we were taught that the sum of the squares of the sine and cosine of an angle was constant and equal to unity. Is there no one who can invent a transformer which will utilize this simple trigonometrical fact?

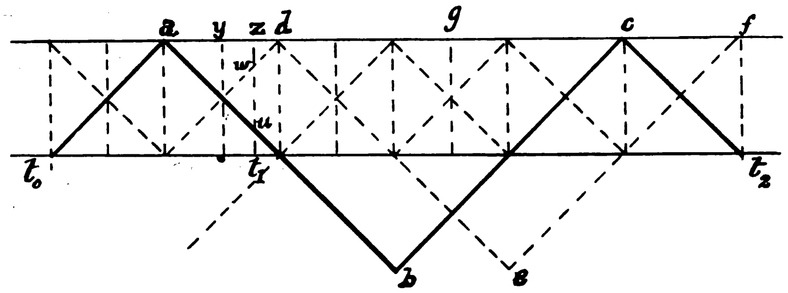


FIG. 1.

I am ever on the lookout for such great opportunities, for I have been trying for years to make steady currents out of unsteady currents but could not. Now, thanks to this kind hint thrown broadcast to the world, I think I can, but not on the plan suggested, for I was never aware that time, pure, simple, easy going time, had a sine much less a squared sine.

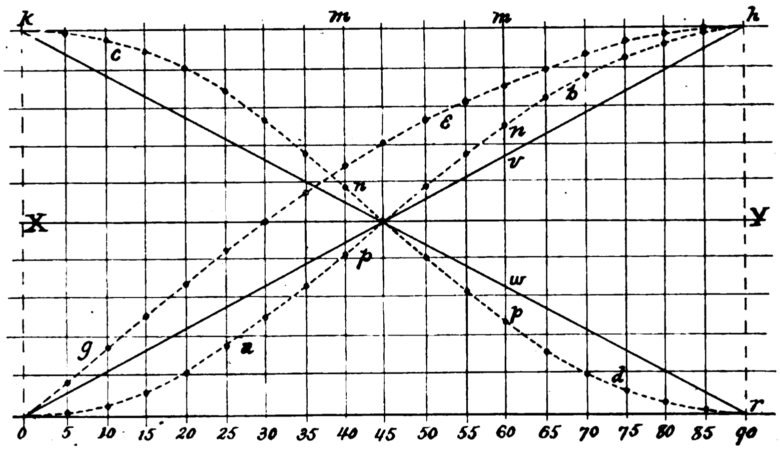


FIG. 2.

Passing this by, however, as a mere slip of the quill, devoid of any intent to mislead, let me get at that steady current that has no hummocky humps, and if I don't find something that varies as the square of the sine of the time I'll get something at any rate that "beats that twice over," and without using Fourier's theorem or the towering mathematics of the coexistence and superposition of greater and lesser harmonics, for I like a "bee line" even if it does wobble round like a Virginia rail fence, with only its corner points planted in the mud. Besides, the square of the sine method is elusive and unsatisfactory; all the negative sines come out with positive squares, and so do the plus sines also, making a one sided old-fashioned direct current that is now altogether out of date.

I am weary of those everlasting sines and cosines, and for a change let's go off on a tangent. A tangent has the faculty of being straight, and we may be able to do something with it; and I find the equation of a straight line in space when referred to a system of rectangular co-ordinates is

$$y = m \tan. x$$

and for another line $y_1 = - m \tan. x + a$

whence we have $y + y_1 = a = $ a constant,

which leaves us to infer that if varying currents expressed by ordinates that vary directly as the time, and not as the sine, of a variable function (the angle of rotation) itself varies directly as the time, then two such currents may be so superposed that the sum of their values (the ordinates) at all times will be a constant.

The condition is that these currents must vary directly as the time between the same positive and negative limiting values, and that the time of maximum value of one current, positive or negative, must correspond to the zero value of the other. The geometrical construction of this great truth seems too self-evident to have escaped the notice of all the searchers for smooth, uniform, direct currents without any "bumps." All that is required are two equal and similarly varying currents, a b c and d e f, Fig. 1. Such currents vary directly as the time, and not as the sine of the angle regarded as a function of the time, as we have been accustomed to make them, or heretofore regarded them as being made—quite a fallacy on the whole, for many alternators come nearer to making the zigzag rail fence curve bounded by two straight lines than the sine curve so much figured on. The assumption of this zigzag rail fence curve as a true expression of the varying current values from instant to instant will do away with much of the complexity incident to the analysis of sine functions. As, for instance, two such currents superposed in quadrature, i. e., maximum of one corresponding in time to the zero value of the other, give as a result an absolutely uniform direct current, a y d g c f, because at any instant as t_1 the small part t_1 u is equal to w z for any and all positions of the ordinate y.

This shows that if you can make an alternating current that will vary directly as the time between equal, positive and negative maxima, then two such currents superposed in quadrature and rectified, i. e., all negative impulses reversed, will give a uniform direct current that will be free from fluctuations, and such a current does not require, as generally supposed, the superposition of many currents of different phase, which in turn are rectified; but any two currents will answer the sum of whose ordinates remain constant.

This we see is a more general law, and if we construct a curve that varies as the square of the sine, as suggested by our English friend, it will fulfil the condition required as well. Thus in Fig. 2 the diagonals g h and k r represent quarter periods of such straight line currents—where o w is always equal to v m; and the sum of the ordinates is always a constant.

Now, g e h is a quarter period of a sine curve, the ordinates being sine values of angles from 0° to 90° and the curve a, p, u, b is one the ordinates of which are proportional to the square of the ordinates of the sine curve. In other words, the two curves, x, c, w, r and a, b, h, are quarter periods of curves that vary as the square of the sine, and being in quadrature with each other, they are also symmetrical with respect to x, y, which is the condition which must be met in order that the sum of the ordinates shall be a constant as required. Any two curves or lines that are symmetrically disposed about the line x y will then fill the required condition.

Evidently any of these curves are easily obtained. Kapp, in his recent little work on alternating currents, pages 65 to 69, shows how the zigzag current is produced by well-known forms of alternators, and the sine square curve, which it is seen differs but little from the sine curve itself, can be easily obtained were it desirable to do so, by slightly modifying the shape of the pole pieces, and properly spacing them.

From all this we may infer that two windings on an ordinary alternator so arranged as to give currents in quadrature, and following any curves or lines that are symmetrical with the line x, y, will, if rectified by separate commutating devices and superposed after rectification, give a uniform direct current without the objectionable "humps."

Unfortunately, we have to rectify, for the dynamo hasn't yet been taught algebra, and don't seem to know how to get a plus or positive quantity by multiplying together two negative ones, which it ought to be taught to do at an early day, and that is what our English friend in fact suggests.

The following experiment for making visible lines of electric force is described by Herr Bruno Kolbe: Into a flat cylindrical vessel pour purified anhydrous oil of turpentine to a depth of about two centimeters, and some sulphate of quinine. To the rim of the vessel attach two wire springs, adjusted so that the two small metallic balls at their ends dip into the turpentine. Stir the quinine with a glass rod so as to distribute it evenly, and place the vessel on a black cardboard. Join the two wires to the terminals of an influence machine, and turn very slowly. At once the white crystals group themselves so as to form beautiful curves, representing the "lines of electric force." The form of these curves recalls that of the brush discharge of the influence machine. Prof. Weiler, of Esslingen, gives the following experiment: Prepare a milky mixture, stirring up finely divided quinine in oil of turpentine. On sending a series of discharges through it, a clearance is produced at the positive pole, and the particles cluster round the negative pole, arranging themselves in streamers directed along the lines of force.

On an Improved Form of Instrument for the Measurement of Magnetic Reluctance.

BY A. E. KENNELLY.[*]

Of the methods that have been adopted for the measurement of magnetic permeance or reluctance of iron, the Faraday ring test with ballistic galvanometer is generally admitted to be the most accurate and reliable. It is, however, essentially a laboratory measurement, requiring considerable time in preparation, execution and computation. For workshop measurements and comparisons, tractive and magnetometric methods have been employed with a convenience and facility usually obtained at some sacrifice in accuracy. Recently, instruments have been used with success in which the reluctance of a sample bar of iron is compared with that of standard bars of soft Norway iron, notably the magnetic bridge of Mr. Thomas A. Edison exhibited at the Paris Exhibition of 1889, and the differential magnetometer of Mr. R. Eickemeyer.[†] It is proposed to here describe a new instrument of this class, for which certain advantages may perhaps be claimed.

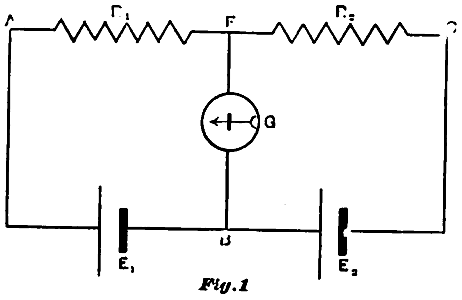


Fig. 1

Fig. 1 represents the well-known galvanic arrangement of circuits in which two resistances R_1 R_2 can be compared by a null method. E_1 and E_2 are two equal and constant E. E. forces, inserted in the conducting paths A B and B C of equal resistance. The galvanometer G connecting the junction F of resistances with the junction B of electromotive forces will indicate no current when R_1 and R_2 are equal. The conductor F B corresponds to the neutral wire of a three wire system of electrical distribution.

Fig. 2 represents the corresponding condition of magnetic circuits. A B C is a stout vertical frame of annealed Norway iron with two coils M_1 M_2 wound with the same number of turns of wire, connected in series so as to develop, with regulated constant current strengths, equal definite M. M. forces. The upright G corresponds to the galvanometer arm in Fig. 1, while the bars A F and F C are test pieces of iron having a cross-section considerably smaller than that in the remainder of the circuit. One, A F suppose, is a standard section made up of one or more bars of soft iron whose quality is known, while the other, F C, is the bar whose reluctance is required.

If the two reluctances R_1 R_2 are equal, the magnetic potentials at F and B will be equal, and the bar G will remain unmagnetized when the coils M_1 M_2 are excited. On the other hand, if R_1 and R_2 slightly differ, the potentials at F and B will not coincide, and magnetic flux will traverse the bar G. Since the magnetic circuits are all closed, the leakage through the surrounding air will be symmetrical and usually negligible, so that calling Φ the flux through the main circuit, and that through G, φ

$$\varphi = \Phi \frac{R_1 - R_2}{R_1 + 2\,G}.$$

In order to ascertain whether flux did traverse the bar G, we might, according to established principles,[‡] cut in imagination an indefinitely narrow gap or crevice through G in a horizontal plane, and insert therein a magnet pole with apparatus to measure the tractive force to which it would be subjected. As the nearest practical approach to this plan, we can cut a gap across G $\frac{1}{16}''$ (0.16 cm.) wide, and swing in the crevice a flat disk armature, carrying a steady feeble current, and with an attached pointer or index close to a fixed scale. We then obtain in all essential features the instrument here to be described.

Fig. 3 represents to scale in front and side elevation the actual instrument. D is the disk armature wound with 100 radial wires from center to circumference. Half of this disk is always covered by the pole pieces above and below it. The unifilar suspension attached to the points P and Q supply a current of about ten milliamperes to this disk. A sensibly constant tension upon the suspension is obtained by means of a spiral spring within the lower slide tube, and it can be readily shown by experiment or computation that small variations in the tension of such suspensions have a very small influence upon the torsional moment.

The modus operandi is as follows:

A sample strip or flat bar of the iron to be tested is laid across the gap F, C, the breadth of the bar being conveniently one inch (2.54 cms) and the height $\frac{1}{2}''$ (1.27 cms.) Strips of soft iron to match this are laid across the gap A F in parallel, each being say $1'' \times \frac{1}{8}''$ (2.54 × 0.318 cms.) If the disk circuit is then closed, and if there is no appreciable residual magnetism in the apparatus, the disk will remain uninfluenced and its index at zero. The field magnets are now excited in series with a suitable and measured current. The disk and pointer will now move to one side or the other about the axis of suspension according to the preponderance of reluctance between the two sides, and soft iron strips have to be added or removed across A F until balance is restored. Generally balance will be found between two adjustments of cross section at A F, and the proper amount can then be computed by proportional parts.

Steinmetz has shown[*] that from a series of such adjustments to equalize between standard and sample bars at various excitations, the complete hysteresis curve of the sample can be deduced through the known valuations of the standard, but since a linear relation is found to exist between the reluctivity and magnetizing force in iron above the critical intensity, two such observations are theoretically sufficient to determine the reluctivity of the sample for supracritical magnetizing forces.

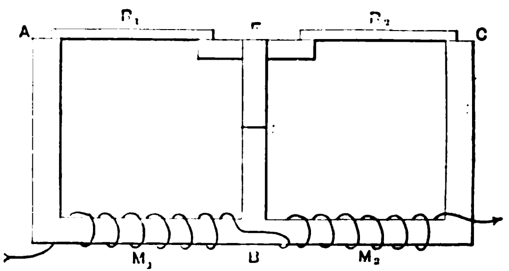


Fig. 2

The instrument can also be employed to readily indicate the retentiveness of sample bars of hard iron or steel. If after a balance has been obtained at a noted excitation the excitation be withdrawn by interrupting the circuit of the coils M M, and the standard bar is removed, the residual flux from the rest piece will, disregarding some slight loss by leakage, pass entirely through the air gap and disk at D. If the constant of the disk has been determined independently, the deflection of the pointer for the observed current through the disk will supply the amount of this flux.

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[*] Read before the International Electrical Congress, Chicago.

[†] The *Electrical Engineer*, March 25, 1891.

[‡] Clerk-Maxwell. "Electricity and Magnetism," Vol. II, par. 396.

[*] Transactions of the American Institute of Electrical Engineers, Vol. IX, p. 33. Jan., 1892.

If N denotes the number of turns in each spool,

I the current strength exciting the spools (amperes),

l the length of the test bar (cms.),

g the reluctance of the air gap at the disk (C. G. S. U.),

H_1 the magnetizing force in the bar during excitation,

H_2 the magnetizing force in the bar with excitation,

Then the M. M. F. of excitation is $\frac{4\pi}{10}$ NI in each coil; and since the intensity in the test bar is considerably greater than in the field frame, the magnetizing force brought to bear upon the test bar is nearly $\frac{4\pi}{10} \frac{NI}{l}$.

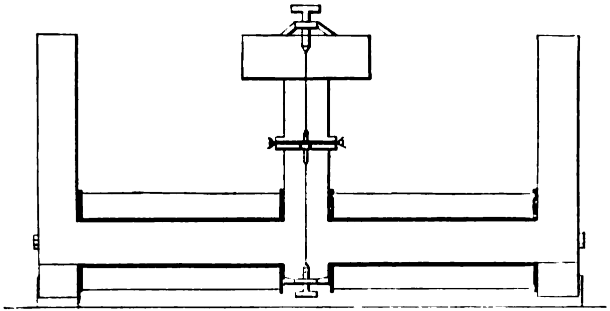

Fig.3. Sectional Elevation.

After removing the excitation and standard bar, the observed residual flux encounters at the air gap a reluctance g, so that neglecting the comparatively small hysteresis of the soft iron field frame, the counter M. M. F. at the gap is $-\Phi g$, representing an average demagnetizing force in the bar of $-H_2 = \Phi g / l$, so that the relative values of residual flux density are readily found with different sample bars for any selected value of H, or more closely, for any consequent ranges of $H_1 - H_2$.

By mounting two opposed parallel plane iron plates between the uprights A and F, in such a manner that the length of air gap between them can be adjusted by a screw, it becomes possible to measure the reluctance of a bar placed between F and C by direct comparison with the reluctance of air. Trial has shown, however, that the additional contact surfaces involved, the dissymmetry introduced into the two sides of the circuit, and the uncertain leakage error with large air gaps, probably more than offset the advantage to be derived.

The errors attending the use of the instrument are:

1. The variability of reluctance in the field frame.

2. Errors in estimating the reluctance of the contact surfaces, and the effective length of the test bar.

The first source of error depends upon the hysteresis in the iron of the field frame. It can be reduced to small limits by keeping the cross section of the test bar a sufficiently small fraction of the cross section in the frame, thus bringing nearly all the reluctance of the circuit into the test bar. A correction can also be made for the outstanding frame reluctance.

The second source of error is common to all forms of permeameters in which straight test bars are employed in closed magnetic circuits. There will be a certain range of reluctance in the contact surfaces that can be kept in subjection by giving to those surfaces adequate area. There is also the more complex error due to misestimation of the effective bar length, for the reluctance of the bar will not only be encountered in the distance between the supports F and C, but also by some portion of the length resting on the supports. The virtual length of bar included in the circuit will thus be a function of the intensity within it and will not generally be the same for the test and standard bars.

The advantages of the instrument are:

1. Absence of hysteresis in the moving and indicating parts which contain no iron.

2. Great sensitiveness and control.

3. Small reluctance in the narrow air gap or path of differential magnetization.

4. Convenience in comparing retentive powers in steel.

The writer desires to acknowledge his indebtedness to Mr. Thomas A. Edison, in whose laboratory this instrument was constructed.

A New Method for the Control of Electric Energy.

BY D. MCFARLAN MOORE.[*]

The rapid growth of electrical science, and the almost daily unprecedented addition to it of new inventions, have caused those well versed in the present state of the art to greet new theories with a certain amount of doubt, owing to the large number of false alarms that have been sounded to tell the world that all present theories and methods will, in the future, be history; and that a new and revolutionizing principle has been discovered.

Be that as it may, there is reason to believe that this paper treats largely of a heretofore uninvestigated branch of electrical science and phenomena which may be of great value to the commercial world, and of even greater interest to the scientific world.

The key to this branch of science may be expressed in a few words, viz.:—a varying-in-pressure contact in a vacuum, produced by a variable magnetic field.

The present means for the control of electric currents—ohmic resistance—is crude at its best, as in any form it is an uneconomical device. All existing forms of rheostats, regulators, resistance boxes, controllers, etc., are bulky, clumsy means for accomplishing a desired object. This is conspicuously illustrated in the case of stage regulators, which often occupy valuable floor space and consist of a tremendous weight and length of wire. That the design of apparatus for controlling current is a matter of great importance and is essential to all electrical installations, is exhibited in the fact that over half of the catalogues issued by electric manufacturing companies are given up to this class of electrical goods. Many problems in electrical engineering are considered impracticable, simply because of the weight and space required for resistance to enable the control of the current as desired.

When one takes into consideration the multitude of switches of every conceivable shape, construction and design, but all having one aim in view—which none perfectly accomplish—viz., to break a current without deleterious sparking, it seems that, as all are designed on the same principle, a new principle should be employed which would perfectly accomplish the object desired; that is, break the current with practically no sparking. It would also be a very convenient feature if each switch would control the brilliancy of all lights on the circuit which it controls.

The regulation of intensity of the incandescence of an electric filament has been a problem, the solution of which has been sought after by electricians in general the world over, and partial success has been attained by the use of the only known means, "dead resistance"; but this method can never be commercially successful, on account of very objectionable bulk, weight and heating of the resistance.

The public in general demands the control of electric lamps and the great convenience gained thereby.

The massive regulators of dynamos and starting boxes of motors should be supplanted by devices occupying but a few cubic inches of space. This is especially the case where the motor is not stationary, as in electric railway work.

There is room for a cheap ampere meter, and still more room for a cheap mechanism to be used as an electric gauge; that is, an instrument which can be adjusted or set so that a current that has passed through it will have any desired quantity or quality. This device could be substituted in place of fusible cutouts and the multitude of appliances of a similar nature. It would be of great value in telegraphy. The application of electricity in medicine should also be improved. Lastly, the reducing of phosphorescent lighting to a commercial basis is desirable.

It is hoped that a solution of these and many other problems lies in the principle stated at the beginning of this paper, i. e., a varying-in-pressure contact in a vacuum produced by a variable magnetic field; and it is doubly valuable in that it can be applied both to the alternating and the direct current. One of the simplest forms of apparatus designed for meeting these conditions is shown in Fig. 1. The varying-in-pressure contact is shown at A, caused by the variable magnetic field due to the movement of the magnet B by thumbscrew C. The evacuated bulb F contains the armature E, supported by spring E, permitting it to vibrate rapidly, producing pulsations or interruptions of the current. The rate or degree of these interruptions depends on the strength of the magnetic field surrounding the armature (in this case acting through the glass), which in turn depends on the distance of the magnet from it, varying inversely as the square of the distance. Varying the magnetic field, and therefore the pressure on the contacts, changes the amperes and volts of the current passing through the device. With properly designed apparatus the movement of the armature is so slight that to all appearances one would think it at rest. In the discussion of this method of current control, let us select that form of translating device known as the incandescent electric lamp. Fig. 2 is a diagram showing the action of a vibrator in series with a lamp without the contacts in a vacuum.

Its action is as follows:—Contact made at A; current flows through magnet and armature is attracted, breaking the circuit; magnet loses its power and spring S again closes the circuit.

Fig. 3 shows the device as applied to each individual lamp, and it will be noted that in this case the vacuum of the lamp is utilized for the vacuum of the contacts as well. The size of the armature is made as light and small as possible not only on account of the general law of all mechanical construction, viz., make moving parts as light as compatible with strength so that the position of the lamp will have no effect on the incandescence of the filament, but to minimize the amount of residual gas in the metal composing the armature, as any foreign gas will be detrimental to the filament.

---

[*] Read at the seventy-ninth meeting of the American Institute of Electrical Engineers, New York, September 20, 1893.

In Fig. 4 a socket of ordinary dimensions is shown constructed on the same principle. A socket of this kind can be adjusted to regulate a lamp of almost any C. P. within limits.

In both of these instances the movement of the magnet produces the regulation, but it is evident that results would be the same by either the movement of the vacuum or the core of the magnet. The filament emits continuous light with an illuminating power corresponding to the rate of vibration of the armature. When the armature is not within the inductive distances of the magnet it is at rest, and the filament being in circuit the light is at its maximum. An attachment to the means for adjusting the magnet is used to break the circuit when it is desired to extinguish the light. Tests show that the volts and amperes vary directly with the light. This is apparent from the following table, a 16 C. P. lamp being used :

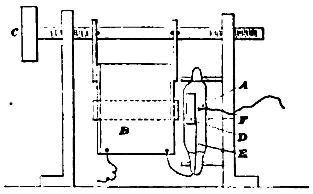

FIG. 1.

Amperes.	Voltmeter No. 2. (See Fig. 2).	Voltmeter No. 1.
.42 full C. P.	115	0
.30	84	31
.17	52	63
.11	35	80
.07	20	95
.04	15	100
.03	10	105
.02 just visible.	5	110

Still lower readings were taken, but below .02 ampere the heating of the filament was not discernible by the eye.

As shown by the readings of voltmeter No. 1, the more rapid the vibrations, the more E. M. F. is required by the contact breaker. Inasmuch as the contacts are in a high vacuum they will remain bright and effective, and the light is regulated without the use of bulk resistance. Again, with this arrangement the current is not thrown on or off the filament suddenly, thus increasing its longevity owing to more gentle treatment. The slight sparking in lamps individually regulated will use up the residual oxygen in the evacuated bulb of the lamp, thus making it more perfect and lengthening the life of the lamp.

It was curious to note that practically as well as theoretically an armature suspended, as shown in Fig. 2, is never perfectly at rest. When a photometrical test would probably decide that the lamp was burning at full C. P., and the screw A pressing the armature B as tightly as the construction of the apparatus would allow against the core of the magnet, if a sounding board is brought into requisition the vibrations of the armature are plainly discernible.

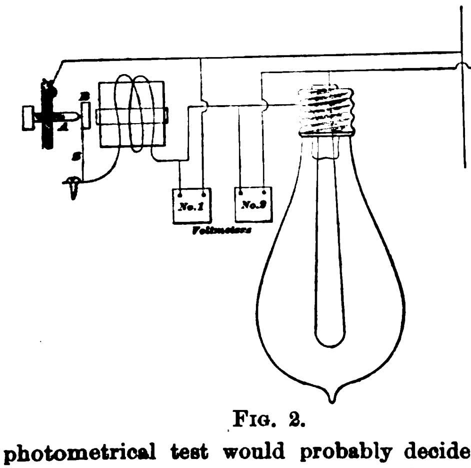

FIG. 2.

An automatic make-and-break, or varying-in-pressure contact, or what has commonly been called, and what has long been sought after, a scientifically formed "poor or imperfect contact," can be used in one sense as a transformer. It will be interesting to note the effect of a large number of lamps of this description working at one time from one dynamo, because if they should accidentally become synchronous the load on the dynamo would be very varying. But such a result is probably impracticable if not impossible.

Now let us again refer to Fig. 2 and note the changes as the lines of force acting at the armature vary.

The vibrator is in series with the lamp, because if in shunt the action is reversed and the liability to short-circuit makes it impracticable.

(1). A and B separated, lamp out.

(2). A and B in contact, lamp full, because B is not in magnetic field of magnet.

(3). Continue to advance A, B enters field, rapid vibrations commence and lamp suddenly becomes dim.

(4). Continue to advance A, lamp gradually brightens until full C. P. is reached.

Fig. 5 shows these periods reproduced diametrically. It will be noted that there are two periods where the lamp can be regulated. Period 2—3 is of too short duration for practical application, however, and by the proper adjustment of the spring can be done away with entirely. Period 3-4 covers the greatest range in C. P. and should be used. The delicacy of the spring supporting the armature determines somewhat the position of point 3; that is, the minimum in C. P. of the filament.

The voltaic arc appears between the terminals of a source of electricity. In the case of the arc lamp, it consists mainly of volatilized carbon. The electrodes are therefore consumed, first by actual combination with the oxygen of the air, second by volatilization. The ohmic resistance of the arc increases with its length and decreases with its area of cross-section. Polarization sets up C. E. M. F., and the extra current produced by self-induction retards magnetic action and causes more sparking. With metallic electrodes the color of the arc is characteristic of the metal, and is of greater length for the same current than that formed between carbon electrodes. To cause electrical vibratory motion, the current must either be greatly weakened or broken. This will cause sparking, which when the life of the contacts is taken into consideration (even though they be in vacuo) should be reduced as much as possible. However, further experimenting may prove the possibility of current regulation by varying the length of the arc in vacuo by means of an exterior magnetic field. Also the construction of a truly incandescent arc lamp on this principle.

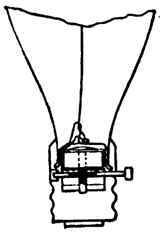

FIG. 3.

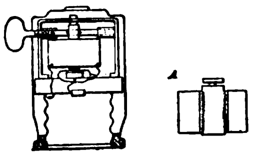

FIG. 4.

Sparking can be relieved in many ways :

(1) Sub-divide the current as much as practicable.

(2) The more rapid the vibrations the more rapid the make-and-break, and consequently the less the spark. To cause rapid vibrations, the point of application of power should be as close to the point of oscillation as possible, or the point of contact should be as far from the point of oscillation as possible.

Magnetic blast, condensers, non-sparking metals, unlike electrodes, high resistance, sheath of copper around bobbin of magnet, metal foil between layers of magnet, separate coils, etc., are all familiar methods.

It is the C. E. M. F., or automatic "choking effect," of the alternating current that permits of its beautiful control without loss, such as is sustained by controlling the direct current entirely with ohmic resistance.

With the method under consideration, the C. E. M. F.'s of the pulsating or intermittent direct current are taken advantage of. That is, both those in the arc and in the magnet.

Besides, when controlling current entirely with ohmic resistances (which can never be completely annihilated), it is constantly in circuit, whereas with the method proposed for lamp control, the only ohmic resistance, that of the arc (that of the magnet being insignificant), is in circuit but one-half of a unit of time, and if there be any foundation for the theory of the persistency of the vision of the human eye, then the filament of the lamp is also dissipating heat but one half the time. Some energy, however, is expended in the continual magnetization of the armature; in fact, this is another reason why the glow of the lamp filament is diminished and why there is a C.E.M.F. in the magnet. The greater the magnet capacity, the less the self-induction and impedance.

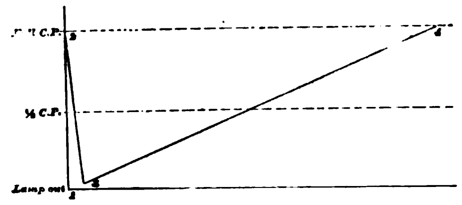

FIG. 5.

(To be continued.)

Mr. McDonald as a Financier.

How the Madison Square Bank was Wrecked.

Talk of the consolidation of the Madison Square Bank (now in the hands of receivers) with the Sherman Bank has brought out the fact that the loans made by the bank to its own officers on insufficient collateral are very large. Mr. Blaut, the president, owes it $80,000, and Mr. R. T. McDonald, one of the directors and largest stockholders, owes the bank about $150,000, directly or contingently as security for the Fort Wayne Electric Company.

What is Necessary.

(From the Commercial Advertiser.)

The duty of stockholders in this concern is perfectly plain. The first thing that they have to demand is an explanation of the methods by which the company has been brought into notoriety. The next thing is to demand an exact statement of the company's financial position at the present moment, especially as regards its notes payable and its contract liabilities, and furthermore, they have to set to work and clear out of the management the parties mainly responsible for the unbusinesslike methods, both commercial and financial, that have brought down the stock from 114 in January of this year to 40. When this is done the General Electric Company will cease to be the scandal and the menace that it has been for the greater part of this year.

The new electric clock of Herr Von Hefner Alteneck may be placed in a circuit like an ordinary incandescent lamp, and is claimed to solve the problem of providing an inexpensive yet effective system of electric control of clocks. The current keeps the clock wound at an annual cost not exceeding that of one 16-candle lamp burning for ten hours—perhaps 8 or 10 cents. Should the circuit be broken, the clock will run without the current about twelve hours. The regulation can be performed by hand from the dynamo room or automatically from an observatory, and consists of a momentary lowering of the circuit potential by 6 to 10 volts at 5 A.M., the effect being to set all the clocks in the circuit at 5. The lamps are not appreciably affected.

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A. I. E. E. Branches. The scheme to establish local branches of the American Institute of Electrical Engineers, which has been proposed for various cities, has been the subject of several editorial criticisms, some of which clearly prove that the proposition has been misunderstood.

The suggestion which is now being considered is simply to have the same papers read at the different local branches of the Institute and discussed by those bodies. These papers under this arrangement would stand upon the same basis as the ones read in former years, and the only practical difference would be the addition of the discussions at the various meetings to the Transactions.

Such a plan seems not only entirely feasible, but it is growing to be an absolute necessity in order to maintain the interest of the distant members of the Institute in its work. The only benefit which such members receive now is the printed Transactions, and something more than this is necessary to extend the influence and add to the membership of the Institute outside the immediate vicinity of New York.

Notwithstanding the plan of establishing local branches grew out of the demands of distant members, a Western contemporary criticises it as follows:

> "It is evident that the committee does not contemplate the organization of a body on an equal footing with the New York association, but merely the establishment of a local branch, a dependency under the control of the Eastern members, taking its orders from the older body, discussing such papers as may be sent out for that purpose; and if perchance an ambitious member of the branch have the temerity to prepare a paper it must be submitted to the parent organization, trimmed and 'edited' to meet the views of the gentlemen who are conferring these privileges upon the Chicago fraternity before it can be read or published in the Transactions."

Whatever the object of such criticism, it is plainly both misleading and unjust, and further, it entirely misrepresents the members of that locality at whose suggestion the present plan was considered. Independent local societies have been tried time and again and proved failures invariably, so that the branches proposed are not likely to interfere with other organizations.

Even our disgruntled contemporary could hardly propose an entirely independent organization parading under the name of the older body, and the talk about "dependencies" at the favor of the New York body is simply a piece of Chicago "bluff," as every branch, including that in New York, would be governed by the officers elected by the whole body of members.

……o……

WE HAVE done the American Institute of Electrical Engineers an injustice by referring to Dr. Adams's paper on the through-by-lightning scheme as having been read before that body in 1892. The paper was read before the Electric Club, which therefore has one more sin to answer for.

……o……

A THOROUGH reorganization of the Sham Electric Trust is demanded.

Central Station Practice. One of the most notable changes in electrical engineering practice from former years is the tendency towards special machinery designed to meet the requirements of special cases, and nowhere is this practice more noticeable than in the equipment of several of our electric lighting stations of recent construction. This fact is true not only in regard to the electrical machinery, but of the steam plants as well, and it is to be noticed further that many of these changes are in line with the practice adopted by European engineers some time before they were attempted in this country.

In the size of units for central station work the change has been most apparent, and we find one machine now replacing five or six of the smaller ones with which stations built a few years ago were invariably equipped. In a number of very large stations the division of the power has been made only sufficient to provide for possible accidents, and in a few others the entire load is ordinarily carried by one machine with a similar one held in reserve for emergencies.

Multipolar fields have also superseded bipolar types for large powers almost completely, and the consequent reduction in speed due to this modification in the design of dynamos has caused a corresponding change in the steam engines used in this class of work. Electric lighting has been credited, and very justly so, with the development of the modern high speed engine, which the demands of central station work have certainly brought to a remarkable state of perfection, but in spite of the nice adjustment and careful balancing of the moving parts, the depreciation of these very high speed machines has been found considerable, and their operation requires the most careful and constant attention.

The avoidance of all countershafting appears to have been the chief motive in the arrangement of a good many plants, and to attain this object a speed of sometimes 275 revolutions per minute and upward was frequently required at the engines so as to belt direct to the generators. The idea of meeting this condition by reducing the dynamo speeds is of very recent date, but the advantages to be gained by this are so obvious that the high speed engine is already disappearing.

The competition in the lighting business has called for the closest economy in the operation of this class of machinery, and the slightest gain in efficiency at any point is not to be neglected. This has been so carefully studied in some of the newest stations that they fairly represent the most advanced ideas in the business. In most of these it is found that the units are as large as possible consistent with the character of the load line, and slow speed multipolar machines are almost the rule. Direct connected dynamos and engines have been found of great advantage for large powers.

Where the size of the station warrants it, the use of automatic appliances to replace attendants as far as possible has proved an economy, not only in the difference in the cost of labor, but in the regularity with which such operations are carried on.

While stations built on these lines mean a large expense for equipment, all of them so far have shown a saving in operating expenses which will eventually prove their economy.

……o……

A Diagnosis of the Situation. The interest which attaches to the condition of the General Electric Company and to its probable future movements is different in degree and in kind from that of a year ago. Then anxious curiosity was expressed as to how high the balloon might soar before it fell to earth; now it has fallen flat, and the trade are all passively waiting for an official and trustworthy statement as to the extent of the damages, the creditors want to know what chance there is of getting their money, and the hundreds of discharged employees how long it will be before they will be put to work again.

ELECTRICITY has little sympathy with the stockholders of the company, who ought to have known better, and hence only a passing interest in the finances. Nevertheless, we are here to give the news, and it seems to us that the chances of the stockholders are not improved. Notwithstanding official denials, the syndicate plan has met with many obstacles, and the cash is not forthcoming as rapidly as was hoped. At least three of the company's creditors have threatened attachments recently in order to collect accounts long past due.

The selling machinery of the company is in even worse condition than it was a month ago. The affairs of the district offices at Syracuse, Cincinnati, Washington and Atlanta are being wound up as rapidly as possible, and the offices will be closed. This and many other changes were no doubt necessary, but a serious blunder seems to have been made in not providing at once, in lieu of the old plan, a single executive head, who might pass on the few orders which are being received. As the case now stands, there is no executive head, for be it remembered Mr. Coffin is shorn of all his powers; the only reason for his retaining the title of President appears to be the reluctance of the Board to kick him out, and his own evident determination to draw his salary as long as possible.

Instead of the former plan, there is now an attempt to run the company by committees—goods are bought by committee and sold by committee, and men are fired by committee. As far as the relations of the company with the trade are concerned this is no improvement on the old plan. The Selling Committee meets Tuesdays and Fridays, and Mr. S. D. Greene is one of the shining lights. It has frequently happened that while this committee has been staring at the ceiling and deliberating, the customer has gone elsewhere to make his purchase. This selling committee contains in its make-up no man who has ever sold goods successfully. There is also a Manufacturing Committee, which contains the best talent in the company, conspicuously Messrs. Upton, Kreusi and Rice, and to which there can be but one objection, which, however, is a vital one. The sessions of this committee take these men away from their posts of duty at their respective factories, where their continuous presence is essential.

Drexel, Morgan & Co. are in absolute and unquestioned control of the company, and Messrs. Coster and Twombly are struggling with the problem of its proper management. We are charitable enough to suppose that the present arrangements are only temporary, and that these gentlemen have a well defined and sensible plan which will be carried out in the near future.

The logic of the situation points to Edward H. Johnson as the only man who can bring order out of chaos, harmony out of bitter strife, and a respected and decently managed company out of the wreck which Mr. Coffin leaves behind.

The logic of the situation also points, with both hands, to the squeezing out of all the water which was injected at the time of the consolidation.

……o……

A Swindler's View of Himself. We have during the past few months received several inquiries from brokers and others as to the merits of the various schemes of Mr. G. B. Pennock. These we have answered privately, as we took it for granted the vast majority of our readers needed no instruction on this point. When such inquiries reach us in the future we shall merely enclose to the seeker after knowledge a printed copy of the following, which was recently sent to the *Electrical Engineer* over Pennock's signature:

> BRIDGEPORT, CONN., Sept. 21, 1893.
>
> I have just read the "roast" your "fake" sheet of the 20th gives me.
>
> I wish you would give my compliments to the so-called Electrical Engineer who claims that he had a "long talk" with me and tell him that he is either a dam' liar or a dam' fool. The man who wrote the article for your "rot" is a dam' dirty thief.
>
> Send your "Gang" up and you'll meet a few honest men who will take great pleasure in "knocking out" a few of the damnest rotten thieves—Dynamo Editors and Dynamo Sharps—who ever scuttled ship or cut a woman's throat.
>
> I am Sir, Your Superior,
> GEO. B. PENNOCK,
> Electrical Engineer and Inventor of the Pennock System.

……o……

They Will Bear Watching. The withdrawal of the Fort Wayne Company from the General Electric Company is not believed by well posted men to be all that has been claimed.

Unless we are misinformed, it is the intention to make the Fort Wayne plant the cornerstone for a new combination. Inasmuch as this company already has three millions of water in its capitalization, it will not prove a very solid foundation.

Whether Mr. C. A. Coffin and Mr. R. T. McDonald win in the sly game they are now playing or not remains to be seen.

ELECTRICITY is looking at them.

……o……

THE WONDER of it is, not that the General Electric Company has ceased paying dividends, but that it ever paid any dividends at all. It has never *earned* a dividend, and if we remember correctly, the payment of any dividend which impairs the capital stock of a corporation is a misdemeanor in this State.

The Telephone Patents. We have been in receipt of a number of inquiries as to the date of the expiration of the Bell telephone patents, which seem to show a desire in a good many cases to take advantage of the liberty to manufacture these instruments as soon as free from the patent.

The patent on the Blake transmitter, it is generally known, expired some time ago, and the patent on the Bell receiver expires on January 30, 1894. After that date anyone can make and use telephones covered by these patents, and there is evidence that a good many will do so, as there have already been several companies organized who are preparing to start business in this field.

The Bell Company owns a number of other patents which are very similar in construction to that of the Bell patent. The Berliner patent, for example, was granted quite recently after being kept in dispute in the Patent Office by the Bell Company, who owned it, but who took this method of extending the time of its usefulness. It will be remembered that this Berliner patent is now undergoing suit for annulment, brought by the United States Attorney-General.

Just what ground the Bell Company may take in regard to those other patents no one outside the company itself can say, but the fact that the Bell receiver and the Blake transmitter will be free after January 30, 1894, is sufficient to warrant the undertaking of their manufacture and use by the public. As to the interference with other more recent patents, that is a question that can only be settled by the Supreme Court.

……o……

THE *Electrical World* has sent out a circular recently, claiming to show that it had lost fewer advertisements than any of its contemporaries during the depression. The statement is not an honest one. If our contemporary would leave out of its calculations the dead advertisements, those of firms who never have paid and never can pay for their space, and the bogus advertisements sent in by its Chicago agent, it would make a less favorable surface showing but one more to its credit. It is not fair to those advertisers who are paying good money for their space for any journal to give the same space away to concerns that are only leeches in the trade.

……o……

THE *Brooklyn Eagle*, which has done more to make the World's Fair a success than any other of the great dailies of the East, has added to its achievements in this line by sending two trainloads of Brooklynites to Chicago on a well-planned "*Eagle* Excursion." Brooklyn is justly proud of the *Eagle*. It furnishes about 360 examples yearly of just what the modern newspaper man thinks a newspaper ought to be. It has not yet attained perfection; but perfection has been reached by only a few of us who read it.

……o……

THE NEXT presidency which Mr. Coffin will hold will doubtless be that of the West End Road. We believe the arrangements are practically completed.

Direct Connected Dynamos with Steam Engines.

BY JOHN LANGTON.[*]

Dynamos directly connected to steam engines have been not uncommonly used in Europe from the first introduction of electric lighting; so much so that the custom has been noted as a distinguishing characteristic of European practice compared with the almost exclusive use of belt driven machines in America.

The early direct connected dynamos were, however, generally uneconomical in material and were in fact high speed dynamos run below their most efficient speed, with a corresponding reduction of output in proportion to their cost. The advances made in the design of multipolar dynamos brought the efficient speeds of this type down to the point where the revolutions per minute compared with the speeds that can be efficiently obtained by modern steam engines, and so made direct connection a general commercial question. The credit for this is very largely due to German engineers and builders, who at the time of the Paris Exhibition in 1889 had brought the type to a high degree of perfection, and had built direct connected dynamos as large as 300 K. W. The general introduction of similar machines into the United States dates from the Paris Exhibition, and since then the rapid increase in their use has been a marked feature in the history of electrical progress on this side of the Atlantic. And although the principal use of machines of this class has been in large sized units, suitable only for large power and lighting stations, the practice has been gradually extended to machines of small power. Under these circumstances the subject would seem a fitting one for consideration by the Canadian Electrical Association, and the object of this paper is to bring the matter before the Association by briefly attempting to discuss in what manner the essential peculiarities of direct connection as compared with belt connection affect the main items which go to make up the cost of producing electrical energy.

The high speed automatic steam engines which are now generally used, belted to dynamos without intermediate shafting, are all suited to direct connection. They thus afford means for an immediate comparison between direct and belt connection which will apply to the majority of cases, and which is divested of all considerations of steam economy by the use of identical engines in both cases. Any conclusions drawn from this comparison, to which the present paper is devoted, may then be taken into account in conjunction with the totally distinct question of steam economy with different types of engines. This is so even for the case of slow speed engines, which in general are not suited to direct connection. The cost of production with high speed belt connected engines may be compared on the one hand with high speed direct driving engines, and on the other with slow speed engines belt driven through intermediate shafting. The question of steam economy has been recently exhaustively treated in a most valuable paper on "The Cost of Steam Power Produced with Engines of Different Types," read before the American Institute of Electrical Engineers by no less an authority on steam engineering than Dr. Charles E. Emery, whose paper gives the items of cost analyzed and tabulated so that special corrections for special cases may be readily applied. (Dr. Emery's paper was republished in the *Canadian Electrical News* of May and June, 1893.)

The subject for present consideration is then narrowed down to the general cases of identical or equally good dynamos, in the one case belt connected and in the other direct connected, to identical or equally good steam engines, used in plants which do not present any special conditions of location or operation. The items of cost to be looked at are:

In the first cost of plant—Cost of generating machinery complete ready for operation. Cost of real estate and buildings to contain generating machinery.

In the operating cost of plant—Repairs and small supplies. Attendance. Fuel.

Notwithstanding some saving in labor and material due to the use of a combined bed plate, the saving of two pulleys, of the whole cost of the belts, and (in situations where they would otherwise be used) of dynamo foundations, it does not seem probable that the first cost of direct connected dynamos and engines erected ready for operation will ever be less than or even as low as belt connected combinations. Any saving of material will be fully counterbalanced by the increased cost of testing the combined machines, whether the engine be brought to the electrical works for this purpose or whether the combined test be made where the plant is erected. Boilers, engines, steam piping, pumps, condensers and electrical apparatus outside the dynamo itself, are all unaffected; but for the dynamo connected to the engine the advantage in first cost is at present with the belt connected machine, an advantage it will probably continue to retain.

The principal difference between the two classes affecting first cost is in the engine room space required. This is most marked, and is in all its bearings the most important characteristic of direct connection. Dynamos belted to engines on the same floor occupy from two to three times the floor space of direct connected combinations, giving the latter a considerable advantage in the first cost of land and buildings required. Where the engines are on the ground floor belted to dynamos on the floor above, the total floor space is about twice that required for direct connection. In this case the real estate covered is the same for both, but the building cost is increased, not only by the extra cost of the second story, but also by the much more substantial character of the work necessary to support the weight and prevent injurious vibration. The double story arrangement of station also presents special difficulties of its own with the belts and bearings, even where dynamos not larger than 100 horse power are used. Where the individual machines are of comparatively small power, as in an arc lighting station, the double story arrangement seems to give satisfaction. By completely separating the engines from the dynamos it also probably somewhat increases the cost of attendance. In every case the saving in first cost of land and buildings has a definite assignable value and can always be taken accurately into account to determine whether it is worth saving. It becomes a matter of fact and not a matter of opinion—a fortunate circumstance in an item which presents greater variations in value than any other single one of those which must be taken into account, varying between such extreme cases as the business portions of New York, where the annual rental of floor space is $5 per square foot, and the small town, where building lots can be bought outright for 5 cents a square foot.

It is surprising what can be done by direct connection in the way of concentrating power. In one plant the writer examined, 20 feet in length of an engine-room 18 feet wide and 8 feet high contained four 75 horse-power engines direct connected to four 50 K. W. dynamos and the switchboard for the whole plant, leaving comfortable room for the attendant to move about the machines and get at and remove any part of them.

Turning next to operating expenses. On our present assumption that equally good machinery is used in both cases, there seems no ground for any difference in the cost of repairs and small supplies, except such repairs as may be required to the belting itself.

In the cost of attendance, whatever difference there may be should be in favor of direct connection, owing to the greater compactness of the engine room plant obtainable by this method.

The weight of the rotating parts of dynamo and engine, the strain of the belt connecting them, and the thrust on the crank pin, will determine the resultant pressures and the consequent friction in the main bearings of a belt connected combination. With direct connection the weights are reduced by the absence of the armature pulley and the driving pulley on the engine; there is no belt strain, and the friction is that due to the reduced weight and the thrust on the crank pin, making the direct connected more efficient than the belt connected combination. What saving in fuel this means is a very interesting and important point which could be definitely determined only by an actual fuel test. But there is a most regrettable scarcity of any published engineering data on the subject, and the writer has been unable to find any records of tests which would determine this point. In the absence of such records we may attempt to form some idea of the possible fuel economy by calculation, but for a general consideration of the subject it helps us but little. In the engine the weights and the total belt strain are constant, and act each constantly in one direction at all loads, but the pressure due to the thrust on the crank pin changes its direction each revolution, varies with the load, and not only varies at different points of the stroke, but varies differently for different loads. Without indicator diagrams and without accurate dimensions and weights of the reciprocating parts of the engine, calculation becomes so approximate as to be of little use. Without these we must leave on one side the friction of the belt connected engine, and with it the whole friction of the direct connected dynamo and engine, which at most cannot be greater than for the belt connected engine alone, since the crank pin thrust is the same for both, the belt strain is absent in direct connection, and the weight of the rotating parts of the engine is but slightly increased by substituting the direct connected armature for the driving pulley on the engine shaft. A rough comparison of weights shows an increase of weight on engine bearings for direct connection, averaging 10 per cent for 8 sizes from 25 to 225 horse power, and 5 per cent. for 5 sizes from 40 to 125 horse power.

We may then take the friction of the belt connected dynamo as the minimum amount saved by direct connection. Now, this is the same actual power whatever the load on the dynamo may be. It depends on the weight and the total belt strain, which are the same at all loads; as the load increases, one side of the belt slackens just exactly as much as the other side tightens. Consequently the per cent. loss in the bearings increases as the load diminishes. If the saving by direct connection is at full load 2½ per cent. of the output of dynamo, it is at half load 5 per cent of the output of dynamo, and at quarter load 10 per cent. of the output of dynamo. Hence the total saving during a run depends, amongst other things, very much upon the average load on the dynamos during the run.

Reference has been already made to the dearth of published records of the performance of direct connected dynamos or of data concerning them. This is a matter for surprise in view of the early use and subsequent development of the type in Europe. But it is still more surprising that such a large amount of capital should have been invested in them in the United States during the last three years, with so little public notice of the reasons leading to their adoption, or the advantages expected to be gained by their use, and a complete absence of information as to what results have been actually realized.

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[*] Read before the Convention of the Canadian Electrical Association.

Some of the Causes of Interruption to Telegraph Circuits.—II.

BY F. C. ROBERTSON.*

Crosses are not of such frequent occurrence as grounds, and in many cases occur through some material defect in the condition of the lines. Wires become crossed usually during the prevalence of a wind storm, which causes them to sway; at long stretches, especially where the wires happen to be slack, they more easily cross. Frequently crosses occur in consequence of a pin or tie wire breaking at an angle in the line, an insulator working loose and raising, or a pin being pulled out of cross-arm at a depression, allowing the wire to depart from its parallel position relative to the other wires. Crosses caused by a piece of small wire or other metallic object being thrown amongst the wires often occur, and on account of its obscurity the cross is with difficulty found by the lineman. I know of several instances where wires were found to be purposely connected with a piece of fine wire (evidently by persons bent on mischief) in such a manner that the fine wire could not be seen from the ground. Eventually in each case a galvanometer test was made and the cross approximately located; the lineman sent out to the supposed locality of the trouble was obliged to climb a number of poles before finding it.

When the nature of an interruption is such that the trouble does not remain on the wire constantly, but comes in and disappears again at intervals, it is called a "swing," and when the intervals are long and the length of time the trouble remains is short, the interruption, though of not so much consequence as regards impeding the working of the line, is more difficult and slow to locate than if the interruption were constant.

When two or more wires are crossed one of them can be cleared by opening the others at stations on each side of the cross. In case a through and a way wire are crossed it is customary to clear the through wire by opening the way wire at the stations between which the cross occurs in such a manner that said stations may have communication on the way with their respective terminals and intermediate offices. Such an arrangement is accomplished in the following manner: Suppose two wires, number 1 and 2, running west from terminal station A to terminal station D, are crossed between way stations B and C, of which B is east and C west of the cross. It is required to clear No. 2 (the through wire) and ground No. 1 (the way wire), so that B can work with A, and C with D, respectively. B opens the west end of No. 1 wire at the switchboard and grounds the east end with instrument in circuit east of the ground, C opens the east end of No. 1 at his switchboard and grounds the west end with instruments in circuit west of the ground; thus that part of No. 1 between stations B and C will be "dead," causing no interference with the working of No. 2. At the same time the circuit in the portions of No. 1 between A and B and between C and D will be closed by means of the ground connections.

Lightning coursing the wires during a thunderstorm has a strong tendency to do damage to the instruments, and were it not for the presence of that valuable arrangement called the "lightning arrester" (which forms an adjunct to modern cutouts and switchboards), many relays would be burned out. Before the lightning arrester was invented the custom was to cut out the instruments during a thunderstorm, but now it is considered quite safe to leave the instruments cut in, regardless of the storm, where the switchboard is provided with this protection, and it rarely happens that a relay is found to be damaged by lightning. The tendency of lightning to do damage is not confined to the instruments alone, poles on the line in the country being shattered and cross-arms splintered. In this connection it may be apropos to remark that the custom of modern line builders to provide the poles at intervals along the line with ground wires may be regarded as commendable; the arrangement appears to give good results in the capacity of lightning-rod protection to the poles.

Office main wires, especially if insulated with paraffined cotton covering, where allowed to rest in contact with a gas pipe or grounded object, are liable to become grounded by lightning penetrating the insulation and carbonizing it in its path, producing a conducting medium and creating a permanent connection between the main wire and grounded object.

During the brilliant display of luminous streamers exhibited in the heavens occasionally, and known as the Aurora Borealis, the telegraph circuits throughout the continent are more or less affected by earth currents, which become so severe at times as to entirely interrupt communication. These earth currents constantly vary both in intensity and polarity, making it impossible to keep the instruments adjusted on circuits having an earth return. It may be of interest to mention that some tests were made by Mr. William Finn, of the Western Union Telegraph Company, on a No. 6 gauge iron wire 213 miles long, extending from New York to Boston, during the magnetic storm of July 16, 1892, which showed that the abnormal current in the wire reached the strength of 133 milliamperes, and the maximum difference of potential of the earth at New York and Boston was 492 volts. Such a high voltage had not been observed during any previous storm. A wire can be worked during a magnetic storm by disconnecting the ground at each end and substituting a wire return instead, thus forming a metallic circuit. I beg here to state that a quadruple circuit arranged with a metallic return was successfully worked by the Canadian Pacific Telegraph Company between Toronto and Montreal during the magnetic storms of last year.

The foregoing mentions only a small portion of the troubles to which telegraph circuits are subject; to enumerate all would occupy much more space and time.

In conclusion I beg to mention a few conditions which, when complied with, have a tendency to prevent trouble to a great extent. The line should be constructed in a substantial manner, only first-class material being used. Poles should be sufficiently stout in proportion to their height, set well in the ground, placed close enough together to render the spans not too long, so as to well support the wires and to prevent them from crossing. At corners the stretchers should be much shorter, the poles well braced or guyed, double cross-armed and straight grained pins used. The wires should be stretched tight and the joints soldered. At crossings of other lines it is best to go above them, but if this cannot be conveniently done, the wires in passing underneath should have a good clearance and be protected by guard wires to prevent other wires from falling on them. At a low point in the line where there is an upward strain the pins should be nailed in, and loops or hooks secured to cross arm over each wire so as to catch it in case it should raise through an insulator coming off pin or a tie wire breaking.

All limbs of trees liable to come in contact with the wires should be removed. Special attention should be given to the wires in cities and towns to guard against crosses with electric light or railway circuits. Office cutouts and switchboards should be provided with lightning arresters, and the wires where they enter terminal offices be supplied with automatic line openers to act in case a cross with an electric or trolley wire occurs. For inside wiring it is preferable to use waterproof insulated wire, but if paraffined cotton covered wire be used it should not be laid in grooved boards, but secured by cleats and placed where it will be free from moisture, and where the insulated covering cannot become abraided. The batteries should be placed in a dry place, easy of access for frequent examination. Binding screws should be examined occasionally to see that they do not work loose. A vigilant and industrious lineman will prevent the occurrence of much trouble by frequent and careful examination of the lines in his charge, making repairs promptly when required and keeping the lines generally in such shape that the apparent liability of their becoming interrupted is reduced to the minimum.

(Concluded.)

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* Read at the Convention of the Canadian Electrical Association.

Long Distance Telephony.

The American Telephone and Telegraph Company gave an exhibition of their long distance telephone lines on Thursday afternoon last to small party of guests who assembled at the Telephone Building in Cortlandt street at 5 o'clock.

Among those assembled to witness the exhibition were Dr. Von Helmholtz, Prof. Alexander Graham Bell, Dr. Herman Knapp, Miss Knapp Prof. Seth Low, Prof. Ogden N. Rood, Prof. Geo. E. Deschweinitz, and Mr. Edward J. Hall, Mr. Melville Egleston and Mr. F. A. Pickernell of the Telephone Company, besides some representatives of the electrical press.

A number of receivers were arranged so as to give each of the party a connection to the line. Connection was made with Boston, Chicago and Washington in turn, and conversations were held with the offices at those points. A cornet was also played which was heard through 500 miles of wire as distinctly as though it were in an adjoining room. The conversation with the headquarters of the Telephone Company at the World's Fair was held with perfect ease, speaking in an ordinary tone of voice. The exhibition proved of the greatest interest to the guests.

A railway based on the Greathead system of tunnels in London is now proposed for Brussels. It is to be worked by electricity and to run fifty feet below the surface. The first portion is to consist of a complete circle about four miles long, with double track, having eleven stations, and a future extension of a second circle of about two miles in length, with four stations; the two tunnels for the different sections will be quite distinct from each other; they run almost entirely below the public streets. The total cost of the first circle is estimated at $3,500,000, a less rate than the City and South London line, which cost $1,000,000 per mile. The elevators are to be operated by hydraulic power and will hold forty people.

A new form of trolley wheel designed for the purpose of keeping the wire free from ice and sleet during winter storms has been devised by John W. Clark, of Menands, N. Y. The spokes of the wheel are formed by radial openings cut through the flanges and also through part of the periphery of the hub, across which they extend and form a series of ice-breaking ridges at the bottom of the groove. This groove is of a size to fit the wire rather snugly, and between it and the flaring flanges of the wheel each spoke is provided with a sharp shoulder which aids in breaking part of the ice before the wire has actually made connection with the wheel, which may be made in two sections joined together.

Current Items.

It is estimated that the plant capacity of all the central electric lighting stations of London, England, reaches an aggregate of 850,000 eight-candle-power lamps.

Cape Town, South Africa, has an electric lighting station supplying 6,000 lamps, 400 of which are of the incandescent type. The water power of Tessina Brook, on Table Mountain, which has a fall of 1,350 feet, furnishes water to turbine wheels at the central station, a distance of four and a half miles. The plant has twenty-two miles of underground lines and fifty-six miles on iron poles.

An electric dredger is in successful operation in New Zealand, and has been found more efficient and more economical than steam dredgers. The use of the new dredger has enabled several changes of great benefit to be made in the ordinary system of dredging, and now operations can be carried on with ponderous machinery to a depth of sixty feet without trouble.

Electricity has either in imagination or in fact been pressed into many strange services, but we doubt whether it has performed anything more curious than it does in the case of the "tromometer," which is an instrument devised by a M. Quintard, of Angers, France, to determine the degree of shakiness or steadiness of the human hand. The "tromometer" consists of a knitting needle and a sheet of metal pierced with a series of gradually diminishing holes. One pole of a battery is connected to the knitting needle, the other to the draw plate, an electric bell being also in circuit. The "subject" has then to insert the needle through the holes in succession, beginning at the largest, until the amplitude of his "shakes" is such that he ends by touching the sides of the hole, a result which is announced to the world at large by the ringing of the electric bell. It is suggested that a "tromometer" would be a useful adjunct to the equipment of a competing rifleman; unfortunately for this idea, steadiness of hand and accurate shooting do not by any means go together, so that the indications of a "tromometer" would, as likely as not, be a cause of unnecessary discouragement.

The *Mail and Express* inclines to the belief that electric roads will prove highly beneficial to the farmer, and suggests possibilities in the matter of electric lighting, heating, etc., for country homes, which may yet be realized and relieve farm life of much of its dreariness and discomfort. That paper, in an editorial, says: "The tendency of country people to flock to the cities, and of inhabitants of the latter to live in the suburbs, proves that while mankind does not take kindly to the lack of social advantages in country life, there is a disposition to live where trees and grass grow, birds sing and flowers bloom, provided that this can can be done without a maximum of discomfort. We have before spoken of the popularity which country life will have when electric railroads run along the principal highways. That such roads will be constructed within a few years admits of no doubt. Already the trolley car connects cities and villages and gives traveling facilities to rural districts that until a year or two ago were far out of easy reach. As electric railroad building is perfected invention will still further cheapen its cost. When the farmer can reach a city or village in a few moments by electric car, and send his produce to market also by ready and rapid transit, much of the discomfort and loneliness of farm life will disappear. It is not impossible that the farmer may choose to live in a village and go to his daily employment on the farm as the New York banker or merchant goes to his counting room every morning. But the electric car is not alone to be the friend of the isolated and to give joy to the solitary. Many farms have running brooks within their limits. The electric power that can be obtained from these may be used to heat and light farm houses and to cook food and run farm machinery. Then country life would become delightful and we would cease to hear tales of the dwindling population of rural localities."

BOOK REVIEWS.

ARITHMETIC OF MAGNETISM AND ELECTRICITY. BY MORROW & REID. BUBIER PUBLISHING COMPANY, Lynn, Mass.

The above is the title of a useful little book which contains a great deal of practical formulæ and mathematical data on the subjects of magnetism and electricity. The book is eminently a practical one, its object being to present in concrete form such information as is specially useful in the commercial applications of electricity which constantly present themselves to the electrical engineer.

Following the general laws of the electric circuit are some chapters on the design of magneto-electric machinery of both the direct and alternating types, for which a number of rules are given not to be found collectively in any other work.

ELECTRICITY UP TO DATE. BY JOHN B. VERITY. F. WARNE & COMPANY, New York. Price 75 cents.

This is a popular treatise on the modern uses of electricity which makes no pretensions to technical merit, but contains a very readable account of the general applications of electricity in a style that will appeal to the general reader.

The general principles of the dynamo, storage battery, electric illumination, transmission of power and other subjects are explained in simple style, and a perusal of this work would dispel much of the mystery which is commonly imputed to the use of electricity by the public.

Legal Notes.

Two mortgages have been filed by the Jenney Electric Motor Company of Indianapolis. A mortgage for $9,984.18, to the Indiana National Bank, covers all the machinery, tools, etc., at present used in the plant. It is given to secure various notes. A second mortgage, given to the Capital National Bank, covers the same property, and is given to secure the payment of $4,000, in five notes of $800 each.

The appeal of the United States Electric Lighting Company in its case against the Edison Lamp Company for alleged infringement on a patented improvement in the process of manufacturing carbon conductors for incandescent electric lamps, was argued before Judges Dallas and Butler, in Philadelphia, on the 3d inst. Decision was reserved. The appeal was from the dismissal by Judge Acheson in the Circuit Court at Pittsburg.

Judgment for $6.732 has been entered against the Daft Electric Light Company in favor of Robert L. Belknap for money lent previous to July 24, 1891. Mr. Belknap was formerly president of the company, which was merged into the United Electric Traction Company three years ago.

A final decree, has been entered by Judge Grosscup, at Chicago, in each of the suits brought by the Edison Electric Light Company against the Illinois Electric Lamp Company and the Sunbeam Incandescent Lamp Company for an injunction and accounting. The decree in each case establishes the validity of the patent granted Thomas A. Edison in January, 1880, for the improvement of electric lamps. It further gives the complainant nominal damages and a perpetual injunction. The settlement is an amicable one, counsel for the several litigants agreeing to the form of the order of court.

The Short Electric Railway Company of Cleveland, through William S. Gummere, the counsel, has filed the bill in the suit against the Trenton Passenger Railway of Trenton, N. J., and asks for a restraining order to prevent them selling $1,000,000 worth of bonds, because they have not complied with an agreement made with the Short Electric Company. This latter corporation had $100,000 worth of notes discounted and sold the plant of the company, taking notes for the same, and they were to receive as collateral $600,000 of the bonds to be issued. They suspect that the bonds are sold or are about to be sold, and they want the company enjoined from disposing of them or any part of them until they give to the Short Electric Company the securities promised.

Judge Acheson, in the United States Circuit Court at Philadelphia, has granted a preliminary injunction pending the litigation in the suit brought by the Edison Electric Light Company and others against the Westinghouse Light, Heat and Power Company, John W. Mehargue and others. for alleged infringement on incandescent lights. The injunction is on the second claim of the plaintiffs' patent. The operation of the injunction, however, was suspended for twenty days.

Boston Notes.

The Haverhill and Queensbury and Gloucester Street Railways have withdrawn from the New England Street Railway Company, and are to receive back their own stock. No reason is assigned for this move, but it is believed that it is the outcome of a growing feeling against the consolidation project. People are beginning to appreciate that monopolies or movements tending in that direction are not always unmixed blessings.

As work becomes a little more abundant at the factories of the General Electric Company in Lynn, some of the old help are taken back at wages upon which a 10 per cent. reduction has been made.

Mayor Matthews is spoken of in Boston business circles as likely to become the successor of Mr. H. M. Whitney as president of the West End Railway. Mr. Matthews is an enterprising business man, who during his mayoralty has had many opportunities of learning a great deal about the needs of the traveling public in and around the city, and there are far less competent men than he who might be thought of for so responsible a position.

The electrical fountain erected on the Common at Lynn, as a bequest from a recently deceased public spirited citizen, was submitted to final tests on Friday evening, in the presence of something like 20,000 persons, and proved to be all that the contract called for. The city council then accepted the fountain as a gift to the city, the designer and builder, Mr. W. Blood, Jr., representing the Franklin Electric Company, Kansas City, receiving many congratulations on the completion of so artistic a piece of work, which is the most striking feature in Lynn's park system.

The Quincy and Boston Street Railway Company having completed its new power house at Quincy Point, is now furnishing the whole of its extensive system with current, which it finds is far more economical than renting power as heretofore from the Quincy Electric Light Company.

The past summer there has been an immense passenger traffic between Boston and the old historic town of Marblehead. Electric cars run all the way, and it has become quite a popular itinerary to take a car in Scollay Square, Boston, ride out to Lynn, there change cars and ride to Marblehead, through most charming country. In fact it may be said that the territory lying immediately to the north of Boston now traversed by the electrics is one of the most pleasant districts in New England.

The consolidation of the Thomson Electric Welding Company and the American Projectile Company, which we made mention of in our last issue, is reported to have been consummated. The company is to be known in future as the Thomson Electric Welding and Projectile Company and will have a capital of $1,000,000. The Welding Company was doing next to no business, but the Projectile Company has contracts with the United States Government that will keep it busy for several years.

General News.

What is Going on in the Electrical World.

St. Louis, Mo.—Electric ambulances are to be introduced here for use in street accidents.

Beloit, Wis.—G. L. Cole, of Ft. Atkinson, has bought the Beloit Electric Light Company's plant.

Dallas, Tex. The motive power of the Dallas and Oak Cliff Railway is to be changed from steam to electricity.

Orange, N. Y.—The trustees of South Orange have passed an ordinance permitting the electric road to use the street.

Tacoma, Wash.—The city council has passed an ordinance for rebuilding and repairing of the electric light station.

Warrensburg, N.Y.—The electric light plant, now being set up in this village, is expected to be in operation by November 1.

Piqua, Ohio.—The Miami Valley Electric Railway Company are considering the building of a line between this city and Minster.

Kingston, N. Y.—The Colonial City Electric Railway Company have announced their intention to begin construction work on their road at once.

Port Arthur, Can.—The electric road connecting the towns of Port Arthur, Fort William and West Fort William, eight miles long, is completed.

Flatbush, L. I.—The town board has awarded the contract for supplying the town with 300 electric lights to the Knickerbocker Electric Light Company.

Jacksonville, Fla.—Work has begun on an electric railroad from Jacksonville to Neptune. The line will be sixteen miles long, four miles of which are graded.

Rochester, Minn.—The Western Electric Company of Chicago will begin at once putting in the $20,000 electric light plant which has been contracted for by this city.

Youngstown, Ohio.—A proposition for the city to issue bonds for $100,000 to establish its own electric light plant is to be submitted to a vote of the people in November.

Lancaster, Pa.—Surveys are being made for an electric line between this city and Reading. The work of construction will be pushed forward as rapidly as possible after the survey is finished.

Middletown, N. Y.—The Traction Company have started work on the line to Goshen, and the proposition for the establishment of a pleasure park at some point on the route is receiving much attention.

Canton, Ohio.—The car house of the Canton-Massillon Electric Railroad was burned to the ground on the 3d inst., and nearly all the motors and trail cars of the company were destroyed, causing a loss of $100,000.

Buffalo, N. Y.—The Buffalo, Bellevue and Lancaster Railway, linking the new industrial town of Depew and the villages of Lancaster and Bellevue with Buffalo, is said to be one of the best electric roads in America.

Montreal, Can.—A. O. Granger, manager of the Auer Incandescent Light Company, has been suspended from the management of the company because he has been charged with defrauding the customs by false entries of goods imported from Vienna.

Oakland, Cal.—A certificate has been filed by the directors of the Alameda, Oakland and Piedmont Electric Railway Company of the action of the stockholders creating a bonded indebtedness of $350,000, which was voted by all the stockholders.

Hillsboro, Ill.—The St. Louis Interstate Electric Construction Company have put in an electric lighting plant here, under contract, and the light will be turned on about the middle of October. The contracting company owns about one-half of the stock.

Wellesley, Mass.—The selectmen of Wellesley have offered a franchise for an electric railway to run between Natick and West Newton to the Natick and Cochituate Street Railway Company, with the provision that it shall be in running order by July 4, 1894.

Poughkeepsie, N. Y.—L. F. Johnson, of this city, chief electrician of the N. Y. C. R.R., has been granted a patent on an electric battery which has been successfully used on the block signals of the road for the last six months, at a saving of $400 per month for each division.

Washington, D. C.—The officers of the Metropolitan road have announced their intention to use an underground electrical system on their lines if permitted to by Congress. They propose to adopt the Siemens & Halske system, which has been in successful operation at Budapest for three years.

Des Moines, Iowa.—Surveys have been made of the streets here with a view to the building of an elevated electric road, and a charter is to be presented to the council for its sanction. A local paper says the Westinghouse Electric Company is at the head of the improvement, and will build the road if it is ever built.

Goshen, Ind.—A receiver for the Indiana Electric Power Company has been asked for. The assets consist of about five miles of new street car track and general equipment. The aim of the company was to connect a belt of towns in Northern Indiana by electric lines. Assets and liabilities are said to be equal.

Plainfield, N. J.—A representative of the electric roads syndicate has been negotiating for the purchase of the Plainfield Street Railway, with the intention of extending it to Newark through intervening towns and to Bound Brook through Dunellen. It is proposed to run a freight car over the tracks as a local express accommodation.

Lowell, Mass.—The franchise of the Lowell, Lawrence and Haverhill electric street railroad through Bradford has expired while as yet the construction is not completed. In order to regain the franchise the company will have to obtain a new hearing. This cannot be had till spring and meanwhile operations on the road will have to be suspended.

Sacramento, Cal.—The Sacramento Electric Power and Light Company has closed a contract for furnishing the material and erecting the plant for transmission of power from their works at Folsom to Sacramento. The specifications cover the three-phase system of the General Electric Company and the two phase system of the Westinghouse Electric and Manufacturing Company.

Provincetown, Mass.—Representatives of an electric company have been here lately conferring with prominent business men as to the advisability of establishing an electric plant for a street railway and lighting the town. The project as outlined calls for an estimated outlay of $75,000. The electric company will invest $40,000 if the remainder of the stock be taken by people of the town.

Providence, R. I.—The Providence Electrical Works, a new corporation, is said to have secured an option on the Daboll Mill buildings at Elmwood. It is stated that the company will start with a capital of $400.000 and will absorb the Consolidated Electrical Works of Boston. Dynamos and a new wire, proof against poor insulation, are to be manufactured, and several valuable patents are to be developed.

Chicago.—The *Herald* states that O. W. Meysenburg, president of the Siemens & Halske Electric Company of America, is at the head of a syndicate organized to furnish rapid transit to the north side of this city and contiguous suburbs by a comprehensive electric railway system. The capital stock of the new concern will be about $5,000,000, and many of the influential and wealthy property owners of the north side have pledged already sufficient subscriptions to assure the capital.

Philadelphia—In the Kensington section of this city the people celebrate the opening of the fall trade by musical parades and street illuminations. The festivities this year began on Wednesday evening, and closed on Friday evening of last week. The illuminations extended all along Frankford avenue. Fifty red and white arc lights in the centre of the street threw out their brilliancy at intervals of 200 feet apart, lighting up the gayly arranged store windows, nearly all of which were also illuminated by their private electric lights. All the extra electric lights for the occasion were donated by the Frankford Avenue Merchants' Electric Light Company. Besides these, thousands of Chinese lanterns, lit with candles, were strung along the house fronts, while at every available place floated the American flag.

A New Alternating Current Lamp.

The Electric Construction and Supply Company the Makers.

Always up to date in supplying what the people want in the way of arc lamps, the Electric Construction and Supply Company of New York have just placed on the market a new lamp for alternating circuits, either 30 or 50 volts, secondary. Two sizes are made at present, 10 and 14 amperes.

The chief points of merit claimed for the lamp are its simplicity of construction, entire freedom from complicated mechanism, lightness and durability—all important features for a successful arc lamp. Prices are reasonable, and the lamp can be supplied in various highly ornamental designs, if desired.

The World's Fair a Success, but it Will Soon Close its Gates Forever.

The grandest exhibition of our time, and possibly for many generations to come, will soon be brought to an end.

There remains but one month in which to visit this marvelous gathering of all the World's Productions, and everybody should strain a point to go to Chicago.

The railroad fare heretofore has been considered a hindrance to all classes, but this has all been changed, and on the following days in October the West Shore Railroad will run high-class excursions on its fast express trains in through cars at one-half its lowest fare, i. e., $17.00 from New York to Chicago and return, and proportionately lower rates from points along its line. These magnificent excursion trains will be in charge of an agent whose duty it is to care for the interests of the company's patrons en route, to furnish detailed information as to accommodations obtainable in Chicago, and to point out the historic points along the grand old Hudson and through the picturesque Mohawk Valley.

These trains will leave Franklin street, New York, at 10:00 A. M., and West Forty-second street at 10:10, as follows: Saturday, October 14; Thursday, October 19, and the last, Monday, October 23.

C.-S. Automatic Magnetic Cut-Out.

A magnetic cut-out so constructed as to withstand the rough usage incident to street car service; one that is easily and conveniently adjusted to open only upon an overload beyond that which the motor at times is expected to carry; one that is compact and simple in construction and which can be supplied at a price that is not prohibitory, is something that was waited for a long time. A magnetic cut-out answering these requirements was first produced by Mr. H. B. Cutter, of Philadelphia, and is now numbered among the C.-S. specialties.

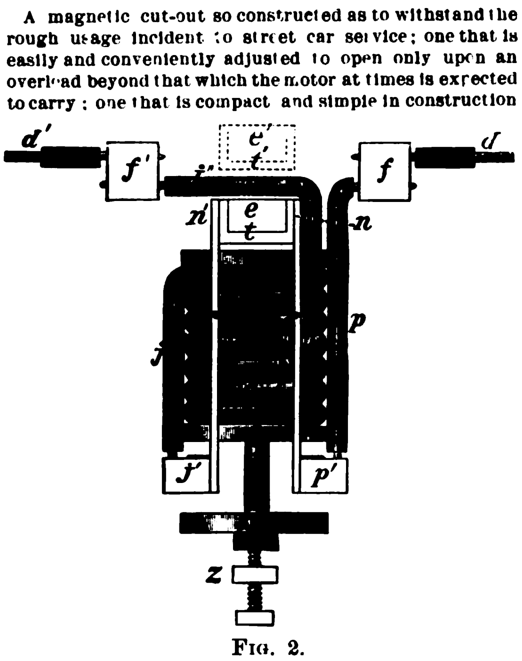


FIG. 2.

Fig. 1 shows this device complete and in position. The iron case which encloses it is hermetically sealed against the weather by means of a packing of rubber between the case proper and its hinged cover which is firmly seated and held in place by the screw lock *a*. The conductor wire *d* enters the case through hard rubber bushings *c* on either side. The dimensions of the case are as shown, and it is fastened in place by means of four lugs, two on either side at the bottom. The act of opening the case breaks the circuit on the trolley side, thus insuring safety in handling and adjusting the mechanism. Figs. 2 to 8, following, fully describe the device in full.

Fig. 2 is a diagrammatic plan showing details of this device. A fuse of low blowing capacity, compared to the maximum current the magnetic switch is intended to pass, is placed in shunt between the two plates of the switch, so that when current is broken at the switch terminals the fuse carries the current for a short period of time.

In street railway practice circuit is from trolley terminal d, through clamp f, conductor p and clamp p' to switch plate n; thence through bridge t, to plate n'; thence through clamp j', conductor j, coil $q\ q$, conductor j'' and clamp f' to controlling switch terminal d'. A small portion of the current passes in shunt from point m on plate n to point m' on plate n' through fuse y. For a 500 volt circuit this fuse would ordinarily be of a rated capacity of 5 amperes.

When a normal current is passing, the pole plate r of the plunger is in position as shown. When the overload comes the plunger is drawn up into the coil, driving the switch bar and bridge into position shown by the dotted lines $e'\ t'$ and breaking the circuit at $n\ n'$. The entire current is carried by the fuse for a period of time sufficient for the bridge to reach a safe position—then it "blows," provision being made against the formation of an arc between m and m'.

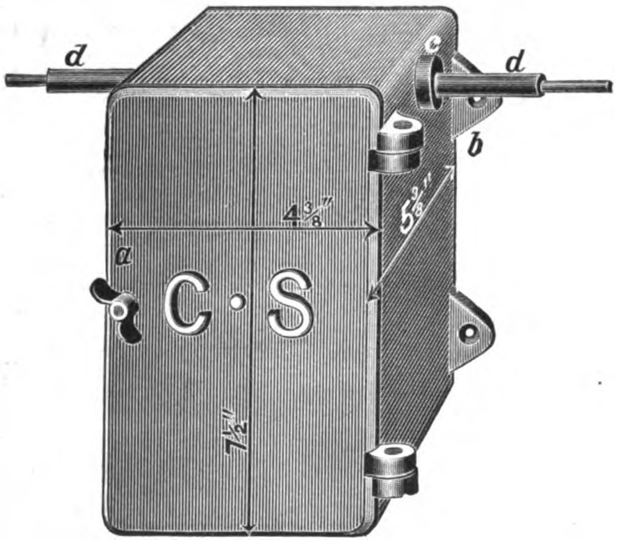
Removal Notice.

Mr. W. F. B. Pratt, who is doing a lively business taking orders for the renewing of Edison lamp for the Boston Incandescent Lamp Company, has move his offices to No. 40 Cortlandt street.

COMMERCIAL PARAGRAPHS.

The Iona Manufacturing Company of Boston, which manufactures special lines of electrical supplies, reports business as improving briskly. They have recently started quite a number of fresh hands to enable them to handle with despatch some very large orders for ceiling rosettes, etc., from the West.

The W. S. Hill Electric Company, Boston, has just secured a splendid contract for several of their high-grade electrical specialties, which contract has compelled the company to increase its staff of men, who will be fully employed for several months on this contract alone. This well known firm enjoys an enviable reputation for the high-grade quality of its goods, and through all the financial depression has kept busy right along. Its large and well equipped factory is now rushing.



C.-S. AUTOMATIC MAGNETIC CUT-OUT. (FIG. 1.)

The New England Electric Heating Company has leased a large factory at Milford, Conn., where it will manufacture its various devices for which there is a constantly growing demand. At the present time the company is way behind its orders.

The Phillips Insulated Wire Company of Pawtucket, R. I., has just declared a dividend of 2 per cent. This company has become so prosperous, and is now doing so large a business, that it is building a large brick factory and equipping it with every modern type of machine, so as to be enabled to handle its growing volume of business.

Notwithstanding the general depression, the Boston Braid Company finds that its enlarged and extended facilities are none too much for the excellent demand it is enjoying for its highly finished silks for lamp filaments.

The Shawmut Fuse Wire Company of Boston have issued a neat pamphlet descriptive of their specialty, which embraces an instructive chapter on "Fuse Wire and its Uses."

The splendid exhibit which the New England Butt Company of Providence, R. I., is making at the World's Fair bringing substantial results, for at the present time here is a brisk demand for its high-grade braiders, etc. The foreign visitors to the Fair who are engaged in the wire and cable business have had many words of praise for this company's machines, and are showing their appreciation by placing some good orders for same.

The Frink Improved Reflectors, which have for many years been recognized as the standard for use in connection with incandescent lighting work, received the well-merited tribute of the award at the World's Fair.

Among orders received by A. L. Ide & Son, of Springfield, Ill., during the last ten days are the following: One 100 H. P. Ideal engine for the Ludington Building, Chicago; one 125 H. P. engine for the Hoopeston Canning Company, Hoopeston, Ill.; three 175 H. P. Ideal tandem compound engines for the new Stock Exchange Building, Chicago, and two 125 H. P. and one 100 H. P. Ideal engines for the Southern Hotel, St. Louis. The Stock Exchange and the Southern Hotel engines are all to have General Electric Company multipolar armatures directly attached to their crank shafts, the Stock Exchange engines driving 100 K.W. machines and the Southern Hotel engines driving 50 K. W machines.

INCORPORATIONS.

The Sacramento County Irrigation Company, San Francisco, Cal.—to operate water rights and works, generate electric and other power and deal in same, etc. Capital stock, $1,000,000. Promoters: J. A. Merrill, A. R. Dow, Oakland; R. W. Button, D. T. Thomas. W. B. Thomas, San Francisco.

The Columbian Gold Mining Company, San Francisco, Cal.—to deal in and operate mines, mineral lands, mills, machinery, electric light and power plants, etc. Capital stock, $1,000,000. Promoters: J. A. Merrill, A. R. Dow, Oakland; D. R. Thomas, R. W. Button, W. B. Thomas, San Francisco.

The Junction City Electric Light, Power and Milling Company, Junction City, Kan.—to furnish electricity for light, heat and power, etc. Promoters: John K. Wright, A. L. Barnes, Junction City; James S. Gibson, Kansas City, Kan.

C. C. Warren Electric Company, at Chicago—for the construction of steam railways and electric light plants. Capital stock, $2.000,000. Incorporators: Holbert B. Warren, W. W. Wheelock and George B. Shattuck.

The South Mountain Railway and Electric Light and Power Company, Boonsboro', Md.—to build an electric railway from Boonsboro', to Keedysville (three miles) and to furnish electric light and power to both towns. Incorporators: George W. Jacobs, Jr., of Philadelphia; Theodore E. Bowne, of New York; Edgar L. Miller and Elmer J. Smith, of Frederick; Charles J. Young, C. E. Shafer and George A. Davis, of Boonsboro'.

The Mecosta Electric Company, Big Rapids, Mich. Capital stock, $25,000.

The Mt. Pleasant Gas and Electric Light Company, Mt. Pleasant, Iowa—to operate a light and power plant at Mt. Pleasant. Capital stock, $72,000. Promoters: Henry Ambler, Geo. H. Spahr, H. E. Snider, Mt. Pleasant.

The Automatic Wind Motor Company, Blasdell, Erie County, N. Y.—to manufacture wind motors, pumps and pumping appliances, and electrical machinery to be used in connection with such motors. Capital stock, $100,000. Directors: David Berry, Big Tree, Erie County; A. R. Meldrum and Henry L. Erisman, Buffalo; Charles M. Nichols, Jamestown, Chautauqua County; Peter Berry, Plumer, Pa.

The California Mutual Investment Company, Los Angeles, Cal.—to furnish electric light and power, etc. Capital stock, $200,000. Promoters: T. K. Wilson, S. A. Butler, I. W. Adams, Wm. A. Elderkin, A. M. Anthony, Los Angeles.

The Wabaska Electric Company, Wymore, Neb.—to construct electric light, power and electrical plants in Nebraska. Capital stock, $25,000. Promoters: Alex. Stewart, S. D. Rengler, H. C. Van Buskirk.

The Oyster Bay (N. Y.) Electric Light and Power Company reports that its capital stock has been increased from $5,000 to $15,000. It has no debts.

The Wenstrom Electric Company, at Baltimore, Md.—to take the place of the Wenstrom Consolidated Dynamo and Motor Company and operate the plant of the defunct concern at Calverton, Md. Capital stock, $1,000,000. Incorporators: Joseph P. Smith, Ferdinand C. Latrobe, John M. Denison, Robert Rennert and John E. Semmes.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED SEPTEMBER 19, 1893

ELECTRIC RAILWAYS AND APPLIANCES.

505,204. Current Converter for Electric Railways. William Lawrence, New York, N. Y., assignor to the Lawrence Electric Company, same place. Original application filed Aug. 17, 1892. Divided and this application filed June 27, 1893.

505,370. Electric Railway Trolley. Elbert R. Robinson, Nashville, Tenn. Filed March 7, 1893.

ELECTRIC LIGHTS AND APPLIANCES.

505,097. Electric Light Fixture. Benjamin F. Flint, Cincinnati, Ohio. Filed June 17, 1893.

505,098. Revolving Electric Light. Benjamin F. Flint, Cincinnati, Ohio. Filed July 5, 1893.

505,183. Electric Arc Lamp. Arthur S. Atwater, Cleveland, Ohio. assignor to the Atwater General Electric Company, same place. Filed Jan. 16, 1893.

505,233. Electric Arc Lamp. Charles Schmidt, Chicago, Ill., assignor of one-half to Pancratus Friedrich, Jeanette, Pa. Filed Jan. 10, 1893.

505,241. Electric Lighting System. Addison G. Waterhouse, Hartford, Conn. Filed Nov. 28, 1892.

505,326. Lamp. Delmar D. Pinkham and Frank E. Lewis, Longview, Tex. Filed July 21, 1892.

505,351. Electric Headlight. Edgar A. Edwards, Cincinnati, Ohio. Filed Aug. 15, 1893.

505,383. Electric Arc Lamp. Sigmund Bergmann, New York, N. Y. Filed July 19, 1893.

505,422. Electric Lamp Socket. John M. Gardner, Jr., Pittsburg, Pa., assignor of one-half to Peter Weber, same place. Filed July 1, 1893.

DYNAMOS, MOTORS, ETC.

505,184. Dynamo-Electric Machine. Arthur S. Atwater, Cleveland, Ohio, assignor to the Atwater General Electric Company, same place. Filed Jan. 16, 1893.

505,207. Automatic Regulator for Dynamo-Electric Machines. Orvis P. Philbrick, Somerville, Mass. Filed April 2, 1892.

505,247. Armature for Dynamo-Electric Machines or Motors. Walter T. Kosinski, New York, N. Y. Filed May 5, 1893.

505,396. Electric Motor. Ernest R. Esmond, New York, N. Y. Filed Aug. 15, 1893.

BATTERIES.

505,392. Electric Primary Battery. Theophilus Coad, London, England. Filed Nov. 10, 1892.

TELEPHONE AND TELEGRAPH APPARATUS.

505,087. Telephone. Joseph B. S. Booth and Ernest J. Falconer, Manchester, England. Filed Jan. 31, 1893.

505,170. Telephone Switch. Thomas W. Ness, Montreal, Canada. Filed May 22, 1893.

505,308. Telephone System. William W. Davis, California, Mo., assignor to himself, Walter Lander and Frank B. Lander, same place. Filed Dec. 30, 1892.

SIGNALS AND SIGNALING APPARATUS.

505,419. Block Signal Apparatus. Johann H. Frischen, Berlin, Germany, assignor to Siemens & Halske, same place. Filed April 13, 1893.

505,420. Block Signal Apparatus. Johann H. Frischen, Berlin, Germany, assignor to Siemens & Halske, same place. Filed May 18, 1893.

MISCELLANEOUS.

505,106. Lightning Rod. Nathaniel D. C. Hodges. Plainfield, N. J., assignor to the American Lightning Protection Company, Sioux City, Iowa. Filed Dec. 17, 1890.

505,123. Insulator Pin. James J. O'Neill, Boston, Mass. Filed April 14, 1893.

505,125. Process for Manufacturing Electrodes. Carl Pollak, Frankfort-on-the-Main, Germany. Filed April 19, 1893.

505,135. Rail Heating Device. Charles S. Smith and Elmer E. Knowles, Spokane, Wash. Filed April 24, 1893.

505,188. Multiple Switchboard Apparatus. John J. Carty, New York, N. Y., assignor to the Western Electric Company of Chicago, Ill. Filed Feb. 2, 1889. Renewed Oct. 16, 1891.

505,200. Indicator Mechanism for Type-Setting Machinery. John Hooker, Beccles, England. Filed Jan. 16, 1893.

505,215. Cleat for Holding a Plurality of Insulated Electric Wires. Elisha W. Buffinton, Fall River, Mass., assignor of one-half to Albert F. Dow, same place. Filed March 27, 1893.

505,243. Recording Voltmeter. William H. Bristol, Hoboken, N. J. Filed April 17, 1893.

505,268. Electrical Metal Working. George D. Burton, Boston, and Edwin E. Angell, Somerville, Mass., assignors to the Electrical Forging Company of Maine. Filed Feb. 27, 1892.

505,270. Electric Door Operating Apparatus. Oliver H. Hicks and Robertus F. Troy, Chicago, Ill.; said Troy assignor to said Hicks. Filed May 15, 1893.

505.271. Electric Door Operating Apparatus. Oliver H. Hicks and Robertus F. Troy, Chicago, Ill.; said Troy assignor to said Hicks. Filed May 15, 1893.

505,293. Printing Telegraph for Cash Recording Systems. Henry K. Hess, Syracuse, N. Y. Filed Sept. 5, 1892.

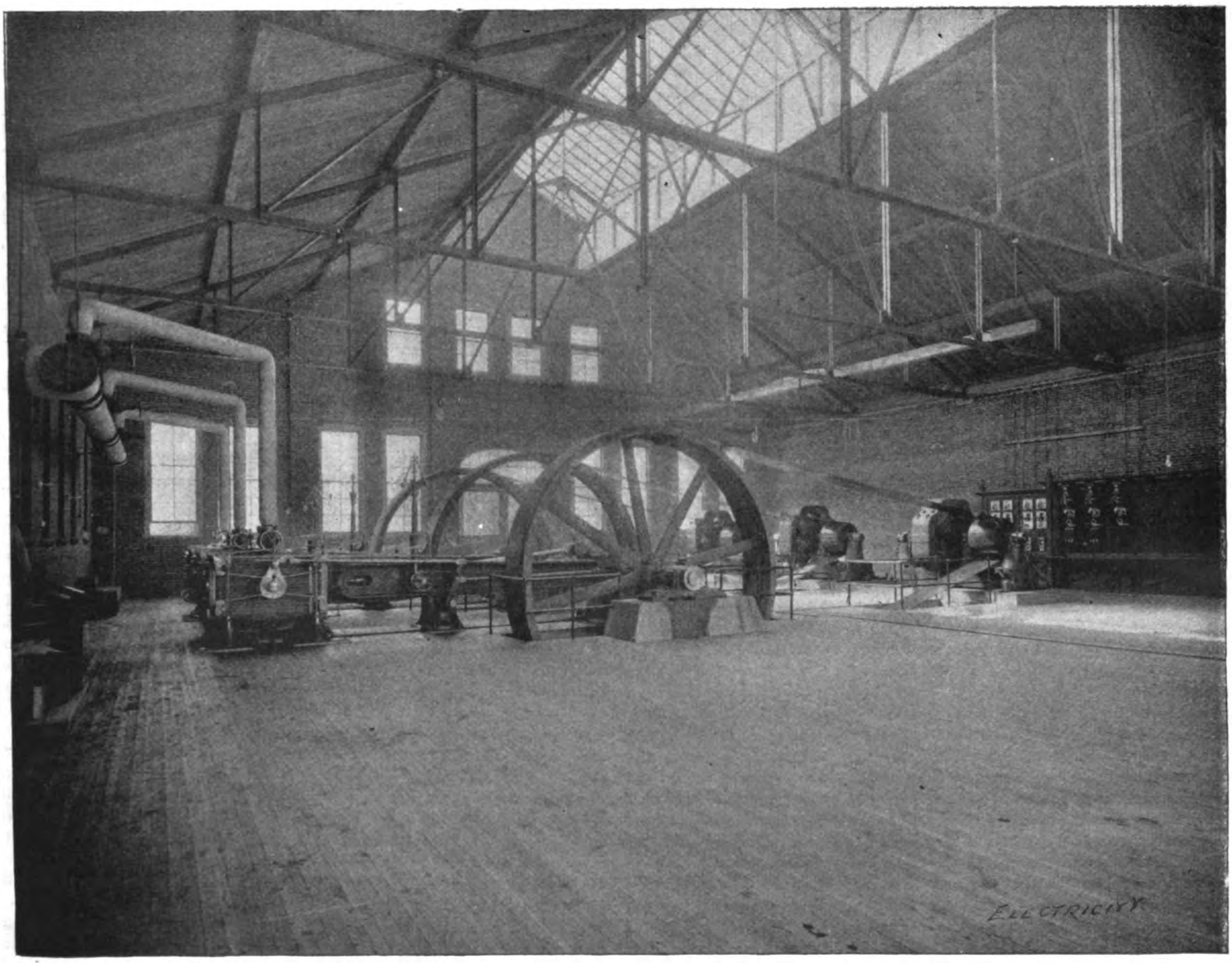
505,346. Electric Illuminated Sign. Henry A. Bierley, Lexington, Ky. Filed Feb. 8, 1893.

505,393. Electro-Medical Air Injector. James Dawey and Frank M. Cattern, Denver, Colo. Filed Aug. 7, 1893.

505,414. Balloon for Observing Distant Objects. Chas. A. Smith, San Francisco, Cal. Filed May 11, 1893.

ELECTRICITY.

VOL. V. NEW YORK. OCTOBER 18, 1893. CHICAGO. No. 14



DYNAMO AND ENGINE ROOM, ST. CLAIR STREET RAILWAY, CLEVELAND. (SEE PAGE 162.)

A New Electric Railway for Cleveland.

The St. Clair street railway line in Cleveland has just been equipped with electricity, and we present herewith a description and illustrations of the plant, which has just been completed.

The power house for this road is built as an addition to the Superior street cable railway building. It is constructed of pressed brick with an iron and slate roof. The engines, shown in the Frontispiece, are three in number and have a capacity of 250 horse power each. They are single cylinder machines built by the Bass Foundry and Machine Works of Fort Wayne, Ind.

The engines are belted direct to three 270-horse power generators of the usual 4-pole railway type.

The switchboard, shown in Fig. 1, is built with an oak frame in which slate panels are set. On one end of this board are placed the instruments and switches belonging to the dynamos. These are all of the Thomson-Houston make. From the other end of the switchboard four feeders are led out to different points on the road, and each feeder is equipped with a lightning arrester and automatic cutout and switch of the Westinghouse type.

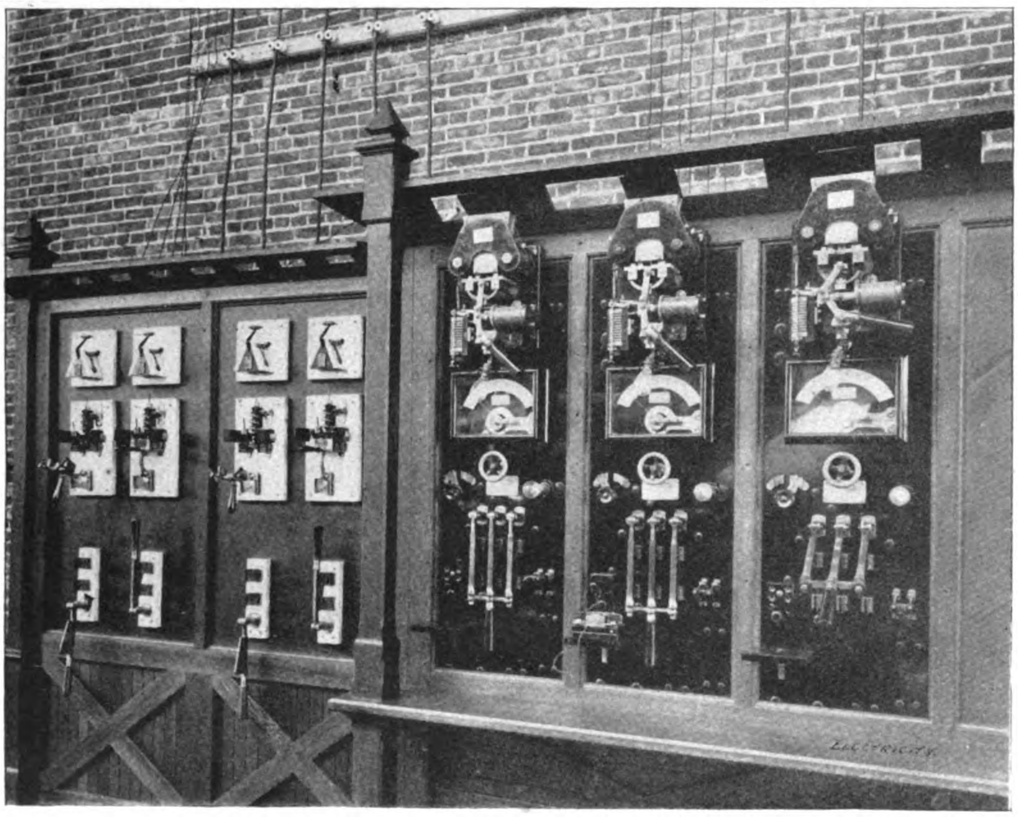


FIG. 1.

The boiler plant of the cable railway consists of four Babcock & Wilcox boilers aggregating 1,100-horse power, and two 750-horse power Sterling boilers were added to this battery for the use of the electric road. The piping on the boilers is arranged so that any boiler may be used to supply power to either plant.

Oil is used for fuel in this plant, which is fed to the boilers through Reid burners. The piping throughout the station is covered with mineral wool and all sizes above 6 inches are flanged and riveted. Jenkins valves are used.

The roadbed consists of 12½ miles of single track on which 90 pound girder rail is used. This rail is 9 inches deep and is laid to standard gauge. The splices are thirty-eight inches long and use twelve ¾ inch bolts. Lake gravel is used for ballast.

The poles on about 3,000 feet of the road are of iron, and the remainder are octagonal wooden poles. The trolley line is divided into four sections, two on each side of the power house, which is located at about the middle of the line.

The cars are equipped with Short motors and multiple series controllers. The cars were built by Jones & Brownell, and are supplied with Dorner & Dutton trucks.

The management of this road, which has been recently completed, is in the hands of Mr. F. M. Faber, M. E.

Various Uses of the Electrostatic Voltmeter.

BY DR. T. SAHULKA.*

In the paper I intend to read before you I shall communicate some measurements made with an electrostatic voltmeter, especially the measurement of the capacity of condensers which are inserted in an alternating current circuit.

The great advantages of the electrostatic voltmeters in comparison with the other voltmeters, especially when using alternating currents, are well known. They require almost no current; the readings are not influenced by the temperature and by the neighborhood of magnetic bodies; by enclosing the electrostatic voltmeter in a metallic shell, it can also not be influenced by electric bodies in the neighborhood. The excellent instruments invented by Sir W. Thompson are well known. They contain a fixed and a movable system. In the multicellular type the fixed system is formed by a number of pairs of quadrants. The movable system consists of an equal number of needles placed between the quadrants and suspended on a thin wire (Fig. 1). If the difference of potential between two points is to be measured, the movable system and the metallic shell enclosing the instrument are connected with the one point, the fixed system with the other point. The movable system is thus deflected; a pointer, which is connected with the system, enables direct reading.

The electrostatic voltmeters are generally used only for measuring potentials. They can also be used for other purposes.

I wished, firstly, to examine how small is the current traversing such an instrument when measuring an alternating potential difference with it, and how great is the capacity of the instrument. That could not be done with any of the known methods, the charging current and the capacity being very small. The instrument I used was a multicellular voltmeter of Sir W. Thompson, range 80 to 400 volts; but the scale intervals are only between 120 and 220 volts, large enough to enable an exact reading. In order to get a suitable difference of potential, I transformed the alternate current supplied by an electric central station, having 2,500 full periods per minute, and a potential difference of about 105 volts, in the ratio of 1: 2 by a step-up transformer. The potential difference e between the terminals of the secondary, was now measured with the electrostatic voltmeter. Afterwards a great graphite resistance r, having no capacity and no self-induction, was connected in series with the instrument. The voltmeter indicated now a smaller potential difference e_1. As the voltmeter is a small air condenser, the phase of the potential difference e_1 corresponding to the same must be 90° behind the phase of the charging current c, whilst the potential difference e_2, corresponding to the resistance r, coincides in phase with the current c (Fig. 2). We have therefore

$$c = \sqrt{e_1^2 + c_2^2}.$$

c and e_1 being known, e_2 can be determined; we know therefore the charging current

$$c = \frac{e_2}{r}.$$

If the number n of periods per second be known, we can also count the capacity K of the voltmeter, for the equation must hold:

$$c = 2 \pi n e_1 K. \quad . \quad . \qquad (1.)$$

The alternating current had 2,500 periods per minute; therefore we have to substitute:

$$p = 2 \pi n = 262.$$

In Table I are contained the results which had been obtained with the voltmeter mentioned before. The values in the column r are given in megohms, the values of c e_1 e_2 in volts; the unit of c is one-millionth of an ampere; the unit of K is one-millionth of a microfarad.. In the last column, r_1, are given the relative impedance of the voltmeter expressed in megohms.

TABLE I.

r	e	e_1	e_2	c	K	r_1
11.05	207.2	195.3	62.2	6.26	122.	31.2
20.78	207.6	177.1	108.3	5.21	112.	34.0
33.16	207.6	154.6	138.6	4.18	103.	37.0
41.90	207.9	140.3	153.4	3.66	99.6	38.3
52.40	208.0	124.4	166.7	3.18	97.6	39.1

The results are represented graphically in the diagram (Fig. 3). The abscissæ represent the number of volts indicated by the instrument; the ordinates of the curve c represent the charging current, the unit being equal to one ten-millionth of an ampere; the ordinates of the curve K represent the capacity K, the unit being equal to one millionth of a microfarad. It is striking how small the charging current and the capacity of the instrument is. The capacity is greater for higher values of e than for lower values, as the movable system of the voltmeter is more deflected towards the fixed system. If there is no potential difference between the terminals of the instrument, its capacity has its smallest value. Should the instrument be arranged in such a way that the movable system would always be brought back to its zero position by the aid of a torsion head, then the capacity of the instrument would be constant, the scale could then be spread over the whole circumference, whilst in the present shape the deflection is always less than 90 degrees.

If the diagram (Fig. 3) would have been plotted for any electrostatic voltmeter, this instrument could be used for measuring great resistances, which have no capacity and self-induction, and are of the same range as the impedance of the instrument. The resistances have to be arranged in series with the voltmeter.

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*Read before the International Electrical Congress, Chicago.

As the alternating current which traverses an electrostatic voltmeter is exceedingly small, this instrument might be usefully employed for the *indirect measurement of the intensity of the magnetic field of converters or electro-magnets, which are excited by alternating currents.* It is only necessary to wind around the core a sufficient number of turns of thin wire, and to connect its ends with the voltmeter. As the instrument requires almost no current, the magnetic field of the core is not influenced by measuring it with the voltmeter.

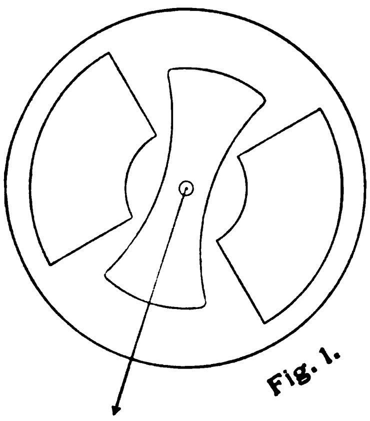


Fig. 1.

The electrostatic voltmeter can also be applied very usefully for *measuring the capacity of condensers, which are inserted in an alternating current circuit.* I used for this purpose a method which is similar to that applied by Toubert for measuring the coefficients of self-induction. I placed in series with the condenser a non-inductive resistance r, its capacity being negligible. The resistance r may be of the same range as the impedance of the condenser. For every condenser a suitable resistance r can be chosen. With the electrostatic voltmeter there may be measured the total difference of potential e, then e_1, corresponding to the condenser, and e_2 corresponding to the resistance r. If the condenser is an air-condenser, and if the frequency of the alternating currents is low, then a rectangular triangle can be designed (Fig. 2), of which the hypotenuse is equal to e, and the sides equal to e_1, e_2. Now, if the condenser has a solid dielectric, then e is no longer 90 degrees behind in phase with the charging current c, but by a smaller angle α (Fig. 4). The potential difference e_2 coincides in phase with the current c. The condenser placed in the alternating current circuit absorbs energy, for which loss Mr. Steinmetz has found the law that loss of energy causes a heating of the condenser. We must conclude that the capacity of the condenser is not constant, but varies in every moment during one period like the coefficient of self-induction of an electro-magnet. In the same way, as special definitions are chosen for the intensity of currents and the electromotive force in alternating current circuits, we have also to define what may be considered as the capacity K_1 of a condenser which is inserted in an alternating current circuit. That could be done in the following way:

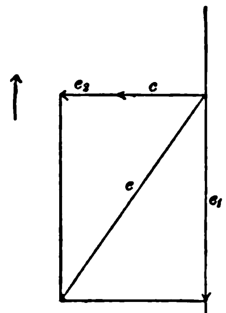


Fig. 2.

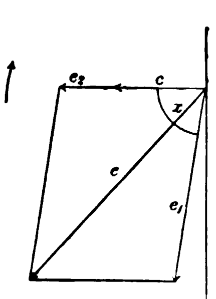


Fig. 4.

The apparent resistance (impedance) of the condenser, that is, the ratio of e_1 to e, must be equal to the reciprocal of $2\pi n$ times K. The definition agrees with the formula 1. In Table II are given some results obtained with condensers having paraffined paper as dieletric. K is the capacity measured with a continuous current electromotive force in the well-known way, by observing the deflection of a galvanometer needle, the unit of the values K being one microfarad. The resistance r placed in series with the condenser is given in ohms. $e\ e_1\ e_2$ are the observed potential difference in volts; the unit of the current c is one ampere; the value of K is equal to $\frac{c}{2\pi n e_1}$, and could be taken as the capacity of the condenser when placed in the alternating current circuit; the unit of K_1 is also one microfarad. There was calculated also the angle of lag α according to the formula

$$\cos\alpha = \frac{e^2 - e_1^2 - e_2^2}{2\,e_1\,e_2}$$

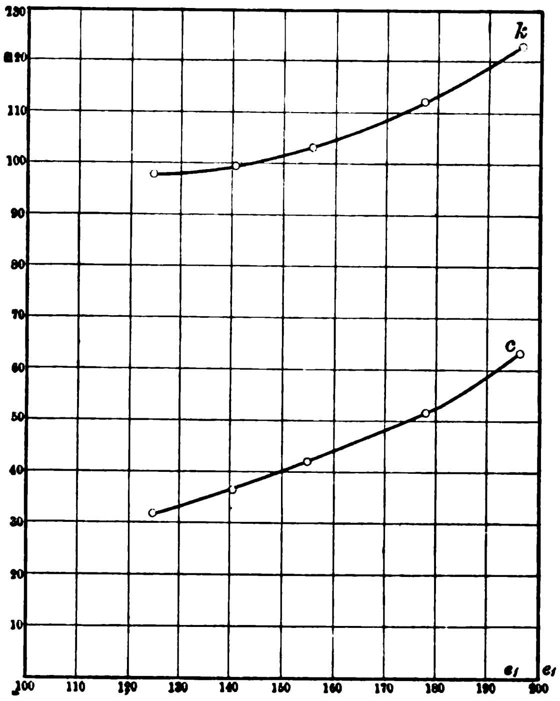


Fig. 3.

and the energy absorbed by the condenser, according to the well-known method of Prof. Ayrton. This energy is named W and is given in watts. $W = e_1\ c \cos\alpha$.

TABLE II.

K	r	e	e_1	e_2	c	K_1	α	W	c	$\frac{1}{2\pi n K_2}$	K_2
1.004	4000	206.9	147.8	135.2	0.0328	0.873	86° 09′	0.336	293.7	4363	0.875
"	5000	206.8	132.0	149.2	0.0298	0.862	85° 31′	0.308	346.6	4416	0.864
"	6000	207.5	120.1	161.1	0.0269	0.855	86° 02′	0.224	309.1	4454	0.857
"	7000	207.4	107.5	170.0	0.0243	0.863	85° 59′	0.183	309.7	4413	0.865
0.514	9000	207.6	139.7	145.3	0.0161	0.440	87° 30′	0.137	527.9	8661	0.441
2.618	2000	207.1	129.8	152.5	0.0763	2.244	85° 58′	0.697	119.7	1697	2.249

In the table are also calculated the values of c and K_2.

The condenser, having a solid dielectric, behaves like an air-condenser, having the capacity K_2, and being connected in series with a resistance C. The quantity K_2 may be considered as the effective capacity of the condenser. I deem it useful to calculate the effective capacity K_2 of a condenser and the loss of energy, which is caused at a certain difference of potential and a given number of full periods per second.

As the value of the cos. α is calculated from a difference of nearly equal numbers, it is not quite exact therefore; also the value of the absorbed energy is not very exact. Should the value of α and the absorbed energy be measured more exactly, every single experiment has to be repeated several times in order to get average values. The table II has been calculated only from single experiments. If the alternating generator runs with a constant speed, the variation of K_2 is less than one per cent.

If we compare the values of K_2, corresponding to the three condensers, taking an average value of the four first experiments, we find the same ratio (1 : 0·51 : 2·60) that have the values of K; *but the values of K_2 are less by 14 per cent. than the corresponding value of K. We conclude from that that the condensers with a solid dielectric have a smaller capacity when placed in an alternating current circuit than when they are charged with a continuous current electromotive force;* only the air condensers will not show such a difference. The cause of this remarkable fact is to be found in the behavior of the dielectric. The dielectric absorbs in spite of its great ohmic resistance a certain amount of electric energy during the charging process. During the discharge a part of this energy is given back, the other part has been changed into heat. Therefore we get, when connecting a condenser with a direct current electromotive force, a too great deflection of the galvanometer needle, as we measure not only the electricity which is stored in the sheets of the condenser, but also the electricity absorbed by the dielectric. In the same way we get a too great deflection of the galvanometer needle when discharging the condenser, as the dielectric gives back a certain amount of the absorbed energy. When using alternating currents, the charge and discharge are finished in a very short time, namely, in the half part of a period. The dielectric has not sufficient time to absorb so much energy as when connected with a continuous current electromotive force of the same size. During the discharge it gives back, therefore, also less electric energy. That is the cause why the condensers have a smaller capacity when inserted in an alternating current circuit. The capacity will also be influenced by the number of full periods per second.

Considering the values of the absorbed energy W in the four first experiments, which belong to the same condenser, we find them in good agreement with the law of Mr. Steinmetz. According to this law the losses are proportionate to the squares of the potential differences, and should therefore be equal to 0·352, 0·281, 0·232, 0·186.

I measured in the same way as explained before the capacity of Leyden jars, but in this case it was necessary to connect the Leyden jars in series with a graphite resistance of one megohm. As the electrostatic voltmeter has an impedance of 30 to 40 megohms, the current passing through it could not be neglected if the capacity of the Leyden jars had to be calculated exactly. That makes the calculation more complicated.

Very small Leyden jars, which had a capacity of the same range as the electrostatic voltmeter, were connected in series to the voltmeter. The potential differences e_1 and e_2 of the Leyden jar and the voltmeter have nearly the same phase and are inversely proportional to the capacities of these instruments; therefore the capacity of the Leyden jar can be calculated very easily.

I hope the method that I explained will be suitable to measure the true capacity and the loss of energy of condensers and concentric cables which are inserted in alternating current circuits.

The Chloride Accumulator.

One of the accumulator cells which has figured the most prominently in successful storage battery work is the chloride battery of which mention was made in the issue of ELECTRICITY of August 2, 1893.

The plates are made up of tablets of chlorides of lead and zinc which are held together by a frame of antimonious lead. When first cast, these plates are not capable of use in a storage battery without entirely changing their chemical composition.

This chemical change is brought about by means of a bath of chloride of zinc, or some equivalent substance, in which the plate of tablets is to be immersed in connection with a slab of metallic zinc. This arrangement is a primary battery, in which the zinc acts as the positive element, while the tablets constitute the negative element.

This operation may be performed with current produced by a dynamo, but it is a very tedious and expensive process as compared with reduction by means of zinc.

The electro-chemical action in this combination results in withdrawing the chloride of zinc from the tablets by simple solution in the bath, and the withdrawal of the chlorine of the chloride of lead from the tablets and fixing it in combination with the zinc with the formation of chloride of zinc. It may, therefore, be said that the chloride of lead tablets constitute material which is destined to become active by electrical disintegration, which is brought about when they are connected with the zinc plates in the bath of chloride of zinc.

After the chloride of zinc is withdrawn from the plates there remains a porous mass of metallic lead, in which condition it is ready for use in a storage battery.

The process of manufacture of these plates has been recently described in a paper read before the Franklin Institute by Mr. Herbert Lloyd, General Manager of the company manufacturing these batteries.

The first step in the production of chloride of lead is to melt the pigs of lead in a suitable furnace, and when the lead is brought to a high state of fusion it is conveyed through a pipe into a closed chamber where it is delivered in a fine stream into a jet of dry steam, the result being that the lead is blown into a moderately fine powder and falls on the floor of the chamber. This lead is then dissolved in a bath of acid from which the chloride of lead is afterwards precipitated.

This chloride of lead is then mixed with the proper proportion of chloride of zinc, and the mixture is fused and cast into tablets of any desired shade. The tablets are then placed in a mould where they are spaced a certain distance apart, and a frame of lead is cast about the tablets under pressure, which besides making a very dense frame makes a very perfect contact with the tablets. The latter on account of their shape are securely dovetailed into the frame.

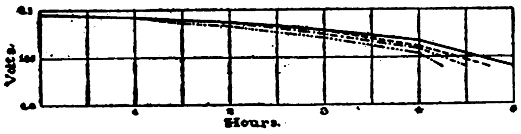
The plate thus formed is then submitted to the reducing process described above.

When the reduction is complete and the plate thoroughly washed in running water, in order to be sure that every trace of chlorine has been removed from the plates, they are all set up as cathodes in a bath of dilute sulphuric acid, plain lead plates being used as permanent anodes in this tank, and a heavy current is passed through them for several hours. If the reduction has been incomplete the chlorine will make itself felt in this operation, and it is practically impossible for a plate to contain any chlorine at this stage.

After removing from the hydrogen bath they are next set up in forming tanks in connection with the plain lead permanent negatives, and here they are charged continuously for several weeks, or until the crystalline, spongy lead has been completely converted into peroxide of lead. The theoretical amount of current necessary to form a pound of peroxide of lead is about 200 ampere hours, and owing to the beautifully porous structure of the plate, this figure holds out very well in practice; the plates will always be found thoroughly peroxidized after they have received a little over the theoretical quantity of current necessary. The positive plates are then set up with the negative plates in a cell, and are charged and discharged a few times until they give their proper capacity.

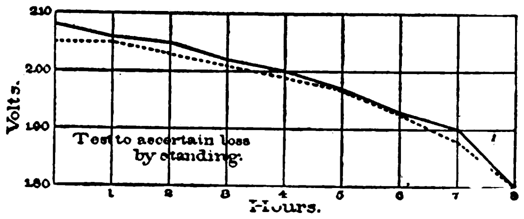
The chloride of zinc is useful, not only to prevent the castings from falling apart on cooling, but it enables any desired density to be produced according to the amount used.

The following curves show the variation in capacity between four cells of the same size, with different percentages of zinc chloride in the castings.

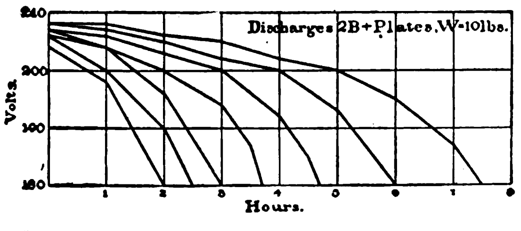


The capacity of cells of this type is from five to six ampere hours per pound of plate. The capacity for weight could be materially increased, but at the loss of durability.

The accompanying set of curves will show the decrease in capacity as the rate is increased. The discharge rate in each of these discharges is above the normal, the lowest discharge being at the rate of three-fourths ampere per pound of plate, and the highest being at the rate of two amperes per pound of plate, or 100 amperes for an ordinary fifty-pound cell, increasing the rate 250 per cent.—decreased capacity but thirty-three per cent.

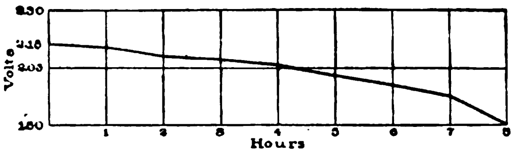


Another set of curves which may be of interest is one showing the effect of allowing a cell to stand charged, the upper curve being for immediate discharge and the lower one after standing charged twenty-four hours. The ampere hours were the same in both cases, but there was a loss in watt hours on standing.



The next curve shows the discharge of a cell at a rate of two-thirds ampere per pound, when it will be seen that over two-thirds of the capacity was obtained above two volts. At the rate of one-half ampere per pound, over three-fourths of the capacity can be obtained above two volts.

Special care has been given to the insulation of the plates. It is well known that the liability of a storage battery to short-circuit has been one of the main causes of trouble. To overcome this, we envelop the positive plate in a piece of beautifully woven asbestos cloth. Between the positive and the negative plate we place a perforated, grooved board of insulating material, the perforations being made opposite the pieces of active material in both plates, leaving free circulation of the electrolyte between the plates, at the same time keeping the asbestos cloth pressed against the face of the positive plate, causing it to form a tight covering over the face of the active material, and while making the plate absolutely safe from short circuit it also adds four-fold to the life of the cell, since the peroxide is held in position instead of being deposited on the bottom of the cell. In traction work this form of insulation is found very beneficial, as the cell is vastly more durable than anything that has been before produced.



Some Measurements of the Temperature Variation in the Electrical Resistance of a Sample of Copper.

BY A. E. KENNELLY AND REGINALD A. FESSENDEN.*

Precision in the determination of the temperature variation of resistance in copper is important not only to electrical science, but also to its applications. Our estimate of the temperature of remote or inaccessible positions, as for example the ocean bed on which a submarine cable lies stretched, or the interior layers of a dynamo armature winding, are often directly dependent for their accuracy upon the completeness of our knowledge of this temperature coefficient.

Electrical text-books in stating the temperature coefficients of copper, usually quote the results of Dr. Matthiessen, or of Dr. Siemens, or both. The results of these two authorities are discordant.

Within the range of chamber temperatures, say from 0° C. to 35° C., the difference between them is practically of little importance. Taking, however, the resistivity of copper at zero as unity, its resistivity at 100° C. is 1.422 by Matthiessen's observations, and 1.388 by those of Siemens, a variation of nearly 2½ per cent., while above 100° C. or below 0° C. this discrepancy increases rapidly.

First in order of date are the elaborate researches of Matthiessen (and of his collaborator Von Bose), appearing in the *Phil. Mag.* for February, 1857, and February, 1861, also in the *Phil. Trans.* for 1858, 1860, 1862 and 1864, the most important series from our present standpoint being those for 1862. The wires tested were varnished with shellac, and immersed in a bath of oil whose temperature was raised by the application of Bunsen burners, and read off by an immersed thermometer. Readings were taken both in ascending and descending series of temperature, and observations are adduced in support of the statements that the application of varnish did not affect the results, and that the observations on a wire heated in a bath of oil were sensibly the same as when the heating took place in air. Matthiessen took six copper wires, all from the same electrolytic source, three annealed and three hard-drawn. Six observations are given of the resistances of each between 0° and 100° C. Having ascertained that all 36 observations accorded very fairly with a parabolic relation between conductivity and temperature, the parabola of closest conformity computed by the method of least squares was $\lambda = 1 - at + bt^2$, or numerically $\lambda = 1 - 0.0038701\ t + 0.000009009\ t^2$, λ being the conductivity at temperature t° C. From this equation, the resistivity (the reciprocal of λ), retaining the terms necessary for accuracy in the fifth digit, at the limit of 100° C. becomes $\rho = 1 + 3.8701\ t \times 10^{-3} + 5.968\ t^2 \times 10^{-6} - 1.177\ t^3 \times 10^{-8} - 9.93\ t^4 \times 10^{-11} - 2.79\ t^5 \times 10^{-13}$. The graph of this equation taking values of ρ as vertical ordinates from a horizontal axis of temperatures as abscissæ, yields a curve bending upwards, so that the temperature variation increases with the temperature, the increase in resistance per degree centigrade being at 0° C. 0.387 per cent., and at 100° C. 0.50 per cent. of the resistivity at zero C. Matthiessen points out that this bending upwards of the curve is distinctly indicated by his results, and that no straight line can represent them. Not only the 36 observations on copper wires, but more than 200 quoted observations on other metals, all point to a temperature coefficient augmenting with temperature and negative the supposition of a simple linear relationship between the variables.

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* Read at the International Electrical Congress, Chicago.

Dr. Siemens' researches formed the subject of his Bakerian lecture in 1871. They were undertaken with the object of obtaining a practically reliable scale for the electropyrometer which bears his name, rather than for the direct purposes of scientific research. After pointing out that Matthiessen's formula can on its own evidence be only fairly applicable between the limits of 0° and 100° C., Dr. Siemens proceeds to advance some interesting although arbitrary hypotheses for the law of temperature variation in metallic resistances, and then shows that his experimental observations on copper and four other metals are capable of close representation by the empirical formula so obtained. These observations were made on wires heated in air, and also in oil, up to 350° C. with mercury thermometers, and in one series up to 850° C. with a platinum ball pyrometer, an instrument whose indications assumed a constant specific heat in the platinum ball throughout the range of temperature employed.

Dr. Siemens' formula for copper is $\rho = 0.026577 \sqrt{T} + 0.0031443\ T - 0.29751$, where ρ is the ratio of the resistivity at any absolute temperature, T, to that at zero centigrade, or T = 273°. For 100° C., or T = 383°, $\rho = 1.3885$, and the rate of increase of resistivity is at 0° C. 0.394 per cent., and at 100° C. 0.383 per cent. of the resistivity at zero C. The graph of the equation is a curve bending slowly downwards towards the axis of temperatures, and the temperature variation diminishes as the temperature rises. All the 170 observations recorded in the paper indicate that the curve bends downward, while all the 250 observations in Matthiessen's 1862 paper make the curve bend upwards. The discrepancy between these two series of results becomes very noticeable between 70° and 100° C.

Professors Dewar and Fleming have published in the *Phil. Mag.* for October, 1892, a number of observations in the resistivity of metals and alloys at temperatures between $-200°$ C. and $+100°$ C., one series for copper being included. The resistivity of the copper wire is stated to have been 1358 C. G. S. U. at 0.7° C., equivalent to 1349 at 0° C., and since Matthiessen's standard is 1594 at zero C., this represents a conductivity 18 per cent. higher than Matthiessen's standard. Aside, however, from this remarkable and perhaps debatable statement, the graph of the observed values of resistance with respect to temperature is very nearly a straight line throughout the whole range, the resistivity at 100° C. being 1.424 times greater than that at 0° C, and the temperature coefficient being approximately 0.424 per cent. per degree centigrade for all temperatures between $-200°$ and $+100°$ C.

Messrs. Cailletet and Bouty, in the *Comptes Rendus* for 1885, give an observed temperature coefficient for copper of 0.418 per cent. per degree C., expressed by $\rho_t = \rho_o (1 + 0.00418\ t)$ between zero and $-58°$ C., and 0.425 per cent. from $-69°$ to 123° C., $\rho_t = \rho_o (1 + 0.00425\ t)$.

In Poggendorf's *Annalen* for June, 1858, Herr Arndtsen quotes a uniform temperature coefficient of 0.369 per cent. per degree from zero to 200° C. He gives, however, one series of observed resistance with a copper wire (containing 0.15 of iron) between 0° and 100° C., showing a linear relation, or a temperature coefficient of 0.394 per cent. per degree C., $= \rho_o (1 + 0.00394\ t)$, and he points out that the divergences from the straight line are within the limits of the observation error.

In view of the discrepancies existing between these best known measurements of the temperature coefficient of copper, Arndtsen, Cailletet and Bouty giving results practically represented by straight lines, Siemens' results with the line bending distinctly downward and Matthiessen's results with the line bending as distinctly upward, the writers of this paper made a number of measurements in the spring of 1890 upon a sample of copper wire. These measurements were made with great care, and repeated until similar results were obtained in successive series. The wire tested was sealed within the bulb of an air thermometer, so that there could be no appreciable variation between the temperature of the wire itself and the temperature indicated by the pressure of the air in the bulb it occupied. The final results, after full corrections for expansion of the bulb, etc., indicate a linear relation between the resistance and temperature of the wire between the limits of 20° C. and 250° C., represented by the equation $\rho_t = \rho_o (1 + 0.00406\ t)$, indicating a uniform temperature coefficient of 0.406 per cent. per degree C. throughout the range, the maximum observed being 0.4097 per cent., and the minimum 0.399 per cent at any point. The details of these measurements are here submitted in the form of an appendix, not only in support of the statements made concerning them, but also because the experimental arrangements of apparatus finally successful were the outcome of a series of experimental failures, and it is believed that the details of construction may be of service to those who desire to adopt the same method of measurement.

Concerning the conclusions that may be drawn, we feel only justified in saying that copper can be found in which a linear relationship holds between resistance and temperature between 20° C. and 250° C., and within the range of small observation errors. It is of course possible that in different samples of wire the temperature coefficient may increase or diminish with the temperature. In other words, the second differential coefficient of resistance with respect to temperature may perhaps in some samples be either positive or negative, but it seems desirable that fresh measurements should be made, and evidence collected to settle this point, and we submit the view that the best experimental means of measuring the temperature, and to ensure the coincidence between the measured temperature and that of the tested wire, is to enclose the latter in the bulb of an air thermometer in the manner here described.

NOTE ON THE TEMPERATURE OF LOWEST VISIBLE RED HEAT.

A few measurements were made of the resistance of copper wires enclosed in exhausted glass tubes and gradually raised to just visible red hea by gradually increasing the current strength through them. The tubes were 30 cms. long, and 2 cms. external and 1.8 cms. internal diameter. The platinum wires were sealed into the glass at each end and connected with the copper wire, one to carry the heating current and the other to act as "pressure wire" in order to eliminate the resistance of the first, or platinum electrode. The copper wire stretched along the axis of the exhausted tube was 30.4 cms. long and 0.0015″ (0.0038 cm.) in diameter. Measuring the resistance of these wires at normal temperature with a very feeble current, they were then raised to redness and their resistance observed under that condition in a darkened room.

Reckoning back with the linear temperature coefficient of 0.00406 from the normal temperature to zero centigrade, the resistance of the wire was found to be three times that at zero when visible luminosity was just attained, the mean calculated ratio being in fact 3.001. If the same linear temperature coefficient be assumed throughout that whole range, the corresponding temperature of lowest visible luminosity becomes 493° C. in this instance.

The method is very sensitive in application, and repeated trials with the same wire and same observer would usually fall within two degrees centigrade by resistance valuation. There was, however, a systematic variation between the observations when the observers were exchanged, amounting to about three degrees of centigrade, and since the criterion of appreciable visibility is merely physiological, it is perhaps impossible to accurately define it. From the sensations experienced in observing, it might be supposed that habit or physical condition might appreciably influence the range of visual appreciation, after the manner of a personal equation.

In conclusion, we desire to express our acknowledgments to Mr. Thomas A. Edison, in whose laboratory the above research was conducted.

(To be continued.)

An ingenious instrument for automatically indicating the place of a fault on underground conductors is being used in Berlin. An alarm is sounded at the central station the moment a fault is developed, and the location is indicated at the same moment. The usual pressure wires are used, and are so connected that a certain difference of potential exists between the copper conductor and the pressure wire. When a cable is damaged the short circuit which then occurs between the pressure wire and the copper conductor produces a change in the voltage existing between them, which in turn actuates a relay and an alarm at the station. The relay also controls an annunciator, which denotes the position of the fault by the dropping of a square devoted to the district affected. The further efficiency of the underground electric service in Berlin is maintained by ground detectors at the station, which show the condition of the insulation, not only of the whole network, but of every single district.

A multiple filament lamp, which has been used for some time in Germany, is thus described: It contains a number of filaments united in common at the upper part; each half can, therefore, be used with any of the others, thus enabling all but one-half of a filament to be used up or broken before the lamp must be renewed; the extra expense is much less than the equivalent in the new lamps; furthermore, several filaments can be used at once, thus increasing the candle power (unless filaments be used which do not blacken the globe, there would probably be little economy, as the lamp bulb would become too black long before all the filaments are consumed).

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Standard of Illumination. A prominent topic which failed to be definitely acted upon by the Chamber of Delegates of the International Electrical Congress is the standard for units of light and illumination. This subject is a most important one and the total absence of any satisfactory standard at present gives rise to constant misunderstandings.

Professor Houston in his inaugural address to the American Institute of Electrical Engineers gave a review of the work of the Congress, and suggested the propriety of taking up this unfinished work by the Institute, making it distinctively the work of that body. The proposition was at once adopted, and a committee was appointed to carry out the plans suggested. Mr. Preece as an honorary member has also offered to co-operate with this work in England.

This kind of an undertaking seems to be specially suitable to the Institute, not only because it is the representative electrical society of this country, but because it includes among its members almost all of the electricians and electrical engineers connected with our colleges, universities, etc., than whom none are better qualified both by ability and opportunity for pursuing these investigations.

Prof. Houston's plan was to increase the regular committee of the Institute on Units and Standards, and to appoint a number of sub-committees to carry on the necessary experimental work, a chairman for each sub-committee being named in such colleges as possess the necessary laboratory equipments for this line of experimental work.

Should the Institute proceed in this matter it will not only supply a much needed unit, but will add to the high standing as a scientific body which it has already attained.

……o……

The Storage Battery Situation. One of our contemporaries, in discussing briefly the recent decision of Judge Colt against the Milford and Hopedale Railroad Company for infringement of the Brush storage battery patent took a distorted view of the storage battery situation, as it does of every other subject whenever the corns of the General Electric Company are in danger of being trod upon: "With their contention now firmly established and the Faure patent on the use of active material in the form of paste, paint or cement expired, it only requires a liberal policy on the part of the victors to give a great impetus to the storage battery industry. The present licensees under the Brush patents have always professed a considerate policy for those whom the courts have declared infringers of their patents."

In the first place, the production of a successful storage battery, either for accumulator service or for traction work, does not depend upon the Brush patent. The problem has been solved entirely independent of that patent; and moreover, the Consolidated Electric Storage Company, which controls the Brush patent, has *never* produced a practical commercial product. Experimenters in this field will use good judgment in working out their own ideas rather than depending upon the liberality of "the victors."

As to the "considerate policy" which the Brush licensees have professed, the correspondence between Mr. Bracken, of the Consolidated Company, and Mr. Gibbs, of the Electric Storage Battery Company of Philadelphia, published in ELECTRICITY for August 2, shows clearly the hypocrisy of any such claims.

And moreover, it is a fact beyond dispute that not only has the Consolidated Company so far failed to make a good battery, but every one of the companies which have been declared infringers by the courts have also failed. The system of the Milford and Hopedale people possesses special merits, but they do not rest in the battery part of the outfit.

Elsewhere in this issue will be found an article dealing with the Choride Accumulator. We invite the attention of our contemporary, and also of the Consolidated Electric Storage Company, to the facts presented.

Right here in our own city Messrs. Waddell-Entz have been conducting for some months an experiment in storage battery traction which is also worthy of note. It seems now to have fairly passed the experimental stage. They are running six cars successfully, which have traversed already 40,000 square miles without any mishaps of any nature. They have at no time delayed traffic, or been hauled by horses. They go. If we remember correctly, this battery has not been claimed to be an infringement of the Brush patents.

Thus we see that the storage battery problem is marching along to a solution entirely independent of the Brush patent, and without regard to the bullying tactics of the owners of that patent.

……o……

Where Accumulators are Practical. In spite of the slow introduction of accumulators in this country there are a great many uses to which they might be profitably put that have been pointed out to us by the practice in France and Germany, where they are in extensive use. They are considered indispensable in many of the largest central stations in those countries, although here no attempt has been made to introduce them for this work.

It is pretty well settled that an efficient battery whose depreciation is not too rapid adds considerably to the economy of a central station by evening the output of the steam plant through the day.

In every station the load line is very variable; during the greater part of the day it runs fairly even at a small amount and towards night increases abruptly to a maximum which lasts only two or three hours, and then falls off to almost nothing later in the night. This is true of almost every incandescent lighting station, and accumulators are admirably adapted to carry the load at the times when the engines are running almost empty. By charging the batteries during the day the load on the engines is increased to an amount at which they run with a higher efficiency, and the stored current may be used to carry the night load and the plant shut down. It may also be used to supplement the dynamos during the hours of heaviest load, and in this way the maximum output of a station may be made considerably greater than the capacity of its steam plant.

The use of accumulator sub-stations has been found advantageous in a number of places, and they are often used in the capacity of transformers to utilize a high tension current by which they are charged during the daytime for an incandescent lighting circuit in the evening. This plan is adopted in the Papp stations in Paris, where twenty-four stations are all charged in series, each station having two sets of batteries, one of which is discharged while the other is being charged.

In railway work there have been a few experiments with battery cars in this country, but the great number of unreliable batteries on the market, and the uncertain legal status of many of them, have been sufficient to check any great progress in this direction. That storage batteries are entirely feasible for street railway work is shown by their success in Paris, where one company operating about forty cars has found them entirely satisfactory after a test of two years' service.

Accumulators have also been found of service on trolley roads for some purposes. In Dover, N.H., the attempt was made to feed the trolley line on a steep grade some distance from the power house with batteries in order to run this section at a higher voltage than the rest of the line, and the plan appears to be entirely feasible. Charging batteries during the time of light load on street railway circuits for the distribution of power has also been favorably considered and there are besides a great number of applications for which the storage battery is specially adapted. These applications are now no longer a matter of experiment, as the value of the storage battery has been thoroughly established abroad, and the absence of any progress here in this direction is invariably remarked by our foreign visitors.

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An operetta is to be produced in Brooklyn this week entitled "The Lieutenant's Dilemma." The author doubtless drew for his plot upon the incidents connected with the dilemma in which Lieutenant S. D. Greene found himself when he was confronted with the alternative of forfeiting Mr. Coffin's good opinion or of committing perjury in the matter of the libel suit against Electricity. Mr. Greene finally elected to commit perjury rather than to offend Mr. Coffin.

......o......

The rule which has heretofore been in force against the admission of cuts in advertisements on the first page of Electricity has been modified. Hereafter we will accept cuts not to exceed one inch square. We are disposed to make all reasonable concessions to our friends.

......o......

Mr. O. T. Crosby, who is to be in Milwaukee this week, will make the circuit of the various district offices on his return trip to New York. Heretofore Mr. Crosby's calls on the district managers have not been productive of good. At Cincinnati, in particular, such calls have usually been followed by a sale of apparatus by the Westinghouse Company. Mr. Crosby should hie himself to the laboratory, where he naturally belongs.

No Further Reasons Necessary. Last year, when the General Electric balloon was soaring skyward, officials of the company and its boomers in Wall Street were stoutly claiming that the company was doing business at the rate of about $30,000,000, on which it was earning 17 per cent. net. It was stated, we believe, that the earnings of the first year would be more than enough to meet fixed charges and dividends for two years. Owing partly to the glamour of mystery which has surrounded all matters electrical in the public mind, and partly to the high standing of several of the directors of the company, these reports found many believers. No doubt some of the directors themselves believed them. They *must* have had absolute faith in the property or they would not, as some of them did, recommend friends and relatives to invest their savings and even funds held in trust. Electricity, however, did not believe them. And to estimate Electricity's position correctly, it must always be borne in mind that we started our campaign against the corrupt business methods and extravagant claims of the stock boomers *over a year* ago. On August 31, 1892, we began, knowing then, as all the world knows now, that the booming of General Electric shares was little better than a swindle; that the scheme must collapse, and that widespread injury to the financial interests of the entire trade must result. In the issue for September 7, 1892, we had the following:

> Even if there were no other electrical concerns in the field, the scheme would only be a partial success. Light and power are now recognized as necessities in all civilized communities. They are in the nature of luxuries, perhaps, but they are something which the people insist upon having, and for which they are willing to pay a good price. But there is a point beyond which they would rebel, and all electrical development on these lines would be at a standstill.
>
> There is no necessity, however, for anxiety on this point. There are scores of electrical manufacturing and supply houses outside of the Trust, fully equipped, and capable of taking care of all the new business and of supplying additional equipment for existing plants at prices ensuring an honest profit only.
>
> We hope, for the good name of the Electrical Industry of America, that English capitalists will not invest their money in this scheme in the belief that it is a promising enterprise and likely to pay large dividends. The whole range of American electric investments would be under a stigma which it would take years to overcome, and a handful of speculators would reap the profits.

And this has been the keynote of the campaign, in which Electricity has *not* been the loser.

Early in this year the stock began to go off. It had reached a ridiculously low figure for an 8 per cent. stock even before the present general depression. Column upon column of supposed explanations have been published to account for it, none of which have been correct. Officers of the company have backed up old lies with new lies for very fresh occasion, until the record is a sickening one.

The critics of the daily press seem unable to believe that the actual condition of the company, its assets and its business, have NEVER been such as to warrant a higher quotation than 50 for the shares. They were so thoroughly humbugged last fall that they still cling to the fallacy that at that time the stock was valuable, and they are continually seeking for reasons for the great drop. They seek, but they do not find. They are all looking in the wrong direction, or passing over the simple truth in the hope of finding a sensational and hidden mystery.

The following table, which has been compiled with great care, will save these critics and financiers generally a deal of trouble. Although the exact figures are at our disposal, we present the table in round numbers for ready comprehension, and the statements may be relied on :

COMPARATIVE TABLE SHOWING BUSINESS DONE BY THE EDISON GENERAL COMPANY, 1891-92, AND GENERAL ELECTRIC COMPANY, 1892-93.

EDISON GENERAL ELECTRIC.		GENERAL ELECTRIC.	
Eastern District	$4,000,000	New York Office	$3,000,000
		Washington Office	200,000
		Syracuse Office	150,000
		Penna. G. E. (Phila. and Pittsburg)	1,000,000
Central District	3,500,000	Chicago Office	3,750,000
		Cincinnati Office	1,750,000
		Portion of N. W. General Elec. territory	500,000
New England District	600,000	Boston Office	1,500,000
Southern District	350,000	Atlanta Office	350,000
Rocky Mountain District	500,000	Denver Office	400,000
Pacific Coast District	250,000	San Francisco Office	250,000
Pacific Northwest District	450,000	Portion of the N. W. General Electric Company's territory not included in above	500,000
Canadian District	350,000	Canadian	300,000
Total business done	$10,000,000	Total business done	$13,650,000

Previous to the consolidation the Thomson-Houston Company had done just about the same volume of business as the Edison General.

So we see that the attempt to form a Trust, to monopolize the electrical business, was abortive, and that the General Electric Company has done only 20 per cent. more business than each of the chief underlying companies did as separate organizations.

In addition to the above there has been some business turned in by the Thomson-Houston International Company, the figures for which are not at hand, but upon which there has been no profit.

Electrical manufacturing companies, with economical management, can earn 15 per cent. net on business done. They cannot earn more, and the average would be about 12 per cent. The General Electric Company has not been economically managed; and even if it had been, the business done, at the maximum percentage of profit, would not have been sufficient to pay dividends on its enormous capitalization. Its selling expenses have been about 75 per cent. of the selling expenses of the two underlying companies previous to the consolidation.

Further than this, it is susceptible of proof that *all* the business done by the Chicago, Cincinnati and some other offices was done at an absolute loss.

The General Electric Company has failed from simple lack of business, as men die from lack of breath.

A STARTLING RUMOR.

CLEVELAND, O., Oct. 13.—Among the many sensational rumors afloat here as to the Brush Company and its future prospects is one that a matter of upwards of half a million of dollars which ought to be in the Brush treasury has been loaned to the Fort Wayne and General Electric companies on notes which are past due and have not been paid. R.

Legal Notes.

On the petition of certain creditors of the Oshkosh (Wis.) Electric Light and Power Company, C. C. Paige has been appointed receiver of that concern. Mr. Paige, who is also superintendent, says that this proceeding is the result of a falling out among the stockholders of the company, many of whom are creditors. He maintains that the company will fulfil all contracts and pay its debts.

The Electrical Forging Company, a corporation of Boston, Mass., having an exhibit in the Electricity Building on the World's Fair grounds, confessed judgment at Chicago, on the 6th inst., for sums aggregating nearly $68,000.

An action has been begun in the United States Circuit Court by Charles W. Russell and John I. Drake, of Providence, to restrain the Utica Electric Supply and Manufacturing Company from the manufacture or sale of a device for suspending arc lights over streets. The defendant is cited to appear at the term of court which opens in Utica, N. Y., on the first Monday in November. The defendant claims a specific agreement with the inventors to manufacture the device.

The *N. Y. Merchants' Review* says: "Electricity is used to great advantage by enterprising retail storekeepers in the larger cities, not only for illuminating purposes but for window displays. The dry goods stores especially often produce very beautiful effects with electric lights in their windows, a recent instance being on the occasion of the opening of a new store in Brooklyn. Excellent imitations of revolving pinwheels were shown in one of the windows, the color of the wheels being made to change from time to time to correspond with the changing hues of the genuine articles at exhibitions of fireworks. Brilliant stars corruscated and twinkled in the same window, while in another a fac-simile of a peacock attracted much attention. The eyes and crest of the bird were made brilliant with electric lights, and the spreading tail was studded with tiny electric bulbs, the whole production a very beautiful and life-like effect. The expense of the display must have been considerable, but as immense crowds were drawn to the store the proprietors no doubt were well paid for their outlay."

A New Method for the Control of Electric Energy.—II.

BY D. MCFARLAN MOORE.*

The two greatest desiderata in connection with the advancement of electrical science, and those which, because they have not been satisfied and fulfilled, have, in a measure, for a number of years barred further progress in the most rapidly advanced industry in the history of the world, are, first, the use of the efficient low voltage lamp on the efficient high voltage current, and second, the prolonging of the life of these lamps. The manufacture of high voltage incandescent lamps is a subject much agitated at present, owing to the fact that the benefit to be derived from a high voltage is almost incalculable, as the capacity of the mains now used by central stations might easily be trebled. But not only does the successful solution of this problem seem impossible in this direction, but it is now unnecessary. The greatest advantage of the alternating system over the direct current system is that, by means of converters, lamps of low resistance, and therefore high efficiency, can be used. It appears, then, that the main advantage (without some disadvantages) of alternating systems can be transferred to the continuous system by using in each socket, or on every circuit, varying pressure contacts, causing an interrupted current of any desired voltage, thus increasing the possibilities of this system to an enormous extent owing to the immense saving in copper conductors.

If an appurtenance of this construction is operated by a centrifugal governor attached to a motor, the best results as regards economy and regulation can be obtained as the voltage will then vary directly as the torque, and the electric energy required will be proportional to the power developed. Owing to the minimum size of this device it can be made an integral part of the motor. The salient disadvantages of a resistance box that can now be overcome by constructing apparatus as described, are: first, size; second, weight; third, susceptibility to changes in temperature, that is, variation in resistance; fourth, poor contact caused by the burning of clips and loosening of wires; fifth, heating and the great fire risk consequent thereto. The new method is certainly unique, and its application will be the means of affording great convenience under many circumstances.

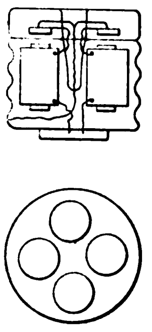
FIG. 6.

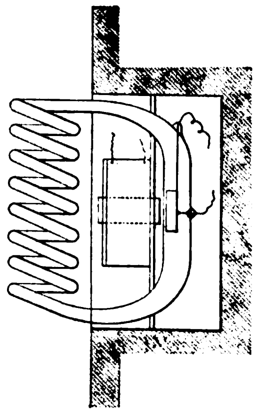
FIG. 7.

Owing to its constancy, due to its non-susceptibility to temperature changes, it can be adopted, when the adjustment screw is used in connection with a graduated dial, with great facility as an electric gauge.

Experiment shows that the continuous sparking (though slight) of the contacts in a vacuum sets in motion the ether molecules, causing a beautiful soft blue phosphorescent light similar to that produced by Geissler tubes. While Maxwell was the first to note that a disruptive discharge was oscillatory and set up vibrations in the ether, Professor Henry demonstrated it experimentally. The conductive discharge which occurs when vibrating metallic electrodes are used, and therefore of small resistance, probably consists of partial discharges producing oscillations which in turn are due to the induction of the current upon itself in the magnet. But the quantity of current passing bears a relation to the amount of disturbance, and the greater the impedance the less the current; also, the more rapid the vibrations or frequency of interruptions, the more prominent becomes the self-induction and the less the true ohmic resistance in the control of the current. These oscillations are increased if the arc is in a strong magnetic field, as it raises the E. M. F. but deteriorates the electrodes more rapidly. If this magnetic field be variable, the effect is magnified, and since free atoms or molecules are made to collide with one another, varying the surrounding potential, we can in a measure account for this phenomenon in that theoretically following every impact the electrostatic force falls from its maximum quantity to zero.

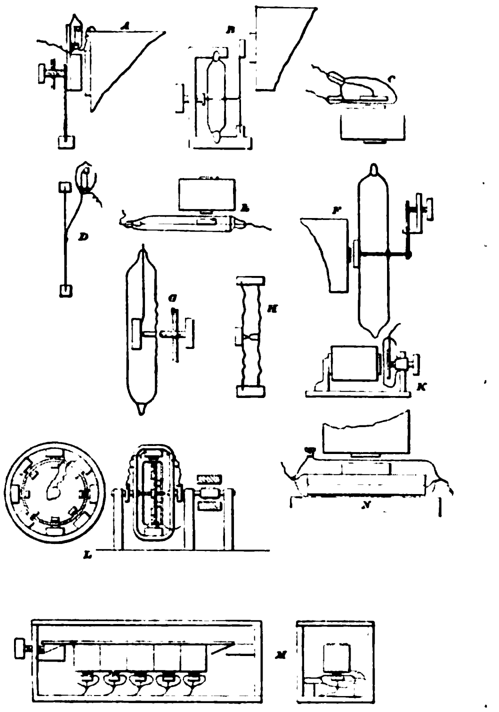

FIG. 8.

Now, by increasing this effect, a light may be produced of greater efficiency than is now obtained by the incandescent filament, which is very inefficient. This method of lighting is a radical departure from anything heretofore proposed, as it will be producing phosphorescent light due to ether oscillations without the use of an alternating current (although there is no reason for not using it) at high tension with expensive and impracticable condensers and transformers. The value of this system will be more clearly discerned when it is remembered that the elements above mentioned as being done away with are those which stand in the way of phosphorescent lighting becoming commercial at present.

Merely the use of this simple and inexpensive device with the direct or alternating low tension current produces phosphorescent light. There is no objection, however, to using high voltages; the effect is simply increased, because the greater the stress between the terminals and the more intense the magnetic field the more rapid will be the interruptions of the current. And the greater the number of impacts per unit of time, the more intense the heating effect and the more economical the light will be. The most economical potential (there must be such) for given electrodes can only be found by trial, because the greater the heat the less the permanency of the vacuum. The phosphorescence is probably in a measure at least caused by the atomic disturbance due to the actual mechanical movement of the armature in the vacuum, the impacts and the static electricity that may be caused thereby in conjunction with the rapid disruptive discharges. This disturbance or action of varying electrostatic force consists in the rapidly moving or vibrating of charged atoms or molecules coming violently in contact with one another, producing friction, heat, light. In fact, the generation of light due to friction within or without a bulb containing rectified gas, and caused by inductive action, is a subject of much interest. Experiment seems to indicate (see plates 8 and 9, L, R, S, T, W, X) that the amount of phosphorescence depends more on the number of contacts in different parts of the vacuum per unit of time than on the influence of a surrounding magnetic field.

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* Read at the seventy-ninth meeting of the American Institute of Electrical Engineers, New York, September 20, 1893.

By reason of the enclosed space in which miniature incandescent arcs can be made to occur in rapid succession throughout its extent, the heat resulting therefrom is conserved and aids in accomplishing the result sought for, a luminosity of maximum radiation emanating from a source of considerable area.

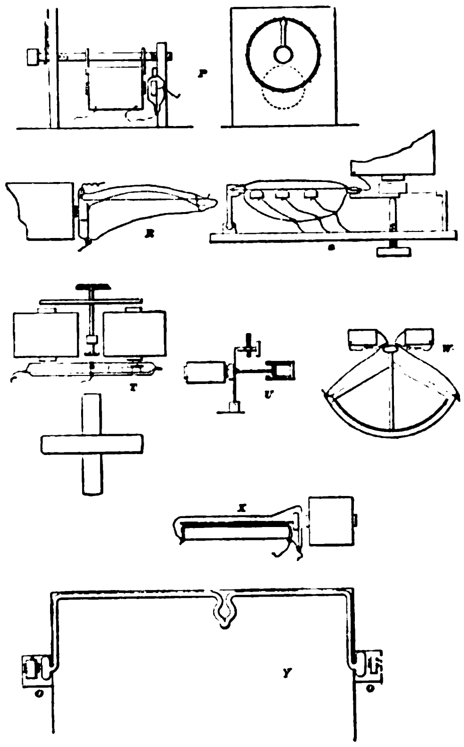


Fig. 9.

If any inert gas, such as oxygen or nitrogen, be substituted for the vacuum, the phosphorescent effect will most likely be intensified on account of more vigorous molecular action, but the life of the electrodes may be shortened. It might be advisable with metallic electrodes to use carburetted hydrogen because when decomposed it would not affect the metal. Owing to the actual contact of the electrodes, their volatilization or disintegration due to the arc is reduced to a minimum, that is, much less than is the case when high tension discharges occur. Of course, the degree of disintegration and the amount of deposit in the bulb depend largely on the nature of the electrodes, aluminium probably being the best. However, the more perfect the vacuum, the less the deoxidization and volatilization, because combustion requires oxygen.

Fig. 6 shows one form of phosphorescent lamp complete, its size a little larger than the base of an ordinary lamp, the C. P. being developed by multiple contacts.

A matter of great importance in the design of a lamp of this description is the form and nature of the evacuated space, partially determined by the melting point of the glass, also whether it is advisable to use double or even triple bulbs, one within the other.

Fig. 7 denotes one of the many forms of lamps that suggest themselves, but experience only can prove that which is most efficient.

The study of this branch of physics and of these highly interesting phenomena brings to our minds innumerable ideas in connection with them which cannot be treated individually in a short paper. A few only of these are illustrated in plates 8 and 9.

If will be noted that the point in Fig. A is that the bulb does not contain the armature, but is mounted upon it, and therefore can be made very small. As shown, its operation its due to the principle of momentum. This is not the best form for producing phosphorescence, in that the heat in the armature caused by dynamic action is not dissipated in producing molecular disturbance in the bulb. Fig. B, elasticity of the glass bulb is suggested. Fig. E, rapid vibrations and quick break. For rapid action use short, thick magnet. Fig. L, friction within bulb and electro-magnetic rotation. Figs. M and N, resistance boxes where gravity is utilized in place of springs.

In Fig. N carbon plates are used for the electrodes, and the bulb should be made of the first quality of refractory glass. On account of the expansion of the gases, formed by excessive sparking, a valve is shown to permit of their escape before a disruption of the glass could occur. This pressure, together with the absence of combustion, bears an important relation to the disintegration of the carbon.

P is a graduated dial attachment to indicate character of current passing; U, vacuum piston instead of spring; W, movement of metal screens upon each other, pendulum action, producing maximum sparking; T, screen with revolving brushes, resulting in a brilliant phosphorescent lighting effect; V suggests transmission of light by phosphorescent tubes generated in concealed portions, O O.

Owing to the immense production of incandescent lamps, the manufacture of evacuated bulbs has been so perfected and cheapened that general current control with this system will probably be many per cent. cheaper than any method now in use.

There are a large variety of rheostats and current controllers on the market designed to be used medically, and since the interrupted current, owing to its peculiar effects on the human system, is now being used in medicine, no better form of current controller could be devised than by employing the principle under consideration, as more delicate currents can be supplied than by any other method or means, owing to the steady rate of vibration caused by the non-deoxidization of the contacts in the vacuum. This is clearly proven in that the pitch of the note produced by the vibrating armature is almost constant.

A varying-in-pressure contact could be used with advantage in connection with all delicate measuring instruments. It would materially aid in making them "dead beat," as it could then be made impossible to strain them by suddenly turning on and off the current.

It is hoped that this paper has been of interest to the Institute, and that it will give new impulse to investigations leading to the discovery of a more economical method for transforming mechanical motion into light, and an ideal means for controlling electric currents.

(Concluded.)

The Electric Manufacturing Company of Rockford, Ill., which had been idle since last spring, has started again on full time with a full complement of men.

The Proposed Electric Conduit Railway in Washington.

President Stevenson of the Metropolitan Railroad Company, Washington, D. C., has made a proposition to the District Committee to install the Buda-Pesth system of conduit on the Ninth street line. He appeared before the committee on the 11th inst., in company with Mr. Wright, of the firm of Misenburg & Wright, who made a statement to the committee giving concise details of the working of the proposed system in the city of Buda-Pesth, Austria-Hungary, where it has been in successful operation for three years. The first line was opened in July, 1889, and gave such satisfaction that the company at once began extending its system, and there are now twenty-five miles of the road in the city. The company have secured a franchise to operate the system in Vienna and are asking for a franchise in Berlin. In 1892 the road carried nearly 11,000,000 passengers in Buda-Pesth.

In reply to questions put by several members of the committee, Mr. Wright explained the points of superiority of the conduit electric system over the cable system, among which were its greater economy and adaptability to the volume of traffic. As compared with other electric systems using conduits, Mr. Wright presented the fact that the Buda-Pesth system was the only one that has carried passengers year in and year out successfully. There was no danger to the public in its operation, for the electricity is conducted on an angle-iron the shape of which is such that the trolley cannot get away from the contact, and even in the case of children playing on the road and punching down in the slot, they would have to establish connection between both angle-irons, a thing almost impossible.

Mr. Stephenson added that the Metropolitan Railroad Company had placed the matter before its board of directors, and is now ready to accept the offer of Mr. Wright to install the system on its lines, if Congress gives its consent. He is satisfied that the system can be successfully operated, and is contented with the guarantee of Mr. Wright.

The committee adjourned without taking action, but apparently favorably impressed by the statements set forth.

A German Colliery Electric Locomotive.

The first electric locomotive put down at the German collieries at Kray, known as the United Bonifacius, has recently been replaced by a new one of improved design, constructed by the well-known firm of Messrs. Schuckert & Company, of Nuremberg. The new locomotive, which is described in *Industries and Iron*, differs from its predecessor in that the battery of accumulators is not carried on the motor as in the old form, but on a separate truck, which forms a kind of tender. By this arrangement it is claimed that the locomotive is much more easily handled, and that the whole apparatus is greatly simplified. The direction of running can be changed at will without the necessity of removing the brushes of the motor. The latter is series wound, and the magnet-winding is divided into sections so that the speed of the locomotive may be easily regulated by means of a regulator-switch. Seats for the driver are provided at each end of the locomotive in close proximity to which are placed switching arrangements. The locomotive has been so designed with regard to its dimensions as to admit of being taken down the shaft in the cage, and also to allow of its having free access to the galleries and cuttings. Ample brake-power and lubricating arrangements have been provided and at full speed the locomotive can attain a speed of 110 metres per minute.

The battery of accumulators carried on the tender was supplied by the Hagen Accumulatorfabrik and comprises forty cells. The latter are inclosed in suitable, strong cases the top of which consists of a glass plate having a small hole in the centre. Special precautions are taken to prevent any spilling of the acid in the accumulators while the locomotive is in operation. The connection between the battery and the switching apparatus on the locomotive is by means of a flexible conductor and a clip contact. The capacity of the accumulators is sufficient for the working of the locomotive with a normal load of ten loaded wagons during one shift. The locomotive is also arranged to work by means of an overhead conductor, the rails in this case serving as the return.

Personals.

Mr. Frank A. Myer, the genial representative of the E. S. Greeley Company, New York, spent a little time among his old acquaintances in Boston this week, and honored our office with a call. Frank A. has made up his mind never to like Boston. He never tires of letting his friends know that Gotham is good enough for him.

City Electrician Henry A. Chase has been promoted by city council to be director of the Signal Service for Boston.

Mr. J. E. Talbot, so well known by the electrical fraternity throughout the East, has been spending a few days on his old stamping-ground. Everybody was pleased to see J. E. T.

Boston Notes.

The most ominous sign of the times in Boston electrical and financial circles is the almost deathlike silence that has come over the General Electric Company's affairs during the last week or two. As far as news goes, the Trust is dead for the present, and both the outside public and the great army of small stockholders are querying what will be the next move. The roseate paragraphs that were wont to appear every day or two in the various papers—morning, evening and financial—apparently failed of their purpose to restore the confidence of the public, so the chief of the Trust's information and press bureau is now devoting himself to other and, it is hoped, more successful and profitable work. It is the unanimous opinion of every one that to play off those paragraphs on a public that has paid so dearly for its electrical whistle was adding only insult to injury. The investors had lost their money and were in no humor for being fooled. That the executive chiefs of the Trust have realized this, is proven by the discontinuance of all news items from the press and advertising department of the company. Meantime many of the old employees, tired of the prolonged vacation, are seeking new appointments and finding them very hard to meet with. They are among those who believe least in the misstatements that have from time to time been published, and take no stock in the oft-repeated promises that the works will start up full blast in a few weeks. About the latest announcement, now more than a week old, was that there was the most perfect harmony prevailing in the Board of Directors, and further that Mr. Coffin has no idea of resigning—at present.

That perennial dispute over the prospective laying of electric car tracks along Brattle street, Cambridge, has again cropped up as vigorously as ever. The matter has been argued this week before the Railroad Commissioners, quite a number of prominent citizens speaking against the project. After two days' hearing, pro and con, the commissioners now have the matter under advisement.

A somewhat unusual funeral procession passed through the streets of Boston a few days ago. The remains of a motorman, who had been in the employ of the West End Railway Company for some years and was very popular with his fellow-workmen, were to be interred in Calvary Cemetery, and in the funeral cortege was the car deceased had run for three years, heavily draped in black. The car moved at the head of the procession.

The Cambridge City Council may be considered to occupy premier place in the matter of having disputes over electrical concerns. As we have noted above, the electric railway is being opposed there for certain reasons, and now the New England Telephone and Telegraph Company has determined upon a line of action that may involve the Cambridge city fathers in a lively kind of a fight. In June last the City Council very precipitately passed a restrictive ordinance which was a severe blow to the Telephone Company. This ordinance, introduced, discussed and adopted all in a single evening, gave the city the privilege to revoke any and all pole locations if the conditions imposed in any one location were not observed. The Telephone Company kicked hard against it, but without avail. Now it has got round to its innings, and to get even with the city fathers it has cancelled all the reduced and free telephone service to the city and notified the Council that in future Cambridge must pay just the same as private subscribers. This fact was embodied in the following letter that has just been forwarded :

To the Honorable the Mayor and City Council of the City of Cambridge.—Gentlemen : We have this day sent to the treasurer of your city notice cancelling all reduced and free rates for telephone service to the city, to take effect one month from this date. Thereafter the rates for telephone exchange service furnished the city will be the regular standard rates to subscribers for similar service.

We regret our inability to continue our gratuities in the way of service, but the onerous conditions imposed by your city upon the conduct of our business and the restrictions placed upon the extension of our facilities to meet the growing demands of the public make it necessary for us to curtail privileges heretofore extended.

Respectfully,
JASPER N. KELLAR.
General Manager New England Telephone and Telegraph Company.

Cambridge as a city has another stubborn fight on its hands for the coming winter, sure.

The hearing of the suit, Mather Electric Company vs. Thomson-Houston Electric Company, that was to have been heard last Monday before Judge Colt, has been deferred, the Judge having notified the respective parties that he could not hear the case that day.

There has been an interesting and exciting telegraph tournament in this city during the present week. The first prize was won by Mr. A. F. Booth, telegraph operator on the Lynn *Daily Item*.

After a series of inquiries, investigations and hearings, supplemented by an extended European trip undertaken by one or two members, the Rapid Transit Commission for this city has presented to the City Council a most elaborate report, setting forth in detail what conclusions have been arrived at for the solution of the rapid transit problem. The estimated cost of the plan most favored by the commission is put at $9,000,000. The report has been submitted to the city engineer, who, after a searching analysis, declares that the scheme cannot possibly be carried out for less than $18,000,000 or thereabouts. Such a difference has roused Mayor Matthews's ire, and he has been saying some pretty strong words about the work of the commission this week. Rapid transit seems as far off as ever from Boston.

During the years 1887 and 1888 the Boston Heating Company erected an extensive plant on Atlantic avenue, and built some four miles of underground conduits of a most substantial character, wherein its pipes were laid. Some $1,250,000 were expended on the enterprise, but after being in business a few months the system gave out so completely for various reasons that the company had to give up their enterprise, which had begun under the most promising auspices. Since that time until recently nothing was done with the extensive plant. At last the whole plant was sold at auction, and the heating station has been entirely dismantled. Now the city council has authorized the defunct Heating Company to transfer to the New England Telephone and Telegraph Company its entire system of conduits, pipes and manholes, also the right to make such changes in the acquired system as may be necessary to adapt it for the use of the Telephone Company in laying wires and cables therein, the Telephone Company to file with the Superintendent of Streets a plan showing the location of the acquired underground system.

The Massachusetts Institute of Technology is entitled to rank as one of the foremost scholastic and scientific institutions in the country. For many years it has been turning out from its laboratories and class rooms hundreds of promising young men who are destined to make names for themselves and to fill leading positions in those great undertakings that are to carry still nearer the front of civilization the United States of America. During the present year the students will have for use in their laboratory instruction in strength of materials some very powerful testing machines, for among other apparatus the laboratory now contains an Emery testing machine of 300,000 pounds capacity, a machine of 100,000 pounds capacity for testing full-sized wooden and iron beams of 27 feet span and less ; a torsion machine capable of breaking, by twisting, a wrought-iron shaft three inches in diameter ; a rope-testing machine capable of breaking a six-inch hemp rope ; a 50,000 pounds tension testing machine, and machines for testing cement and wire. There has also just been added a Blake duplex pump, having a capacity of 1,000 gallons a minute, a Davis plunger pump, two water motors and an indicator tester.

The medical profession in this district are in a state of excitement over an electrical device invented for their special use by a member of the profession, and orders for the same are being received daily. For dealing with contagious and other dangerous diseases this apparatus is going to offer an unerring safeguard.

Canadian Notes.

The Toronto Street Railway Company are busily engaged in laying new and heavier rails on the streets where they have not yet run trolley cars. Before the winter sets in the whole system will be converted into electricity.

The Lake Shore & Mimico Electric Railway is completed to New Toronto, and the extension was opened on Friday.

A force of 55 men is engaged laying the tracks for the electric railway in London, west. The work is well advanced and the early completion of the road is expected.

A meeting of the shareholders of the Hamilton, Grimsby & Beamsville Electric Railway was held last week for the purpose of appointing a permanent board of directors and placing the company on a proper business basis. The shareholders appointed the following gentlemen directors of the company: C. J. Myles, J. T. Middleton, E. Freeman, J. McRoberts, J. Bradley, Walter Grieve and H. S. Martin. The directors then appointed the following officers: President, Mr. C. J. Myles; vice-president, Mr. J. T. Middleton; secretary, Mr. Adam Rutherford.

The experiments in opening and closing the lock gates of the Beauharnois Canal by electricity have proved very successful, and it has been decided by the department to utilize this motive power, not only on the Soo Canal but also on the Soulanges Canal.

The Port Arthur Electric Railway is now completed. It connects the three towns, Port Arthur, Fort William and West Fort William, and is eight miles in length. An hourly service will be inaugurated between the three towns.

There are rumors afloat to the effect that the Toronto Electric Light Company have secured control of the Hamilton Electric Light Company, and judging from indications it is not unlikely the case.

At a meeting the other day of the Galt and Preston Street Railway Company it was unanimously decided to operate the road by electricity.

C. F. Stillwell, manager of the Edison Lamp Works at Hamilton, which has gone to Peterboro, intends organizing a new company, and expects to start with 40 or 50 hands.

The brick work of the General Electric Company's new power house on York street, London, is about completed. The smoke stack is the tallest in the city.

Mr. D. H. Keeley, Acting Superintendent Government Telegraphs, has just returned from the Gulf of St. Lawrence, having seen to the repair of the cables to the Magdalen Islands and St. Paul's Island, as well as the laying of a new short line at Anticosti.

The Auer Incandescent Light Company of Montreal, which has been in one trouble after another ever since the Customs officers took charge of the establishment, on the ground that the company had defrauded the customs by undervaluation, furnished a new sensation the other day. J. Brooks Young, one of the directors, and H. J. Bell, general manager, were arrested at the instance of Mr. A. O. Granger, the suspended general manager and principal promoter, upon a charge of conspiracy. The conspiracy consists in alleging that Mr. Granger forged a transfer of 500 shares of the stock. The two gentlemen were released on $500 joint bail, and the case comes off before Judge Dugas next week.

The electric light, gas and telephone companies of Toronto have this year, for the first time, been assessed on their mains, poles and wires. In the case of the Toronto Electric Light Company, this will mean, says Manager Wright, an increase of taxation from $1,200 to about $7,000 per year, and will take one-fifth of the company's net income to pay taxes. If the assessment stands, he declares he will close the machine shop, in which twenty heads of familes are now employed, and purchase all necessary supplies from Peterboro instead of manufacturing them in Toronto.

The annual meeting of the shareholders of the Standard Light and Power Company of Montreal was held in that city on the 27th ult. The Standard Light and Power Company succeeded to the St. Henri Company, and now it is amalgamated with the Citizens' Light and Power Company. The Citizens' Company does the lighting, whereas the Standard Company has the railway privileges. The Standard Company has sold its gas privileges to the John Coates Company, which has received a franchise. The shareholders are yet to decide what is to be done with the railway privileges.

General News.

What is Going on in the Electrical World.

Richmond, Va.—The Richmond Railway and Electric Company has nearly completed the work on the new electric line which is to run to Barton Heights.

Louisville, Ky.—Electric cars are now running on the Bank Street line, and it is probable that the East Walnut Street Railway will soon be equipped with electricity.

Titusville, Pa.—Interest is being revived in the projected line of electric railway between Meadville and Titusville. The line is strongly advocated by the local press.

Wheeling, W. Va.—Work on the Wheeling and Elm Grove Company's Electric Railway through East Wheeling is still awaiting the action of the city council.

Elizabeth, N. J.—The board of freeholders have granted a franchise for the introduction of the trolley system in this city and through Union County to the Consolidated Traction Company.

Alden, N. Y.—A survey has been made through this place for the proposed trolley line from Lancaster to Rochester. The line takes in nearly all the villages lying back from the railroad.

San Antonio, Tex.—The San Antonio Street Railway Company has purchased the Citizens' Electric Railway, and Superintendent Greer of the San Antonio Company is now in charge of both systems.

Port Jervis, N. Y.—Parties from Scranton, Pa., were in town last week looking over the ground for a proposed electric street railway, and there is a probability that such a road will be built next spring.

Savannah, Ga.—The mayor has imposed fines amounting to $2,000 upon the Electric Railway Company for failing to comply with the provision of the ordinance requiring that street railway tracks be graded.

Pittsburg, Pa.—An electric railway line between Steubenville and Pittsburg for passengers and freight is advocated on the ground that it would be of great convenience to a numerous farming population.

Middletown, Conn.—The Schuyler Electric Company's shops here, which have been practically shut down for two months, will reopen soon. The company's affairs are being reorganized and the office salary list is being cut down.

Montreal, Can.—A charter has been obtained for an electric railway line at Cote St. Antoine to run from the north of the Cote St. Antoine road to the boundary of Cote des Neiges, including some mountain grading of 10 per cent.

Wilmington, Del.—A committee, consisting of Dr. J. H. Wilson, S. B. Smith and H. A. Newland, has been appointed to confer with the Alms House Committee on the subject of electric lighting for the county and State institutions.

McKeesport, Pa.—The White Electric Traction Company has assigned to Robert R. Hammond and William E. Tustin, under date of October 6, 1893. It conveys all the real estate and also all goods, chattels and effects and property of every kind.

West Chester, Pa.—A preliminary survey of the projected electric railway between West Chester and Philadelphia has been made. The line will pass through a number of towns in Chester and Delaware counties, and will be twenty-three miles long.

Los Angeles, Cal.—At the foreclosure sale of the Pacific Railway Company's property (cable road) on the 4th inst., E. P. Clark, general manager of the Consolidated Electric Company, bought the machinery and appurtenances offered for the sum of $17,476.30.

Batavia, N. Y.—The *News* is authority for the statement that an electric railroad from Depew to Batavia is to be constructed; a corps of engineers are now at work surveying a line to Batavia running parallel with and but a short distance from the new Buffalo road.

Orange, N. J.—An ordinance granting a franchise to the Newark and South Orange Railroad Company to run cars through South Orange was passed by the board of trustees on the night of the 6th inst.; immediately men were set at work setting poles and stringing wires, and at 10:45 the following day a car was sent over the line.

Defiance, Ohio.—The Defiance Electric Light and Power Company has been reorganized with the following officers: President, S. L. Nelson; vice-president, W. B. McKinley; secretary and treasurer, Frank L. Smith; board of directors, Henry Smith, F. L. Smith, C. C. Rush, of Bay City, Mich, W. B. McKinley and S. L. Nelson.

Meriden, Conn. The street railway company has decided to put in the Thomson-Houston system of electric cars and work will be begun next week. The majority of the stock of the company has been sold to a Philadelphia syndicate represented by Walter F. Douglass. Electric cars will be running by December.

Hartford, Conn.—An incandescent lamp invented by Henry Green, of this city, is being tested in Springfield, Mass. Some of the lamps already completed are of 52 and 110 volts; they are each of 16 C. P., and show an efficiency of three volts per candle. The lamp, it is reported, has been received with great favor in Springfield.

Berlin, Ger.—The Berlin Rapid Transit Commission have accepted a definite plan for the new railroads projected for Berlin, and the Werner-Siemens Electric Company will do most of the work. In the less busy parts of the city the cars will run in the street; in other parts on elevated roads; and in the busiest part of the metropolis they will dip into an underground tunnel. The cars will all be run by storage batteries.

Jersey City.—Proposals and bids will be received by the board of chosen freeholders of Hudson County for the erection and completion of the electric light wiring for the new lunatic asylum building at the county farm, Snake Hill, at their meeting to be held at the Court House, Jersey City, Thursday, October 19, 1893, at 4 o'clock P. M. Plans and specifications and forms of contract can be seen at the office of the board, next the Court House, and at the office of H. Kreitler, 55 Montgomery street, Jersey City.

Myersville, Md.—At a recent meeting of the stockholders of the Catoctin Valley Electric Railroad and Power Company, held here, the following directors were elected: Geo. W. Jacobs, Jr., T. E. Bowne, C. F. Flook, D. V. Harp, G. W. Wachtel, E. J. Smith and Edgar L. Miller. The intention of the company is to build an electric road from Middletown via Myersville to a point in the northern part of Middletown Valley, twelve miles in length. The contract for the building of the road was awarded to the Hughes & Rigby Engineering Company of Baltimore.

Vicksburg, Miss.—The Weaver-Campbell Electric Company, of this city, made a test a few days ago over the Valley route wires, between the general office of the road in New Orleans and the train dispatcher's office in this city, of the Magno-Secrograph, an invention of J. P. Weaver, said by the local press to be of "indispensable value to brokers, railroad magnates, etc., and destined in the judgment of experts to revolutionize certain branches of telegraphy." The test was of considerable duration and the new instrument sustained the claims made for it.

New York.—At the annual meeting of the Western Union stockholders, held on the 11th, President Eckert's report was presented. The capital stock was shown to be $95,320,000. Revenues during the year, $24,978,442; expenses, $17,482,405 During the year there were added to the company's system 360 miles of poles, 30,000 miles of wire and 378 offices. The six vacancies on the board of directors, caused by death and resignations, were filled by the election of the following: John Jacob Astor, Oliver Ames 2d, George Bliss, Louis Fitzgerald, C. Sidney Shepard and J. B. Van Every.

Brooklyn, N. Y.—The trustees of the big bridge spanning the East River have been making investigations into the relative efficiency of cable and electric traction systems and are said to be in favor of substituting electrical motive power for the cable on the bridge road.—The Brooklyn Young Men's Christian Association has outlined for the winter season of 1893-94 a course of lessons and lectures on the "Theory and Practice of Electricity," which promises to be unusually attractive as well as instructive.—One of the big fly-wheels in the power-house of the Atlantic Avenue Railroad Company burst on Wednesday night last, injuring three of the employees and a woman and doing damage estimated at $40,000.—The Grand street line of the Brooklyn City Road, which runs to Maspeth, Newtown and Corona and its branch to Calvary Cemetery, by the way of Humboldt street and Meeker avenue, will be equipped with the trolley on November 1. Nearly all the wires have been strung, the men broken in as motormen and the new cars are ready.

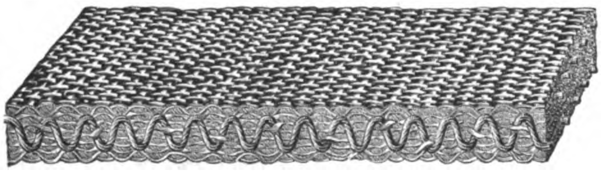
Baltimore, Md.—In the Female House of Refuge in this city an electric system has been introduced which will greatly lessen the danger to the lives of the inmates from fire. The women are locked up in their rooms at night, and under the old system many of them would undoubtedly perish if the building were burned down. Should a fire occur now, the matron by moving the switch to the point marked "Fire" releases all locks on the doors leading to the fire escapes, also all locks on the doors of the refractory cells, located in the basement, and sets the different fire alarm bells going, so that no accident may be caused by delay.—The Brush Electric Light Works building was destroyed by fire on the night of the 13th.—The *Herald* says the expedition with which the old horse car lines in Baltimore have been changed into cable and trolley roads surprises everybody. It is yet only three years since work was begun on the first cable road, and already twenty-one lines have been fitted out with rapid transit and some of them are new routes which were not even projected in 1890. But this unheard of activity in pushing forward rapid transit lines is likely to be duplicated many fold in the Maryland counties within a brief period. There are the projected roads to Washington, the extension of lines to Sparrow's Point and Lutherville, not to mention an air line road across Anne Arundel County to Annapolis and Bay Ridge. But the great centre of electrical railway development is to be found in Frederick County.

Maddox Cotton and Wire Belting.

The strong claims of merit and superiority made for this belting are based on the material it is made of, the way these are woven together, and the way the belting is made. It is made of cable soft steel wire and cotton, woven solid together, making it strong and durable. The cables of wire are each composed of six soft steel wires, twisted together like a cable. The cables are laid lengthwise in the belting, about one-eighth of an inch apart, forming part of the warp, the cables composing about one-half of the warp, the rest of the belt being composed of strong, tough cotton yarn, spun especially for this purpose.

The cotton filling or woof is woven in solid with the warp, the process of weaving causing the cables of wires to become corrugated in form, or doubled back and forth through the thickness of the belting, the corrugations being about one-eighth of an inch apart, and about as long as the belts are thick, the cotton woof being woven in solid in the meshes or corrugations of the cable. The weaving of the cotton and wire solidly together completely and thoroughly covers up the wires with the cotton, so that the wire cables do not come in contact with the pulleys; the wire cannot be seen in the belting except when it is cut so as to expose it. The rough surface given to the belting by the cotton forms an elastic, rough face that prevents any air cushions forming between the belt and pulley. It is claimed the belting is absolutely waterproof, being thoroughly filled with a permanent waterproof material. It is also claimed that it is not affected by water, steam, dampness, moisture, heat, dryness, oils, grease, acids or chemicals or the vapors of them, changes of climate or weather, dirt or dust.

Some interesting tests of the durability of the Maddox wire and cotton belts have recently been made. In one case a 5-inch belt, 26 feet long, and traveling 2,200 feet per minute, was used on a band veneer saw. The belt crosses immediately under the saw at the point where the dust from the saw fell on it, the conditions being so very unfavorable that leather or rubber belts would last but a few weeks. The Maddox belt, in this case, has run three months without showing any signs of wear. Government tests of the Maddox belt are about to be made at the ordnance shops of the United States Navy Yard at Washington, under the supervision of Commodore Sampson, Chief of the Bureau of Ordnance. Two belts, each 46 feet long by 8 inches wide, are to be tested on blowers in the forge shops, while other belts are to be tested on woodworking machines. Mr. H. N. Green, the general agent of this belt, whose temporary headquarters are at 254 Fulton street, Brooklyn, N. Y., has received many highly complimentary opinions of the Maddox belting, and looks for its use in all departments of trade.



Maddox Cotton and Wire Belting.

Columbus Electrical Machine Works.

The business of this house was established about eight years ago by the Minott Electrical Machine Company and came into the hands of the present owners in April, 1893. The firm consists of J. M. Keleher and J. Hickey and was organized with a capital of $20,000. The large two-story building occupied by them is equipped with a most complete line of modern machinery adapted to their business. The business consists in the manufacture of dynamos, motors, platers and engine governors. They also manufacture all kinds of electrical appliances, as well as pulleys, shafting and hangers of every description, and plates for electrical silver and nickel plating. They also design steam plants, construct electric light plants and repair electrical machinery. They pay special attention to the installation of isolated plants. Mr. Keleher is a man of large experience as a machinist, having been connected with the McNamor machine works at Newark, O., for twenty-five years, during which time he acted as their superintendent for fourteen years and did most of the designing and perfecting of their machines. Mr. J. Hickey is also a thoroughly experienced machinist. He has been in this line of business for about thirty years, and was seven years with Whitely, Fassler & Kelley, of Springfield, O., where he had charge of the tool room and designed and superintended their special work. The office of the firm is located at No. 56 Vine street, Columbus, O. These gentlemen have displayed a great deal of energy in the establishment of their new enterprise and are well worthy of the success which they have achieved. Persons desiring work in the line would do well to give them a trial.

The Mica Insulator Company.

The Mica Insulator Company of New York and Schenectady will make a fine display at the meeting of the American Street Railway Association in Milwaukee.

This will be the first time this company has made an exhibition of micanite. It will be of interest to all who are in need of a perfect insulator. Micanite is surely and steadily being adopted as a reliable insulator not only in the United States but in Europe.

This company has made several important improvements in the method of manufacturing, and they are very happy to say that micanite of to-day is far ahead of what they put on the market when they first began business.

The exhibit will be in charge of Mr. Charles W. Jefferson, their manager, who is thoroughly posted on insulation. Mr. Jefferson was for several years manager of the insulating department of the Edison General Electric Company at Schenectady.

COMMERCIAL PARAGRAPH.

The Metropolitan Electrical Company, offices 319-320 Manhattan Building, and salesroom 307 Dearborn street, recently organized, will make an announcement shortly as to the scope and general plan of the company. Mr. Wm. H. McKinlock, of this company, feels that the outlook for business is encouraging, and sees the promise of liberal support for a good, strong company, conservatively managed. Evidence of this fact is fast multiplying. In the meantime they are receiving orders for general supplies and N. I. R. Wire, with which they are generously stocked.

INCORPORATIONS.

The Egan Electrical Company, Chicago, Ill.—to manufacture and use all kinds of electrical machinery, devices, appliances, etc. Capital stock, $60,000. Promoters: R. L. Duval, Charles E. Egan, George P. Jones and B. C. Caldwell.

The Overbrook Electric Company, Philadelphia, Pa.—to supply light, heat and power by means of electricity to the public in Philadelphia. Capital stock, $10,000. Promoters: John W. Paul, Jr., Edw. T. Stotesbury, Philadelphia; Herman Wondell, Wayne, Pa.

The Fullner-Danhoff Electric Company, Chicago. Capital stock, $5,000,000. Incorporators: Franz Fullner, A. B. Coon, Henry A. Gates, William B. Keep.

The Electric Heat Register Company has been incorporated, with a capital stock of $40,000, by J. H. Ames, of St. Paul, Minn. A. S. Robbins, W. F. Decker, W. R Sweatt and C. H. Magnuson, of Minneapolis.

The Enid and Perry Railway Company, Guthrie, Okl.—to to build an electric railway between six towns in Enid and Perry Counties, in the Cherokee Strip, with a total length of forty miles. Capital stock, $500,000. Incorporators: E. L. Dunn, R. W. Patterson, C. O. Wood and J. W. Thompson, of Enid, and James A. Pearce, of Denver, Col.

Articles of organization have been prepared incorporating in Hartford the Connecticut Royal Arc Electric Company, a branch of the Royal Arc Electric Company of New York City. This company will handle a new incandescent arc light.

The Hillsboro Electric Light and Water Company, Hillsboro, Ore.—to maintain and operate an electric light and water plant in Hillsboro. Capital stock, $40,000. Promoters: Harry V. Gates, Duncan Kankin, Helen M. Gates, W. E. Pruyn, Hillsboro.

The Lancaster Investment Company, Seattle, Wash.—to build and operate street and other railways, electric light plants, etc. Capital stock, $100,000. Geo. H. Danner, M. F. Phantz, D. L. Hamaker, Manheim, Pa.; J. F. Eshelman, Chas. William Cropp, Jas. Skinner, Seattle.

The Eureka Brick, Tile and Electric Company, Eureka, Ill.—to manufacture and operate brick, tile and electric plants. Capital stock, $50,000. Promoters: J. M. Deck, J.A. McGuire, W. S. Allen, Albert Gudeman, Samuel Gudeman, W. A Davidson, N. B. Crawford.

ELECTRICAL PATENT RECORD.

Letters Patent Issued Sept. 26-Oct. 3, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

505,457. Trolley-Wire Support. Lucius T. Gibbs, Milwaukee, Wis. Filed Oct. 15, 1892.
505,605. Closed Conduit for Electric Railways. Geo. W. McNear, Oakland, Cal. Filed Aug. 1, 1892.
505,686. Controller-Roller for Electric Cars. Ernest P. Warner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed June 21, 1892.
505,687. Automatic Passenger Train Annunciator and Alarm. Alfred E. Watts, Duluth, Minn. Filed Jan. 18, 1892.
505,841. Conduit Electric Railway. Lawrence A. McCarthy, Brooklyn, N. Y. Filed Feb. 6, 1893.
505,994. Electro-Conducting Bearing for Trolley or Other Wheels. Elmer A. Sperry, Chicago, Ill., assignor to Frank R. Greene, same place. Filed Sept. 17, 1891. Renewed Feb. 21, 1893.
506,001. Controlling Device for Electric Railway-Cars. William P. Coldren, Lebanon, Pa., assignor of two-thirds to Jacob M. Shenk, same place, and William H. Conrad, Reading, Pa. Filed April 22, 1893.
506,043. Trolley-Wire Support. Maurice Hoopes and Oscar S. Hertzog, Lynn, Mass. Filed July 1, 1893.
506,124. Electric-Railway System. Harry A. Lewis, Norristown, Pa., assignor of three-fifths to John T. Dyer, same place. Filed March 3, 1893.
506,149. Electric-Trolley Wire Crossing. Edgar P. Binford, Cincinnati, Ohio. Filed Nov. 3, 1892.

ELECTRIC LIGHTS AND APPLIANCES.

505,585. Adjustable Supporter for Electric or Other Lamps. Otis C. White, Worcester, Mass., assignor of one-half to George E. Francis, same place. Filed Mar. 31, 1893.
505,913. Incandescent Electric Light. Henry D. Burnett, Lynn, and Samuel E. Doane, Swampscott, Mass., assignors to the Thomson-Houston Electric Company of Connecticut. Filed June 27, 1892.

DYNAMOS, MOTORS, ETC.

505,505. Multiphase Motor. Louis Bell, Boston, Mass., assignor to the General Electric Company, same place. Filed June 14, 1893.
505,539. Field-Magnet Core for Dynamos or Motors. George S. Strong, New York, N. Y., assignor to James N. Gamble, Cincinnati, Ohio. Filed Feb. 3, 1892.
505,594. Controlling Device for Electric Motors. Chas. G. Curtis, New York, N. Y. Filed Oct. 22, 1892.
505,622. Dynamo-Electric Machine. Arthur S. Atwater, Cleveland, Ohio, assignor to the Atwater General Electric Company, same place. Filed Jan. 23, 1893.
505,665. Dynamo-Electric Machine or Electric Motor. Robert Lundell, Brooklyn, assignor of two-thirds to Edward H. Johnson, New York, N. Y. Filed Oct. 31, 1892.
505,729. Armature for Electric Motors. William J. Sherwood, Ashtabula, Ohio. Filed April 16, 1891.
505,783. Electric Motor. Ralph Ashley, Philadelphia, Pa., assignor of one-half to Charles W. Kennedy, same place. Filed May 20, 1893.
505,859. Alternating-Current Motor. William Stanley, Jr., and John F. Kelly, Pittsfield, Mass., assignors to the Stanley Laboratory Company, same place. Filed June 8, 1892.
505,914. Regulator for Dynamos. William H. Elkins, Cambridge, Mass. Filed Nov. 21, 1892.
505,926. Armature for Electric Machines. Albert Schmid, Pittsburg, Pa. Filed Nov. 3, 1893.
505,927. Alternating-Current Generator. Albert Schmid, Pittsburg, Pa. Filed Nov. 3, 1892.
505,928. System of Electrical Distribution. Charles P. Scott, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, same place. Filed Sept. 28, 1892.
505,957. Armature. Martin Rahner, Union, N. J. Filed Dec. 7, 1892.

BATTERIES.

505,467. Secondary Battery. Isidor Kitsee, Philadelphia, Pa. Filed May 23, 1892.

TELEPHONE AND TELEGRAPH APPARATUS.

505,628. Duplex Telephony. William Marshall, New York, N. Y. Filed Feb. 28, 1892. Renewed July 8, 1892.
505,730. Telephone-Circuit. Theodore Spencer, Cambridge, assignor to the American Bell Telephone Company, Boston, Mass. Filed Feb. 20, 1893.
505,917. Transmitting Telephone. Silas W. Holman, Boston, Mass. Filed May 4, 1893.
506,132. Coin Controlled Telegraphic Call Apparatus. Graydon Poore, Putney, England. Filed March 29, 1892.
505,724. Coin Controlled Electric Call Apparatus. Graydon Poore, London, England. Filed May 16, 1892.

ALARMS AND SIGNALING APPARATUS.

505,819. Fire-Alarm System. Harry T. Downs, New York, N. Y., assignor of one-half to Loren N. Downs, same place. Filed Oct. 1, 1892.
505,834. Fire-Alarm. August Crastin, Cleveland, Ohio. Filed Jan. 6, 1893.
505,833. Contact for Signaling to Cars. Frank E. Kinsman, Plainfield, N. J. Filed May 26, 1892.

MISCELLANEOUS.

505,561. Electrical Connection. William I. Smith, Memphis, Tenn. Filed April 19, 1892.
505,669. Means for Preventing Railroad Collisions. Eduardo M. de Monte and Carl Jost, Bombay, India. Filed Oct. 28, 1892.
505,775. Apparatus for Molding and Pressing Carbons. Louis B. Marks, New York, N. Y., assignor to the Washington Carbon Company, Washington, Pa. Filed Oct. 26, 1892.
505,798. Manufacture of Cables for Multiple Switchboards. Oro A. Bell, Brooklyn, N. Y., assignor to the Western Electric Company, Chicago, Ill. Filed Nov. 7, 1892.
505,808. Electric Time Cut-Out. Frank Beland, Cairo, Ill. Filed July 8, 1893.
505,822. Protector for Pipes from Powerful Electric Currents. Frederic Egner, St. Louis, Mo. Filed June 17, 1893.
505,838. Lathe for Dressing Commutators. James A. Mebane, Wytheville, Va. Filed Jan. 28, 1893.
505,860. Method of Working Condensers. William Stanley, Jr., John F. Kelly and Cummings C. Chesney, Pittsfield, Mass., assignors to the Stanley Laboratory Company, same place. Filed March 18, 1893.
505,895. Apparatus for the Electrolytic Production of Soda and Chlorine. Elisha B. Cutten, New York, N. Y. Filed Dec. 30, 1891.
505,911. Rheostat. Alexander Wurts, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, same place. Filed Dec. 22, 1892.
505,912. Cleat for Holding Insulated Electric Wires. Elisha W. Buffinton, Fall River, Mass., assignor of one-half to Albert F. Dow, same place. Filed June 1, 1893.
505,916. Insulating Compound and Method of Manufacturing the Same. Joseph Hoffman, Schenectady, N. Y., assignor to the General Electric Company of New York. Filed Dec. 2, 1892.
506,002. Insulating Support for Metallic Circuit. Alfred C. Cousens, Boston, assignor, by mesne assignments, to Charles A. Stone, Newton, Mass. Filed May 6, 1893.
506,034. Insulating Joint. Samuel W. Burtchaell, San Francisco, Cal. Filed June 20, 1892.
506,066. Means for Determining the Presence and Intensity of Atmospheric Electricity. Jesse Opperman, St. Louis, Mo. Filed Feb. 15, 1893.
506,092. Electrical Switch. Carl O. C. Billberg, Philadelphia, Pa. Filed July 23, 1892.
506,169. Electric Elevator. Ernest R. Esmond, New York, N. Y. Filed Feb. 21, 1893.

ELECTRICITY.

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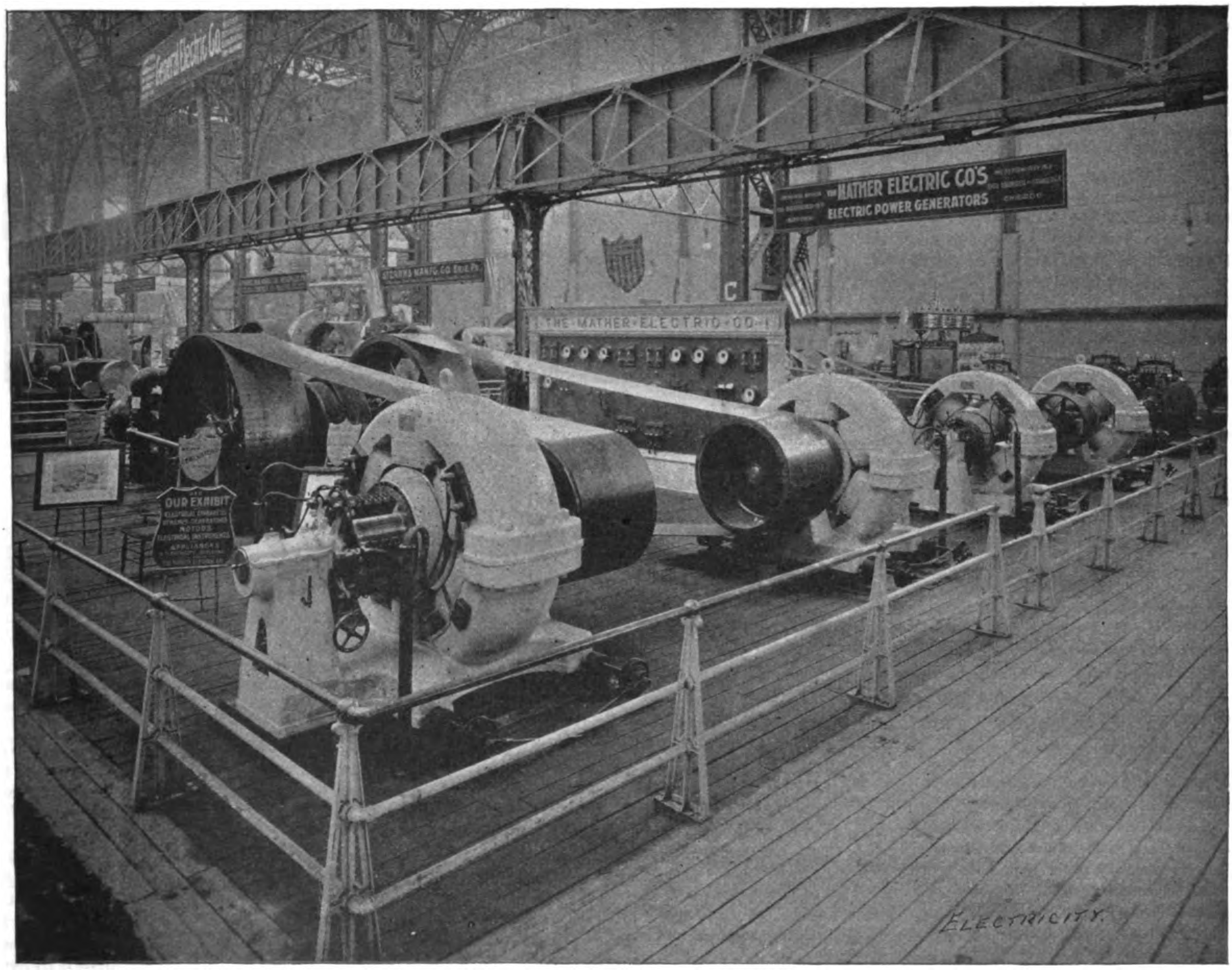

MATHER ELECTRIC COMPANY'S WORLD'S FAIR EXHIBIT. (SEE PAGE 174.)

World's Fair Notes.

The Mather Electric Company's Plant in Machinery Hall, Section C.

This exhibit contains two compound wound electric power generators, capacity of 225 K. W. each, and working at a potential of 550 volts 450 revolutions per minute, and two compound wound electric power generators, capacity of 120 K. W. each, and working at a potential of 550 volts 525 revolutions per minute.

The 225 K. W. generators are 6-pole machines with field magnets and armature supports cast in one piece without joints except between the upper and lower half of the field.

The winding of the armature is such that there are only two paths for the current through the armature, and yet opposite bars of the commutator are connected and so maintained always exactly at the same potential. The commutators are cross connected, so that the opposite bars are maintained always at the same potential, therefore it is possible to use either all the sets of brushes or any two sets, as may be desired.

The generators are mounted on sliding iron bases fitted with four screws, connected together in pairs by means of a chain, and operated by ratchets so that the generator can be kept in perfect alignment and the tension of the belt regulated.

The base frames are firmly bolted down to the foundations, which in this case are made of heavy timber and hard burned brick laid in Portland cement.

The four generators are connected to one set of bus-bars, so that all the machines can be operated in multiple when desired.

The switchboard to which these generators are connected is made of slate slabs set in a steel frame, making the switchboard self-contained.

On it are mounted four rheostats, four triple pole switches through which the generators are connected to the bus-bars, four ammeters which record the quantity of current generated by each machine, one voltmeter which is so connected by means of their voltmeter switch that readings may be taken from either generator or from the bus-bars by moving the switch bar on the respective points, one differential indicator which may be connected by means of their indicator switch to any one of the generators when it is desired to throw one or another of the generators into circuit while one or more are in operation, and this instrument indicates correctly when the machine to be thrown in circuit attains the proper potential.

There are four double pole single throw switches through which the circuits are connected to the bus-bars, four ammeters which show the quantity of current used on each circuit, and the circuits are protected by means of double pole safety cutouts which carry a fusible strip of suitable capacity, and are further protected by means of the automatic adjustable circuit-breakers mounted on separate frames behind the switchboard.

The switchboard is encased in a massive framework of pure Doric style, and finished in white enamel and gold.

The bus-bars and all the connections between the switches and instruments are of the best quality of copper, of ample capacity, symmetrically mounted on the back of the switchboard, all polished and lacquered.

These generators have been supplying the current for operating the motors in the Mines and Mining Building, Agricultural Building, the Movable Sidewalk on the pier, the Mather Electric Company's exhibit plant in the Electricity Building, and other motors.

The generators are all finished in white and gold, the whole plant presenting a handsome and imposing appearance.

These power generators are particularly adapted for street railway work, mining work and factory power plants, their regulation being superior and their efficiency at the highest point.

The Hicks-Troy Door Opener.

The Hicks-Troy door opener, which we illustrate herewith, has turned out to be one of the most novel and interesting exhibits in Electricity Building. Owing to some difficulty in getting the proper machinery, the firm were unable to complete their exhibit for some months after the Fair opened. Since they have completed the arrangement of the doors, the exhibit has been literally besieged by visitors who desire to see "a door opened by electricity." The operation and mechanism are extremely simple. The doors are hung on ordinary hinges with spring attachments which have a tendency to throw the door open. Electricity is brought into play to close and hold the door shut. This is accomplished through the means of a small electric motor which is mounted in the neighborhood of the door. A small cord is attached to an arm extending out from the top of the door, the cord then passing over a pulley on the door frame to the motor, whose function is to wind up the cord after the door has opened. The electrical mechanism is put in operation by a person who desires to pass through the door stepping on a mat which closes the circuit and allows the springs to come into operation. As soon as the mat is relieved of the pressure the current is interrupted, but the swinging of the door has closed a magnetic switch in connection with the motor which operates to wind up the cord and thereby close the door.

THE HICKS-TROY DOOR OPENER.

The invention is credited to Messrs. R. F. Troy and O. H. Hicks, of Chicago, who are showing several of the doors in operation in the southeast gallery of the Electricity Building at the Fair.

The New York Electrical Society.

The 153d meeting of the New York Electrical Society will be held at Columbia College on Tuesday, October 31, at 8 P.M.

Mr. D. McFarlan Moore will lecture on "Electricity in Advertising," and will describe the latest developments in this branch of electrical application.

An Electrical Man in Politics.

Mr. James A. Roberts, of Buffalo, who is widely known in the electrical field, has been nominated on the State ticket for Comptroller. Mr. Roberts, who for some time represented Erie County in the Senate and Assembly, settled in Buffalo some years ago, where he went to take the position of superintendent of a school at that place. He subsequently studied law, in which field he has built up a large practice. He is widely known among electrical men, on account of his numerous connections in this business, being one of the founders of the old Thomson-Houston Company of Buffalo, vice-president of the Buffalo and Belleview Street Railway Company, vice president of the Buffalo and Niagara Falls Electric Light and Power Company, and secretary of the Buffalo General Electric Company. Mr. Roberts is eminently qualified for the office to which he is nominated, and his electrical friends wish him every success in his coming campaign.

DeLand's Synoptical Index.

The excellent index of current electrical literature which has formed a leading feature of *Electrical Engineering* is to be still further extended in its scope and will hereafter be printed on separate sheets, each sheet to be devoted to a single subject.

This arrangement is with a view to filing the index under each general head separately if desired, and judging from the thorough character of Mr. DeLand's index heretofore, the new system promises to furnish the most complete and best arranged synopsis of electrical literature ever published.

The value of Mr. DeLand's work in this direction has been thoroughly recognized from the start, and ELECTRICITY wishes him every success in the prosecution of his new project.

Electricity in addition to its other manifold uses is a sanitary agent. When Professor Tyndall was experimenting with atmospheric dust in his researches on the origin of the lowest forms of life, he found that an electric discharge passed through a dusty atmosphere purified it by causing the minute particles to settle. And long before these researches, it was commonly said and believed that a thunderstorm purified the air. Thus a scientific foundation is found for the popular belief, and the lightning flash takes its place as an accredited sanitary agent.

The Milwaukee Convention.

Twelfth Annual Meeting of the American Street Railway Association.

The twelfth annual meeting of the American Street Railway Association was held in the Assembly Hall of the Milwaukee Industrial Exposition Building, October 18-20.

WEDNESDAY'S PROCEEDINGS.

The president called the meeting to order and introduced Mayor John C. Koch, of Milwaukee, who welcomed the delegates as follows:

"It affords me great pleasure in meeting you to-day in our city and in our Exposition building. I welcome you and extend to you the freedom of the city.

"Gentlemen, you are interested in one of the great forces of modern times, which builds up large cities and gives us the convenience of rapid transit. The street railways are great factors in our progress. They relieve the large cities from being overcrowded and allow the spreading of our population over widely extended territories, thereby giving the people the benefit of fresh air in the suburban neighborhoods, which is of inestimable value to the health and happiness of the population of large cities.

"I hope this meeting will be productive of much good and have a satisfactory result. I hope also that besides the practical part of this meeting, you will enjoy your visit to our city and that friends here will take good care of you. Gentlemen, you are welcome."

President Longstreet responded briefly to the welcome of Mayor Koch, and addressed the convention as follows:

This has been a busy year in the great work of consolidation, reorganization and active progression; the financial cloud which has hung so threateningly for so many months over every industry in our land has had its retarding effect upon our particular industry, but perhaps it has affected our business in a less degree than any other branch of business employing so large a capital.

The hundreds of millions of dollars invested in urban and suburban transportation, will always be a safe investment. If, in our enthusiasm we have sometimes over-discounted the future we have only to wait a little longer period for the dividends which are sure to come.

Financial panics through which we are now passing are of irregular occurrence, yet they are sure to reappear, affecting receipts and making economies of management a subject of deep study.

In my experience, covering a period of nearly thirty years, I have found it better to keep up the quality of service at such times even at the expense of dividends for the time being; the public by a more liberal patronage will eventually more than make up the loss which would follow on the heels of a reduced and debased service; the faithful employee and the roadbed and equipment should be the last to suffer.

Economies should begin in other directions—in the purchase of supplies, in better methods of work and in improved appliances, aiming always for the best service at the least possible cost; and that, gentlemen, is the fundamental principle of the prime reason for our organization; and that is why, in just such times as we are now passing through, we should see if some plan cannot be devised which will increase the usefulness of our Association.

The statistics of our business which a dozen years ago looked so large are dwarfed into absolute insignificance by the figures of to-day, and yet the work has only just begun; very much more progress will be made in the next decade than has been made in the last, and therefore an active struggle to get the best results and to keep thoroughly "up to date" in all the details of construction, equipment and management will be worth more to our interests than can be foretold.

The report of the Executive Committee was read by Secretary Richardson, and showed that, after numerous consolidations among members, the present membership is 200 companies.

The committee congratulated the inventors, manufacturers and all others who contributed to the street railway part of the Columbian Exposition in both the Transportation and Electricity Buildings; and also congratulated the Exposition authorities on their success in having given to the world, and especially to the United States, the greatest Fair the world has ever seen.

The committee paid a fitting tribute to the memory of James W. Hyatt, of Norwalk, Conn., George D. Capen, of St. Louis, and Edward E. Denniston, of Philadelphia, members of the Association, who had died during the year.

After considering at some length the formation of the American Street Railway Industrial Association, the chief feature of which would be a two or three weeks' exhibit annually of street-railway apparatus, the committee decided that it was best to hold the project in abeyance until general business has improved.

The report of the treasurer was read, and showed receipts and expenditures during the year as follows:

Receipts	$8,763.77
Expenses	6,541.48
Balance	$2,222.29

The convention then adjourned until 8 o'clock P. M.

WEDNESDAY EVENING SESSION.

Mr. O. T. Crosby being called upon to give his opinion of the relative conditions of the power required in the generator and the engine, said in part:

The question is in regard to the proper proportion to be established between the rated capacity of dynamos and engines. I have believed for some time that the best practice is that an engine should be at least no greater in capacity than the dynamo to which it is attached. The engine will certainly not do its work as economically if it be run ordinarily at a considerably lower output than the output for which it has been calculated as a normal output. The dynamo does not suffer by any means so badly in thus being brought below its rated work. If, therefore, an engine of 600 H. P. be attached to a dynamo of 500 H. P., the man running the station will ordinarily and very properly limit the load which is thrown on the couple, since they now constitute a couple, below the capacity, as he understands it, of the dynamo rather than of the engine. He will endeavor to keep within safe limits with respect to his dynamo. In thus keeping within safe limits with respect to his dynamo he is keeping too far under the limit with respect to the engine for economical work. The dynamo is not what you should have unless it can be run at its rated load without any injury.

There is another point as between vertical and horizontal engines. I do not think the matter as far as it went this morning was presented just as it should have been. There is no difference in the machines, intrinsically, as to their value. You can make a splendid vertical engine, and you can make a splendid horizontal engine. A vertical engine as compared with a horizontal engine involves a difference in the space occupied; and space represents money investment; and there, in my opinion, is the most of the whole question. There is enough experience in the engineering practice to justify us in feeling that vertical engines and horizontal engines are almost equal in value and driving power.

The location of the station is always an important matter, especially as to the cost of conductors and the question of condensing engines. In the case of a man who is in a city with a river running through it in such shape that he can put his station near it, he will be at once led to the condensing engine.

The next paper read was the report of the Committee on Heating and Lighting of Street Railway Cars, which was received and ordered to be placed on the minutes.

The report of the Committee on Standards was called for, and Mr. O. T. Crosby, chairman of the committee, reported that no written report had been prepared; that the committee regretted not having a report ready, but it was unavoidable. The committee was continued another year.

The president announced the next business to be a report from the Committee on "Can the T Rail be Satisfactorily Used in Paved Streets?" A letter from Mr. C. Densmore Wyman, the committee on this subject, was read, in which he regretted his inability to prepare a report, owing to the demands of other duties. The president then requested a discussion of the subject by the meeting, after which, on motion, the appointment of a Committee on a Standard Rail for Street Railway Use was referred to the Executive Committee.

THURSDAY MORNING SESSION.

The first business was the reading of the paper on "Storage Batteries in Connection with Central Stations for Utilizing Surplus Energy for Lighting or Power."

The paper was read by the secretary.

Mr. Mailloux—I earnestly hope that the members will discuss this paper. As street railway men, you are all interested in getting the full percentage of your production of power. Our experience with storage batteries in this country has been negative, passive and generally unsatisfactory. It is in my opinion largely due to the fact that we have attempted to accomplish too much. Abroad it has been quite the reverse. They have made more substantial batteries, and have taken advantage of the fact that in central stations there is no objection to putting in a large amount of material to make the machinery sufficiently robust and large, even though it may have a much lower capacity for the same weight and cost. I believe that one of the most important things to be done is to get at the efficiencies of the engines under varying conditions. I submit that it is of the highest interest to know whether your engines are consuming 20 pounds of water per horse power hour or 60 pounds; and I do not think the Association could do better work than to take steps to have the fact ascertained, to find out what, for example, on a ten car road is the average consumption with a certain type of engine per horse power hour; and so on with a 20, 30 and 40 car road under the same or other conditions. There is a great difference of opinion to-day as to whether compound engines are adapted to use in central stations for railroad purposes. There is no doubt that they are the best with storage batteries, because you have a constant load, which is the ideal condition in which condensing engines can give their highest efficiency.

On motion, the report was received and ordered to be placed on the minutes.

Mr. Elmer A. Sperry then read a paper on "Traction and Street Railway Trucks" which was received and ordered to be printed.

Mr. O. T. Crosby then introduced Mr. Fritz, of the Bethlehem Iron Works, who was invited to address the meeting.

Mr. Fritz said that he was entirely unprepared to make any remarks; that he did not come to make a speech, but to form the acquaintance of the members; that he was a man of work rather than a talker; and thanking the convention for its courtesy, begged to be excused from making any remarks.

The president appointed the following gentlemen the Nominating Committee to nominate officers and select a place for the next meeting:

Messrs. Lang, of Toledo, O.; Hean, of St. Joseph, Mich.; Baumhoff, of St. Louis, Mo.; Rugg, of Pittsburg, Pa.; Stephenson, of Washington, D. C.; Lusher, of Montreal, Canada; Perrins, Trenton, N. J.

Mr. Payne, of Milwaukee, here announced that the Wisconsin Telephone Company desired to extend to the gentlemen in attendance at the meeting the use of its long distance wires, running to all sections of the country, free of charge, for business or social purposes.

The announcement was greeted with applause.

Mr. Payne also announced that the Bell Telephone Company extended an invitation to the delegates to visit their exhibit at the World's Fair, where they would be pleased to show the appliances and the improved methods of the telephone art. Mr. Payne said he had no doubt it would be a great benefit to all to know more about the intricacies of that very delicate instrument the telephone. The telephone system and the street railway system do not always get on well together, unless they are properly built, and, no doubt, it would be to the mutual advantage of all concerned if they should become better acquainted each with the other.

THURSDAY AFTERNOON SESSION.

The first paper read was "Direct Driven Generators," which was ordered to take the usual course.

The secretary announced that if there were any gentlemen who desired to make a tour of the car stations and power house cf the Milwaukee Street Railway Company on Friday, cars would be placed at their disposal for that purpose.

Mr. Armstrong, of Camden—I would like the convention to hear a short paper on an important subject. I do not want to take up the time of the meeting, but the subject treated in the paper I think will be interesting to the convention. It has been prepared by the electrician of our company, and is on Magnetic Cutouts.

The privilege was accorded to W. E. Barrington, of Camden, to read the paper, which was ordered filed and printed in the minutes.

The secretary announced that the following companies had become members of the Association:

Chicago, Ill.—Calumet Electric Street Railway Company.

Marinette, Wis.—Marinette Electric Light and Railway Company.

New Orleans, La.—New Orleans Traction Company.

Mr. Lang, as chairman of the Nominating Committee, reported that the committee recommended the following officers:

President, Henry C. Payne, Milwaukee, Wis.

1st Vice-President, W.J. Stephenson, Washington, D. C.

2d Vice-President, James R. Chapman, Grand Rapids, Mich.

3d Vice-President, Lewis Perrins, Jr., Trenton, N. J.

Secretary and Treasurer, W. J. Richardson, Brooklyn, N. Y.

Executive Committee: D. F. Longstreet, Denver, Colo.; Thomas H. McLean, Indianapolis, Ind.; Edward Whittaker, St. Louis, Mo.; W. Y. Seper, Ottawa, Canada; E. S. Goodrich, Hartford, Conn.

Mr. Lang—Mr. Burt, who is president of the Atlanta Consolidated Street Railway Company, appeared before the committee and extended an invitation for the Association to meet in Atlanta next year. He left no doubt in the minds of the committee that there was sufficient hotel accommodation, and that there would be ample provision made for the supply men for their exhibits, even if they had to erect a building for that purpose; that they had the reputation of enterprise to meet any such emergency. The committee feels that if the Association decides to go to that city, it will be pleasant and instructive to all. The committee, therefore, recommends Atlanta, Ga., as the next place of meeting.

A motion was then made that Mr. Rugg, of Pittsburg, cast the ballot of the Association for the gentlemen named as the officers for the ensuing year.

Mr. Hurt was appointed teller. The teller announced a unanimous vote for the persons named, and the chairman declared them to be elected.

Mr. McNamara, of Albany, moved that the recommendation of the committee as to holding the next meeting in the City of Atlanta be adopted. Carried.

Mr. Lusher, of Montreal—At the meeting of the committee this afternoon, in arranging for the next place of meeting, I desired to get in edgeways that there was such a place as Montreal. I was ruled out of order, being a member of the Executive Committee. We should be very much pleased if the Association would hold its meeting in our city the year after next. Of course, if you come to us in Montreal you will be coming to foreigners; but we will treat you in a kindly way. We have good hotels—we all like good hotels and what they bring forth—and we think we have many things of interest in our city, and would like to have you come. Please think this matter over during this year, and at the next meeting we hope you will make up your minds to pay us a visit.

Mr. Longstreet then introduced Mr. Payne to the convention, who said:

Mr. President and gentlemen, I thank you for the high honor conferred upon me by this election. I shall endeavor to maintain so far as lies in my power the high standard heretofore prevailing in this Association. I will not take up the time of the convention in trying to make a speech; and again I thank you.

Mr. Burt—Mr. President and gentlemen of the convention, I wish to assure you that I feel great pleasure in the announcement just made that Atlanta has been selected as the place for your next convention. I can assure you of a hearty welcome; and I earnestly hope that each and every gentleman here will be present with us at that time. We would like you to see what we have been doing in the last twenty-five years. We will give you the best we have in our shop.

The president next introduced Mr. Herbert Claude, of Washington, D. C., who explained the operation of the conduit railway system in that city, and was followed by Mr. M. D. Law, who spoke of the construction of this line, which was done under his superintendence.

At the close of these remarks, Mr. Baumhoff moved the following resolution, which was carried:

Resolved, That the Executive Committee be requested to draft a suitable memorial to the various State legislatures and municipalities, asking them on behalf of the American Street Railway Association to enact laws to prohibit the common practice of children jumping on and off moving cars, and that copies of the same be furnished each member company of this Association.

Mr. Lang moved that the convention return its thanks to the Milwaukee Street Railway Company and the various enterprising men in the city who have extended special invitations for their kind and hospitable treatment while this convention has been in session. The motion was carried and the meeting then adjourned.

The Entertainment.

The delegates were royally treated by the citizens of Milwaukee, and will remember the town with pleasure until able to pay another visit. The hotels are good, the Plankinton being especially entitled to praise for its service and courteous treatment of its many guests.

On Wednesday afternoon the entire delegation was taken in special cars over the electric line to the power house, stopping at the immense engine works of the E. P. Allis Company, where a substantial collation was served. This trip also included a close inspection of the Pabst brewery and its product, both of which are beyond criticism.

On Thursday and Friday the ladies were in the hands of the reception committee, and made several excursions about the city.

Thursday evening the banquet at the Pfister was attended by about 300, and was an enjoyable affair.

The J. G. Brill Company, the Railway Equipment Company and others kept open house in their parlors, and altogether there was no lack of cordial entertainment.

The Boston Specialists.

The Boston delegation started from Boston aboard the special cars Salmon River and Indiana on Saturday at 3 P. M. Their route was via Boston and Albany, New York Central and Michigan Central roads, and they arrived in Chicago on Sunday night. Nearly all the gentlemen were accompanied by their wives, daughters or sweethearts, and the party was a merry one, numbering sixty-one passengers. Following is the register:

W. P. Ferguson, E. P. Shaw, R. S. Brown, H. A. Willis, W. W. Sargent, E. E. Foster, A. F. Breed, John Gorman, W. S. Mendell, E. O. Evans, Chas. Odell, Franklin Woodman, H. B. Rogers, C. E. Barnes, H. H. Damon, E. S. Belding, Samuel Winslow, E. S. Goodrich, E. F. Page, E. L. Fairbanks, H. R. Goodenough, G. M. Hoadly, G. R. Reed, C. D. Morse, C. S. Clarke, E. P. Shaw, Jr., James S. Shaw, C. F. Luther, Geo. F. Morse, W. C. Kuntz, Eben Sumner, Bill Nye, Col. J. H. Cunningham, P. F. Sullivan.

List of Street Railway Delegates and Attendants.

Armstrong, E A, Camden, N. J.
Ahearn, T, Ottawa, Can.
Addison, T, General Electric Co.
Andrew, P, The J. G. Brill Co.
Bradley, E A, Waterbury.
Brenner, W H, Montreal.
Baker, N F, Washington, D. C.
Binner, E, Dayton, O.
Bimminger, J, Milwaukee.
Bailey, T P, Kalamazoo.
Belden, D A, Aurora, Ill.
Blum, Isaac, Philadelphia.
Burke, M F, Terre Haute.
Bean, W W, St. Joseph, Mo.
Ballard, W J, Dubuque, Ia.
Blood, J B, General Elec. Co.
Bailey, T P, " "
Bannister, L, Westinghouse Co.
Burrows, T W, Westinghouse Co.
Connette, E G, Nashville.
Charlton, B E, Hamilton, Ont.
Colliander, A, Chicago.
Christopher, J M, Baltimore.
Conovers, C C, Hot Springs, Ark.
Clegg, C B, Dayton, Ohio.
Corwin, D B, " "
Crossman, T E, Brooklyn.
Crowley, H J, Atlanta, Ga.
Clark, W J, General Electric Co.
Clarke, W C, Westinghouse Co.
Cutter, George, Chicago.
Corpening, C M, "
Degen, N E, Manistee, Mich.
Doremus, H M, Bridgeport.
Dunning, R, Buffalo, N. Y.
Dean, W W, Hamilton, Can.
Dixon, A, Port Huron, Mich.
Dorr, C A, Charlotte, N. Y.
Dean, J, Hamilton, Ont.
Davis, N A, Cincinnati.
Everett, H A, Cleveland.
Ellis, C E, Philadelphia.
Evans, Major H C, The Johnson Co.
Fenimore, F, Phœnixville, Pa.
Flynn, C E, Peoria, Ill.
Ferguson, W B, Haverhill, Mass.
Fraser, J D, Ottawa, Can.
Fritz, J, Bridgeport, Conn.
Foster, W H, Pittsburg.
Gettschall, W C, Muncie, Ind.
Goodrich, E S, Hartford, Conn.
Guyer, B H, Moline, Ill.
Gorman, John B, Worcester, Mass.
Griffin, W H, Galveston, Tex.
Adkin, James, St. Louis.
Ashton, Jr., S K, Milwaukee.
Atkinson, J M, Burlington, Iowa.
Arnold, B J, Chicago.
Adams, W, The J. G. Brill Co.
Ackerman, P C, New York.
Baumhoff. G W, St. Louis.
Bickford, J H, Scranton, Pa.
Brown, F W, Youngstown, O.
Burt, T M, Berlin, Ont.
Bartlett, A, Los Angeles, Cal.
Becker, Danforth, Milwaukee
Bowen, M K, Chicago.
Bradford, H P, Cincinnati.
Brown, R S, Gloucester, Mass.
Breed, Amos F, Boston.
Browning, G G, Camden, N.J.
Bemis, P S, Jr., Chicago.
Beach, R H, General Elec. Co.
Baylor, A K, " "
Brown, R S, Westinghouse Co.
Bragg, C A, " "
Brill, J, The J. G. Brill Co.
Bartlett, E E, New York.
Carpenter, R, Mansfield, O.
Candee, J C, Bangor, Me.
Crosby, O T, Wilmington, N. C.
Carr, W F, Roanoke, Va.
Cameron, W S, Jamestown, N. Y.
Crawford, R C, Chicago.
Candee, L, New Haven, Conn.
Clarke, E P, Los Angeles.
Colby, F L, Rockford, Ill.
Collins, C E, General Electric Co.
Corwin, S, The J G Brill Co.
Crane, J O, New York.
Cary, P H, "
Dixon, H A, Port Huron, Mich.
Durnin, T J, Milwaukee.
Delaney, W H, New York.
Durbin, C K, Denver, Col.
Dickson, W D, Great Falls, Mont.
Duncan, E, Dubuque, Iowa.
Downs, E E, Kalamazoo,
Degenhart, Fred, Chicago.
Edwards, F, Lincoln, Neb.
Elliott, Miller, Pittsburg.
Evans, E O, Johnson Co.
Evans, O C, "
Frenyear, T C, Gloversville, N. Y.
Foster, E C, Boston.
Flesh, L M, Piqua, Ohio.
Frederick, C R, Davenport, Iowa.
Fry, J H, Detroit, Mich.
Field, A W, New York.
Glass, A, Washington, D. C.
Goodwin, W W, Detroit.
Greenwood, G F, Pittsburg.
Grover, T F, Milwaukee.
Green, Alfred, Rochester.
Green, Frank B, Chicago.
Greer, J W, San Antonio, Tex.

Goodrich, C E, St. Paul.
Gunn, J, Toronto, Can.
Haynes, G D, Newark, N. J.
Hurt, Joel, Atlanta, Ga.
Holbrook, E M, Cedar Rapids, Iowa.
Howell, T E, Dayton, O.
Hayward, A H, Allentown.
Hoffman, J F, Milwaukee.
Heft, N H, Bridgeport, Conn.
Hager, W S, Wilmington, Del.
Haven, W E, Fishkill, N. Y.
Hayes, Henry, New Britain, Conn.
Hurley, P E, Trenton, N. J.
Heulings, W H, The J G Brill Co.
Hitts, C I, Boston.
Jenkins, T M, Covington, Ky.
Jones, F G, Memphis, Tenn.
Jones, W E, St. Louis.
Kilgour, B L, Cincinnati.
Kelbe, J W, Baltimore, Md.
Kelly, W T, Columbus, O.
Knowles, P L, Phœnixville, Pa.
Kuntz, C, Pittsburg.
Krider, J S, "
Lee, P, Wilmington, Del.
Law, M D, Washington, D. C.
Lusher, L, Montreal, Can.
Littell, H M, New Orleans.
Littell, H H, Buffalo, N. Y.
Lawless, E J, Paterson, N. J.
Littlefield, W S, Johnson Co.
McLean, T H, Indianapolis.
Merse, G C, Taunton, Mass.
Melms, C J, Milwaukee.
McNaughton, A, "
Maslin, G W, Brooklyn.
Minary, J S, St. Louis.
McIntire, L H, Philadelphia.
McCartney, J L, Norfolk, Va.
McClery, J B, Birmingham, Ala.
McKinney, C A, Houston, Texas.
McQuaid, J P, Norristown, Pa.
McGiffert, J S, New Britain, Conn.
Mock, H A, Brooklyn.
Murphy, Michael, Brooklyn.
Martin, Edward, Hamilton, Ont.
McCarty, M, Westinghouse Co.
Marsh, J W, Pittsburg.
Newton, C E, Hartford.
Odell, Chas, Newburyport, Mass.
Partridge, John N, Brooklyn.
Phillips, G A, Milwaukee.
Pidd, Thomas, Milwaukee.
Pratt, Mason D, Steelton, Pa.
Potts, H T, Philadelphia.
Peck, Frank C, Kansas City.
Peckham, Edgar; New York.
Porter, Geo F, New York.
Richardson, William, Brooklyn.
Rusling, T O, Chicago.
Rogers, HB, Brockton, Mass.
Rigg, J A, Reading, Pa.
Radel, Andrew, Newark, N J.
Rice, E W, Jr., General Elec Co.
Randall, F C, The J G Brill Co.
Smith, Walter C, Milwaukee.
Scullin, Harry, St. Louis.
Smith, A P, New Bedford, Mass.
Sullivan, P T, Lowry, Mass.
Stephenson, W J, Washington, D C.
Shaw, E P, New Haven.
Shaw, P F. Newburyport, Mass.
Stedman, J. H, Rochester, N Y.
Stebbins, Theo, General Elec Co.
Sanderson, E V, Westinghouse Co.
Seeley, John A, New York.

Grant, John, Detroit.
Gray, E W, Westinghouse Co.
Haynes, J E, Newark, N. J.
Hilgard, F T, Milwaukee.
Halm, C W, "
Hubbard, F C, "
Hatch, W S, Detroit.
Hendrie, S, "
Henry, D F, Pittsburg.
Hay, A E, Chambersburg, Pa.
Hulsizer, John, Joliet, Ill.
Harrison, Russell B, Terre Haute, Ind.
Hawks, J D, Detroit.
Heinrichs, E H, Westinghouse Co.
Hickson, Harry, Chicago
Ives, E B, Philadelphia.
Jewell, W S, Anderson, Ind.
Johnson, J W, Kalamazoo.
Keithley, H R, Chicago.
Klinkerfus, Milwaukee.
Klau, G W, "
Kelsey, I A, New Haven.
Kingston, W W, Montgomery, Ala.
Knight, W H, Gen'l Elec. Co.
Kemp, — —, Chicago.
Lang, Albion E, Toledo.
Luther, C F, Pawtucket, R. I.
Lynn, A W, Milwaukee.
Leckey, R, Helena, Mont.
Lipper, M W, Philadelphia.
Longstreet, D F, Denver.
Liggett, J C, Detroit.
Lockwood, J E, Detroit.
Louthit, W S, Chicago.
McNamara, J W, Albany.
McLaughlin, Chas, Paterson,
McCloskie, C H, Chicago.
May, J M, Dubuque, Iowa.
Minary, C K, Springfield, Ill.
Macfarlen, L J, Pittsburg.
Marks, Ferdinand, Philadelphia.
Morris, H W, Milwaukee.
McCulloch, Robert, St. Louis.
Markle, A, Hazleton, Pa.
Morton, H T, Ann Arbor.
Mailloux, C O, Washington, D. C.
McCartney, I, Norfolk, Va.
Mendell, C S, New Bedford, Mass.
MacDonald, C F, Ottawa, Can.
W L Mason, Milwaukee.
Myers, L E, Chicago.
Magee, F A, New York.
Mason, W R, Chicago.
Ostrom, J F, Steelton, Pa.
Pierson, C H. St. Louis.
Patterson, W H, Bloomington, Ill.
Penington, T C, Chicago.
Pearine, Jr., Lewis, Trenton, N. J.
Perrin, H P, Trenton, N. J.
Payne, H C., Milwaukee.
Pantaleoni, G, Westinghouse Co.
Patton, E K, Chicago.
Rommell, W B, Pittsburg.
Routzahn, M H, Dayton, O.
Richardson, W J, Brooklyn.
Reed, W P, Salt Lake City.
Rugg, J E. Pittsburg.
Rogers, Lewis H, Cleveland.
Reed, G F, Springfield, Mass.
Rutherford, J A, Westinghouse Co.
Shepardson, A C, Waterbury, Conn.
Smith, Clement, C, LaCrosse.
Sullivan, D W, Brooklyn.
Schloss, S, Detroit.
Sinclair, H B, Galveston, Texas.
Sterling, J R, Detroit.
Stone, A L, Oakland, Cal.
Sperry, E A, Cleveland.
Sargent, W W, Fitchburg, Mass.
Short, Prof. Sidney, Cleveland.
Stearns, C K, General Elec. Co.
Stewart, B F, Westinghouse Co.
Shain, Chas D, Siemens & Halske Co.

Scull, W S, Camden, N J.
Shewmon, Allen, Racine, Wis.
Scheerer, W, Newark, N J.
Sullivan, J J, Philadelphia.
Smith, W C, Pittsburg.
Stern, W A, Philadelphia.
Traggard, J G, Pittsburg.
Ticknor, F A, Rockford, Ill.
Upham, C C, Lincoln, Neb.
Von Babo, Alex, Siemens & Halske Co.
Winsor, Paul, Boston, Mass.
Williams, Chas A, Rochester, N Y,
Woodman, Franklin, Haverhill, Mass.
Wood, H H, Birmingham, Conn.
Wightman, M J, Middletown, N Y.
Whitney, F H, Milwaukee.
Willard, Ben, General Elec Co.
Wyman, C D, New York, N Y.

Swift, C M, Detroit.
Shaw, Jr., E P, Norwich, Conn.
Smith, W H, Omaha, Neb.
Shelmerdine, W H, Philadelphia.
Shaffer, W, Asbury Park, NJ.
Tindolph, E F, Vincennes, Ind.
Thompson, A C, St. Louis.
Valentine, John, Portland, Ore.
Von Voorhis, G H, Chicago.
Williams, Chas H, Manchester, N. H.
Wright, L R, Denver, Col.
Wheeler, Geo F, Dubuque, Ia.
Ward, Elias S, Newark, N.J.
Whitehead, H C, Norfolk, Va.
Woods, Henry F, Boston.
Woodruff, R S, Trenton, N.J.
Wheeler, G K, Kalamazoo.
Wood, C V, Boston.
Wright, A D, Siemens & Halske Co.
Yeales, R H, Chicago.
Young, A M, New Britain, Ct.

Newspaper Men.

T. C. Martin, "Electrical Engineer," New York.
L. W. Collins, "Electrical Engineer," Chicago.
W. Forman Collins, "Western Electrician," Chicago.
——— Kiley. "Western Electrician," Chicago,
M. J. Sullivan, "Electrical World," New York.
H. W. Blake, "Street Railway Journal," New York.
J. H. McGraw, "Street Railway Journal," New York.
——— Pennington, "Electrical Industries," Chicago.
——— Short, "Electrical Industries," Chicago.
F. S. Canfield, "Street Railway Review," Chicago.
W. W. Hess, "The Car," Philadelphia.
B. E. Greene, ELECTRICITY, New York.
C. E. Stump, "Street Railway Gazette," Chicago.
J. W. Dickerson, "Street Railway Gazette," Chicago.
——— Bennett, "Street Railway Gazette," Chicago.

The Exhibitors.

Fulton Foundry Co., Cleveland, O., trucks.
The Curtis Electric Co., Jersey City, N. J.
Ellis Car Co., Amesbury, Mass.
Baltimore Car Wheel Co., Baltimore, Md.
Siemens & Halske Co., Chicago.
Walker-Marshall Automatic Switch Co., Milwaukee, Wis.
Hartford Woven Wire Mattress Co., Hartford, Conn.
Viaduct Mfg. Co., Baltimore, Md.
Sperry Electric Railway Co., Cleveland, O.
H. W. Johns Mfg. Co., New York.
Charles Scott Spring Co., Philadelphia, Pa.
Consolidated Car Heating Co., Albany, N. Y.
W. F. C. Macallen Co., Boston.
W. L. Adams & Co., Chicago.
Hope Electric Appliance Co., Providence, R. I.
Eureka Tempered Copper Co., North East, Pa.
Paige Iron Works, Chicago.
Pawtucket Brass Foundry. Pawtucket, R. I.
Pinkham Car Track Sander Co., Boston.
National Elastic Nut Co., Milwaukee, Wis.
Safety Brake Shoe Co., Boston, Mass.
Taylor Electric Truck Co., Troy, N. Y.
Scanitt Furniture Co., St. Louis, Mo.
National Time Recorder Co.
Jones & Laughlins, Ltd., Pittsburg.
Time Transfer Printer Mfg. Co., Pittsburg, Pa.
International Electric Co., Detroit, Mich.
Link Belt Machinery Co., Chicago.
New Process Rawhide Co., Syracuse, N. Y.
Burrowes Car Shade Co., Portland, Me.
R. D. Nuttall & Co., Pittsburg.
Reliable Mfg. Co., Boston.
The Johnson Co., Johnstown, Pa.
Rochester Car Wheel Works, Rochester, N. Y.
Mica Insulator Co., New York.
J. H. Stedman, Rochester, N. Y.
Prohl & Fiedler, Milwaukee, Wis.
Reliance Gauge Co., Cleveland, O.
Jewell Belting Co., Hartford, Conn.
Adams & Westlake Co., Chicago.
Wadham's Oil & Grease Co., Milwaukee.
Standard Railway Supply Co., Chicago.
R. A. Crawford Mfg. Co., Chicago.
Dorner & Dutton Mfg. Co, Cleveland, O.
Chas. A. Schieren & Co., N. Y.
Taunton Locomotive Mfg. Co., Taunton, Mass.
Stern & Silverman, Philadelphia, Pa.
R. Bliss Mfg. Co., Pawtucket, R. I.
Pittsburg Steel Hollow Ware Co., Pittsburg, Pa.
E. F. De Witt & Co., Lansingburgh, N. Y.
St. Louis Register Co., St. Louis, Mo.
Washburn & Moen Mfg. Co., Worcester, Mass.
Sterling Supply Co., N. Y.
Stanwood Mfg. Co., Chicago.
Standard Oil Co., Milwaukee.
Stever Railway Joint Co., Chicago.
Hale & Kilburn Mfg. Co., Philadelphia.
Baltimore Sand Box Co., Baltimore, Md.
Union Electric Co., N. Y.
Newhaven Car Register Co., New Haven, Conn.
The Sargent Co., Chicago.
United States Projectile Co., Brooklyn, N. Y.
Railway Equipment Co., Chicago.
Cudahy Lubricating Co., Milwaukee, Wis.
Chas. Munson Belting Co., Chicago.
Cutter Electrical & Mfg. Co., Philadelphia.
Robinson Machine Co., Chicago.
American Architectural Iron and Brass Works, Chicago.
Superior Machine Co., Cleveland, O.
Graham Equipment Co., Boston.
Laffin Brake Shoe Co., Chicago.
P. Wall Mfg. Supply Co., Allegheny City, Pa.
Wm. Wharton, Jr., & Co., Philadelphia.
Falls Rivet and Machine Co., Cuyahoga Falls, O.
L. Katzenstein & Co., N. Y.
Miamisburg Electric Co., Miamisburg, O.
Claflin & Kimball, Boston.
Davis Car Shade Co., Portland, Me.
Keller Printing Co., N. Y.
W. R. Pitt Composite Iron Works, N. Y.
J. G. Brill Co., Philadelphia.
Lewis & Fowler, Brooklyn, N. Y.
Pennsylvania Steel Co., Shelton, Pa.
S. S. Smith, Spokane, Wash.
Harrison & Cary, N. Y.
Peckham Motor Truck and Wheel Co., N. Y.
Mosher Arc Lamp Co., Chicago.
Standard Underground Cable Co., Pittsburg.
National Conduit Co., N. Y.
American Electrical Works, Providence, R. I.
A. Groetzinger & Sons, Allegheny, Pa.
American Electric Heating Co., N. Y.
George Cutter, Chicago.

Convention Notes.

The Mica Insulator Company made a handsome display of their new material, including sections of conduit which they will soon place on the market.

Mr. C. I. Hitts was kept busy shaking hands with his friends of the Novak lamp.

Mr. J. A. Sheriff, of the Mosher Electric Company, had ten Mosher arc lamps running from the trolley circuit just outside the hall, creating a great deal of favorable comment.

The Peckham Truck Exhibit was well patronized, but needed little explanation as all leading roads have them in actual service.

The Westinghouse Electric and Manufacturing Company were conspicuous at the Pfister, and the Westinghouse cars carried most of the delegates between the hotels and convention hall.

The Washburn & Moen Manufacturing Company made a good exhibit of their hard drawn copper wire and other specialties.

Mr. John R. Coffman was active in distributing fac similes of the medal which the Eureka Tempered Copper Company was awarded at the Fair.

The Curtis Electric Company of Jersey City showed one of their motors in operation, mounted on a Brill truck.

The Siemens & Halske Company's 750 H. P. generator coupled direct to a Buckeye engine was a splendid advertisement for both engine and generator.

Major Harry Evans was, as usual, one of the happiest men at the meeting, fully satisfied with the sales of Johnson rails.

The J. G. Brill Company had the most elaborate display of cars, sweepers, etc., including a double decker, in service.

Courses at the Young Men's Institute.

The evening educational classes of the Young Men's Institute, No. 222 Bowery, have a larger enrolment than in any previous year in the history of that institution. Over forty are taking the course in steam engineering, thirty-five in the class in electricity and forty in bookkeeping; altogether three hundred young men, who are working in the daytime, devote their evenings to these studies. Special attention is given to technical subjects and the membership is largely made up of young mechanics.

ELECTRICITY.

The Popular Electrical Journal.

GEORGE R. METCALFE, - - - - EDITOR.
R. H. WILLOUGHBY, - - ASSOCIATE EDITOR.

B. E. GREENE, Publisher.

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NOTICE.—Hereafter cuts will be admitted to the first page of "Electricity," not to exceed one square inch in size.

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The Street Railway Convention.

We present in this issue a report of the Convention of the American Street Railway Association held last week at Milwaukee, and a glance at the list of papers read at these meetings is enough to show the important part which electricity now holds in the street railway industry. It will be noticed that almost every paper read deals with some subject connected with electric railways, and the majority of the papers deal exclusively with electrical subjects. While the prominence of the topic is largely due to the wonderfully rapid introduction of electric railways during the past few years, a still greater reason for the discussion of this subject is that the engineering practice in this branch of street railway work embraces a large field, and includes a number of open questions which remain to be settled. In the cable and horse systems the engineering problems are comparatively simple, and have been pretty closely worked out.

Almost every item entering into the equipment of an electric railway can be profitably studied with a view to reducing the expenses of equipment or increasing the efficiency of the plant. From the boiler plant to the smallest detail of line or car equipment each successive step admits of numerous modifications according to the environments of each special case, and no railway manager can afford to neglect the smallest item which will reduce the car-mile cost of operation on his road.

For these reasons the papers read at each successive convention of the American Street Railway Association have gradually assumed a more technical character, and a number of those read at the present convention deal in a very practical manner with some of the most important subjects which come before the electrical engineer for solution.

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An Unfortunate Precedent Established.

The action of the council of the American Institute of Electrical Engineers in ordering a paper read before another society to be printed in the Transactions of the Institute was severely criticised at the last meeting of that body, and although the decision of the council appears to be final on such questions, the opposition expressed in this case at the general meeting was sufficiently emphatic to show that the introduction of irrelevant matter into the printed Transactions of the Institute for the accommodation of a single member is far from being generally approved.

Although this subject was pretty thoroughly threshed over at the last meeting of the Institute, and is well known to those present at that time, it may not be amiss to briefly present the facts of the case, as those in attendance formed but a small proportion of the total membership.

During the week of the annual meeting of the Institute early last summer an invitation was extended by the New York Electrical Society to attend one of its regular meetings at which the paper under discussion was read, its title being "A Brief Glance at Electricity in Medicine." Dr. W. J. Morton, of this city, was the author, and it must be understood that no objection can be raised as to the merits of the paper, which bears evidence of very thorough technical knowledge and research in this branch of medicine.

It appears that this paper had been prepared at the request of a member of the council of the Institute to be read before that body, and a promise had been given by that member to have the article printed in the Transactions, though with what authority does not appear. The paper, however, was read at a regular meeting of another society, as every printed announcement of it shows, and for that reason has no connection with the proceedings of the American Institute of Electrical Engineers, and has no right to appear in its Transactions.

In order to fulfil the unauthorized promise of one of its members, the council of the Institute ordered this same paper to be read by title at a regular meeting of the Institute nearly six months after its delivery before another society, and to be printed in the Transactions.

This arbitrary proceeding on the part of the council can only be explained by its desire to relieve one of its members from the embarrassment in which his unauthorized assumption had placed him; and it is to be regretted that sufficient influence was brought to bear in his behalf so that, in spite of all precedent, as well as propriety, the Institute is obliged to appropriate the paper of another society and bear the expense of printing it in its Transactions.

It is certainly an unhealthy condition in any organization when a single member or a small clique is able to commit it to such an unprecedented action, and it is to be hoped that the dissatisfaction expressed in this instance will deter the council from committing any further irregularities during the remainder of its term.

The Institute can justly feel proud of its printed Transactions, and it should be the aim of every member to maintain them at the highest standard, but according to the precedent just established there is nothing to prevent the publication in them of any other society's papers at the pleasure of some member who possesses the necessary influence.

......o......

A Common Sense View.

It is certainly refreshing to find a New York newspaper sufficiently unprejudiced on the subject of trolley railways to apply an ordinary amount of common sense to the discussion of rapid transit, and in this respect the New York *Independent* is to be congratulated.

In an article recently published in that paper, headed "Rapid Transit in Cities," the writer has omitted the usual death-dealing, murderous and deadly epithets which are generally applied to the trolley, and has substituted a commendable amount of logic in place of the usual invective.

The conclusions drawn in the article are of considerable interest and should carry weight, as the writer proves his judgment to be unbiased in either direction by finding the trolley to be neither an unmixed blessing nor an unmitigated curse.

Speaking of the experience of Brooklyn, it states that within a short time most of the surface roads of that city have changed from horse power to trolley. The promoters of the change calculated on an increase of 25 per cent. in the number of passengers, but the trolley cars have actually carried more than double the number of two years ago. It is also beyond question that the speed with which the trolley cars now move from the business centre of Brooklyn to the outlying sections of the city, together with the better cars used, is favored by the traveling public, as shown by the great increase in the number of passengers carried.

But the new system brings in its own problems, and nowhere more seriously than in Brooklyn. Fulton street, the main thoroughfare, winds through the city, taking its course from the old cowpaths. Out from it radiate the other avenues, and the consequence is that the main street in its lower part is choked with traffic. Since the advent of the trolley things have become worse, until it is now dangerous even for an adult to cross the street, while children are killed nearly every day. We are thus brought squarely to consider these two opposing conditions, and whether we like the trolley or not it seems quite reasonable to assume that the surface cars in our cities will generally move faster than did the old horse cars. The great gain to the majority of the people from more rapid transit is certain in the end to overcome the disadvantage to the few. Many have a great dislike to the trolley, and its poles are indeed often most unsightly; but the *real complaint* is against the increased rapidity. Yet there seems no hope of returning to slow speed, even if some other form of propulsion less ugly than through the overhead wire be discovered.

This, we believe, constitutes the true explanation of the opposition with which the introduction of trolley roads is often met. The kind of motive power adopted makes very little difference to the public, and accidents due to the electric currents of railways are at most very rare, and with the best construction may be entirely avoided. The real opposition to the trolley lies in the increased speed of these cars over the old horse cars, and on the other hand this greater speed is just the condition demanded by the traveling public.

As the trolley system has been the first to comply with the demand for higher speed it has had to bear the onus which this condition imposed, but when the prejudice on this subject gives way to reason, it will be admitted that this motive power has been held responsible for what the speed, which the public demands, is alone to blame.

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The electrical trade is well represented in the political campaign just opening. Mr. James A. Roberts, of Buffalo, being a nominee on the State ticket for Comptroller, and Mr. Charles A. Schieren, of Brooklyn, a nominee for Mayor of that city. Both of these gentlemen have the best wishes of their electrical friends, and are sure to carry the solid electrical vote.

A Doubtful Retrenchment.

To the Editor of Electricity.

Since my last letter, September 15th, I am informed that Mr. Sunny has inaugurated a nondescript departure in the management of the Chicago office of the General Electric Company, which as a "dust thrower" may be a temporary success, but as a "dividend earner" is as dismal a failure as his previous schemes. His first move in the game has been the consolidation of the seven divisions of his sales department (referred to in my former letter) into five departments—a wonderful stroke of economy!—retaining his previous seven managers by hiding two of them as assistant managers, and still using the pruning knife among his poorly paid employees. He thus persists in carrying out his deceptive policy of retrenchment and reform under a new garb, concealing, as he vainly imagines, his true motives, as the ostrich thinks he hides his body in concealing only his head. Every one familiar with the present business of the General Electric Company in the Western district knows full well that there is no department which requires the services of an assistant manager; but his particular cronies must be cared for—perhaps it is necessary to "close their mouths" in this way, that the true inwardness of his business methods may be for a time concealed from the blinded stockholders. His second move in the game is in a reduction of five per cent. upon the monthly salaries of employees receiving $100 and under, and a reduction of fifteen per cent. on monthly salaries of over $100. We have not heard whether Mr. Sunny has made a proportionate reduction in his own salary and that of his department managers—judging from his previous policy of beginning at the wrong end, hardly yet, if ever. A great many people in this city like yourself have questioned whether the withdrawal of the Fort Wayne Company from the Electric Trust is bona fide. From appearances its connection with the Trust was not bona fide. The policy of the Fort Wayne Company has been entirely independent of the Trust and dictated by Mr. McDonald, although ostensibly given out as if a part of it. The Thomson-Houston, Edison, Brush and Excelsior Companies have, however, been under the control of the chief officials of the Trust, the interests of the Trust being used to further those of the Fort Wayne Company, where possible, to the exclusion of all those other companies composing it; especially does this seem to be the case with the Chicago office. We have learned from those who have been in a position to know, that in the sale of plants where the agents of the Thomson-Houston and Fort Wayne Companies were in competition, those of the Thomson-Houston Company were not allowed to cut figures (although there was plenty of margin to do so) to meet those of the Fort Wayne Company, but ordered to assist the agents of the Fort Wayne Company in securing the contract, while when in competition with the apparatus of the Edison, Brush and Excelsior Companies (members of the Trust), liberty was given to meet the figures of these companies. Some have considered this action of the "powers that be" in the Chicago office to signify that Mr. Sunny, as well as Mr. Coffin, are so interested with Mr. McDonald in the Fort Wayne Company that they receive greater benefits to themselves from the sale of the apparatus of that company, not having the same interests in the apparatus of the other companies composing the Trust. I must say that all appearances lead to such a conclusion, and I would not in the least be surprised to hear, upon the retirement of Mr. Coffin from the General Electric Company, of the formation of a company by Messrs. McDonald, Coffin and Sunny, under the title of the Western General Electric Company, as rumor has it, if they have not already done so.

If by these letters I can, through Electricity, open the eyes of the Eastern stockholders to the strange management of this district as one of the causes for the depreciation of their stock, and thus remedy the evil, if possible, I will have fulfilled the purposes I have in view.

Stockholder.

Chicago, Oct. 12, 1893.

Mr. R. T. McDonald Arrested.

A Charge of Forgery Made.

Warrants for the arrest of Mr. R.T. McDonald, of the Fort Wayne Electric Company, together with several other directors of the Madison Square Bank of New York, were issued on Monday on the information of the receivers, who charge gross irregularities in the management of the bank's business.

It is alleged that Mr. McDonald subscribed for $100,000 of the stock, for which he was to pay $150,000 in cash, and it was sworn that he had so paid. He became a director on the strength of that subscription and supposed payment. Then, it appears, he borrowed the entire money from the bank with which to make the payment, and the directors passed a loan, some of them at least knowing the purpose for which it was made. McDonald and Uhlmann, another of the directors, practically ran the bank for over a week prior to its failure, and they must have known of its rotten condition all this time. A few days before the failure McDonald, who, with Uhlmann, was managing the bank, under a written authority from Blaut, whom they sent away, directed the cashier to take his notes of $150,000 and indorse on the back of them that they were not negotiable, thereby changing the entire character of the security.

Legal Notes.

In a suit brought in the Mercer County (N. J.) Court for damages for injuries received from being struck by an electric street car, Judge Abbett, before whom the case was argued, held that it was the duty of the plaintiff (Mrs. Cecilia Connelly) to look the instant before she stepped on the track, and in failing to do this she was guilty of contributory negligence and could not recover. An exception was allowed and the case will be taken to the Supreme Court.

On the recommendation of Master in Chancery Noyes, Judge Ewing has appointed C. S. Burton receiver for the Cicero Light, Heat and Power Company. The company was organized in 1891 and owns valuable plants, franchises and contracts, and supplies Cicero, Oak Park and other suburban towns near Chicago with light.

Judgment for $12,419 has been entered in New York against the Brush-Swan Electric Light Company of New England, of which Colonel William L. Strong has been president, in favor of William R. Montgomery, for legal services performed in an equity suit in the United States Circuit Court in which the above company was complainant and the Brush Electric Company defendant. The legal work was performed by Evarts, Choate & Beaman and William G. Wilson, who assigned the claim to Mr. Montgomery.

In the United States Circuit Court, New York, on Thursday last, Judge Lacombe appointed Henry C. Adams ancillary receiver for the Newtown Electric Company of Newtown, Long Island, to take charge of the company's affairs in the home district. Receivers for the firm were appointed by Chancellor McGill of New Jersey on October 16.

Some Measurements of the Temperature Variation in the Electrical Resistance of a Sample of Copper.—II.

BY A. E. KENNELLY AND REGINALD A. FESSENDEN.*

DESCRIPTION OF TESTS.

Within the cylindrical glass tube of an air thermometer was enclosed about 240 cms. of fine copper wire. Short platinum wires sealed into the glass bulb brought this copper wire into communication with apparatus for measuring its resistance. The bulb rested in an oil bath heated electrically, and the height of a mercury column required to balance the pressure of the internal air was measured by cathetometer at the moment that the resistance of the copper wire was noted. The bulb was thus operated as an air-thermometer at constant volume, and corrections were applied to the expansion of the glass walls of the bulb, and for the variation of barometric pressure during the period of observations, also electrically for the resistance of the leads up to and including the platinum seals.

A vertical section of the thermometer bulb and its accessories is shown to one-third true scale in Fig. 1. The capacity of the chamber was approximately 75 c. c. Three separate platinum wires were sealed in at D, and welded with three exterior copper wires, E, F and G, forming the leads to the apparatus. The central was also welded within the bulb to a copper wire, and the seal supported this wire axially along the bulb to its termination at H.

This copper wire DH was entirely covered by a glass tube, closely threaded on which were beads or short cylinders cut from glass tubing. The beads served as sleeves or washers to clamp between them at their junctions circular disks of mica, with a hole in the centre. Two circles of holes were drilled concentrically around this disk, each circle having fifteen holes. A plan view of a mica disk is shown in Fig. 2 to full scale.

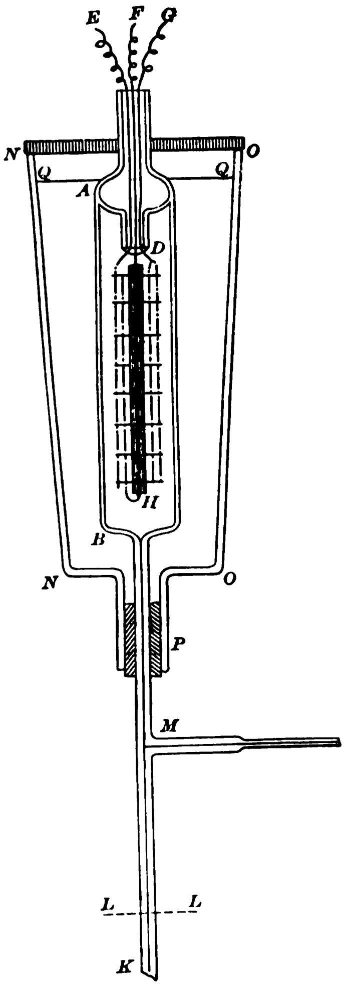

Fig. 1.

The copper wire tested was of good commercial quality and double silk covered. The silken covering was dissolved off with hot caustic soda, diluted so as not to oxidize the wire, and the bare wire threaded up and down through the mica disk and parallel to the axis of the bulb, first filling up the inner cylinder of holes and then the outer. The inside end was soldered to platinum wire No. 1, connected with the lead E, the final exterior, and soldered to platinum wire No. 2, from lead G, and the junction or midway point connecting the inner and outer cylinders was connected to the copper wire at H, which communicated with lead F. By this means two separate loops of wire of nearly equal length were provided within the bulb, arranged in two cylinders, one within the other. The object of this arrangement was to furnish a check by duplicate, upon the observed resistance of the tested wire, and so to ascertain what difference in temperature, if any, existed between the air at radius 0.5 cm. and the air at radius 0.8 from the axis of the bulb, the source of heat being entirely external. Had the mean temperature of the inner and outer cylinders differed at any time in virtue of gradient of temperature within the bulb, by one-tenth of one degree centigrade, it would have been within the range of observation, and had it amounted to one-fifth of a degree it could not have escaped detection. No appreciable difference was at any time discovered, the increase of resistance in the two cylinders being always proportionally coincident, so that finally the two loops were combined into one for facility in observing, and only divided for an occasional check. The diffusion and convection of the air within the bulb must have been sufficiently rapid to practically equalize the temperature within the air space. The course of the wire within the bulb is indicated by the dotted lines in Fig. 1.

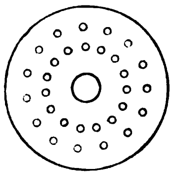

Fig. 2.

The bulb communicated with the mercury through a glass tube DK, round which a hair, secured 15.2 cms. below the bulb at L L, formed the fiducial mark.

The bulb was held vertically upon the axis of a glass percolator N N O O, the lower tube passing through a rubber stopper at P. The space between the bulb and walls of the percolator was filled with boiled linseed oil up to the level Q Q, and a cylindrical grid of platinoid wire, not shown in the figure, was immersed in the oil. A steady current of from two to three amperes through this platinoid wire of 16 ohms resistance served to raise the temperature of the oil and immersed bulb at a convenient rate. A disk of asbestos cloth, N O, rested as a cover upon the percolator, and more of the same material was wrapped around the exterior surface N N O O, in order to impede the escape of heat from the chamber.

The resistance of each cylindrical loop of wire within the bulb was about 10 ohms at the normal or initial temperature, in the vicinity of 20 C., making twenty ohms in all, and at the highest temperature reached in the measurements these resistances doubled, so that the total range of observed change in resistance amounted to 10 ohms in each loop or 20 when the loops were in series.

In the first trial, the resistances were measured by Wheatstone's bridge. This method was found to be unsatisfactory both in respect to swiftness and precision.

Later, two differential galvanometers were employed. One balanced the two loops within the bulb against each other to detect variations of temperature within the bulb, and the other compared the resistance of both loops in series against a fixed standard in platinoid wire (30 ohms).

Finally, the first galvanometer fell into disuse, since no variation could be detected between the resistances of the two loops, and measurements were confined to the second differential galvanometer, with one Wheatstone bridge reading as a check at the outset and another at the culminating temperature of the series.

The differential galvanometer method is very convenient for such measurement. It enables the variations of the tested resistance to be constantly watched and balance can be quickly readjusted with a dead-beat instrument by rheostat thrown into the circuit of preponderating influence.

The main circuit consisted of the bulb with its two loops in series, a standard resistance of 30 ohms in platinoid, and an additional resistance of 50 ohms in a rheostat. A single Edison-Lalande cell delivered a steady current of from 6 to 7 milliamperes through this circuit. The two coils of the differential galvanometer had about 2,700 ohms each; one was connected to the terminals of the standard 30 ohms, and the other to the terminals of the bulb. A change of resistance in circuit of either coil amounting to 1 ohm could be plainly observed on the scale.

The first four series of observations were rejected. When computed and plotted, with ordinates of resistance to abscissas of temperature, they showed curves bending slightly upwards, after the manner of Matthiessen's, but the descending curve was distinctly below the ascending branch, so that the diagram appeared to form a loop as though the wire had a lower resistance for a given temperature when cooling than when heating. The cause of this error is not known, but may have been due to fluid friction of the mercury in the bulb tube.

The sixth series appeared to be most reliable. Its graph is practically a straight line up to the maximum temperature of 255 C. with no appreciable deviation between the ascending and descending branches, the latter being carried in this instance no lower than 207° C.

(*Concluded.*)

American Institute of Electrical Engineers.

At the regular monthly meeting of council, held October 18, the following associate members were elected: Merton H. Bentley, Richard Fleming, J. A. McCrossan, Loyall Allen Osborne, Russell Robb, Henry H. Sykes.

At the 80th meeting of the Institute in the evening, the paper announced by Dr. Frederick Bedell on "Hedgehog Transformer and Condensers," and that of Ralph W. Pope on "Monthly Meetings of the Institute," were read by the authors.

The following resolutions were subsequently passed:

Whereas, Requests and suggestions have been received from members in various parts of the country looking to the holding of local meetings for the reading and discussion of papers, and

Whereas, It is the sense of this meeting that any measures proposed with the view of increasing the usefulness of the Institute to its distant members should have earnest consideration and careful action; it is hereby

Resolved, That the president be requested to appoint from the council a committee to consider the subject of local meetings; such committee to be supplied with copies of all correspondence and papers on the subject in the files of the secretary and that the council report as early as possible to a monthly meeting of the Institute: first, upon the expediency of local meetings, and second, if they deem such meetings expedient, to recommend a suitable plan for the organization of local meetings and for their proper relation to the general body.

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* Read at the International Electrical Congress, Chicago.

Report of Committee on "Direct-Driven Generators."*

TO THE AMERICAN STREET RAILWAY ASSOCIATION.

Gentlemen : Back in the early eighties the different manufacturers in Europe, including Brush, Siemens & Halske and others, commenced the building of direct-driven generators of small capacities connected to different types of engines, operating at a high rotative speed. Among these were a large number of Brush machines connected to Westinghouse engines. About the first apparatus for use in central power stations were those designed and built by Mr. Edison for the old Pearl Street Station in New York City. These machines were about 300 horse power capacity, directly connected to an Armington-Sims automatic, single cylinder engine, operating at about 250 revolutions. This apparatus is still in use at the present day, except a few of them which were destroyed in a fire in the station several years ago. One of these units is shown in the exhibit of the General Electric Company at the World's Fair. There is also a large power station operating in Milan, Italy, with the same type of apparatus. Although it is now nearly ten years since these particular units were built, it is only within the last two years that we have commenced their their introduction to any general extent on large power station work. Although these units operated in general in a satisfactory manner, the type of generator and engine was not perfected generally to give the best of service, and therefore electric manufacturers abandoned their development after these first ones and returned to belt-driven generators, and they continued to be the standard type of power station generators until two years ago.

In Europe, though, we have a different history of the matter. The development of their electric apparatus has been slower, and they have therefore had more time to work up special designs and perfect different types of generators. The general commercial requirements were not so rushing, and when American manufacturers commenced to develop to a large extent direct-driven generators, they found their co workers in this line in Europe so far ahead of them in that they had several years ago a number of large stations in Berlin, Paris, London and other parts of Europe operating with units up to a thousand horse power, directly connected to different types of engines, principally vertical ones. The writer remembers in 1887 and 1888, when he was connected with one of the electric manufacturing companies, the difficulty he had to get the shops to build the first small direct-connected generator for naval service. This really commenced the development of this type of apparatus with American manufacturers, and the old Edison, Thomson-Houston and Westinghouse Companies commenced building them in small units. All of the foregoing generators, although for different types of central station and power work, were not any of them used on electric railroad work. Commencing in 1890 the Thomson-Houston, Edison, Westinghouse, and later the Siemens-Halske Company of America, commenced designing and building railway generators for direct connected work, and during the past year there has been quite a number of new stations operated and building which are equipped entirely with direct connected generators, running in size all the way from 100 K. W. to 1,500 K. W.

The type of generator being built and furnished to-day for direct connected work is far superior in every respect—almost beyond the question of comparison—to the early and antiquated small generators which many of our friends are using and struggling along with to the tune of the popping of the safety fuses and circuit breakers, the whirl of the revolving grease-besmeared belts, and the squeak of the friction clutch pulley. The direct-driven generators built by the different manufacturers in a large measure are of the same general construction so far as general details go, differing in minor points only.

TYPE OF ENGINE TO USE.

The type of engine to use in connection with the operation of direct driven generators is one of the serious factors to consider in this connection.

There are many points to be considered of economy, reliability, continuous service, good regulation, ability to stand the direct and severe shocks due to overloading generators, short circuits, economy in floor space, etc.

On the question of whether vertical or horizontal is better adapted, common sense seems to indicate that as we are laying out a compact plant in every respect, a vertical engine is best adapted for this work. The question of regulation is a very serious one. The engine is undoubtedly called upon to stand a test which no belted machine has had to do on account of being directly connected to the generator, and some one of the different types of shaft governors in use on some of the standard machines seems to be best adapted thereto, and will govern within a range for this work of say two or three per cent.

On the question of economy so-called high speed engines are in a measure out of date on this kind of work, as generators are reaching a size beyond the capacity of our old friend, the single valve automatic engine. This engine seems to have reached its limit in economy at about 200 to 300 horse power, that is, where controlled by a single valve. We are confined, then, to one or two types of engine. The old standard of general commercial practice, the Corliss engine, which, on account of our large experience with it, has been called upon more largely for service on this kind of work than any other, in general is meeting these requirements in most respects. There seems, though, to be some question of reasonable doubt as to whether it will regulate sufficiently close to meet the more exacting requirements of this class of work where called upon to control very wide and sudden changes of load. On the question of economy they have shown in the past the highest economy obtainable, but that has been more especially on steady loads near their rated capacity. With loads which fluctuate as railroad work does, they cannot reach nearly their guaranteed economy. We also have the disadvantage of the controlling valve when cutting off over half stroke. In Europe, where their practice on direct connected work has extended over a much longer period than ours, they are using largely various modifications of the vertical marine type of engine, controlled by different types of governors. An engine of this class, well and substantially built, with double valves on the steam and exhaust, and controlled by shaft governor controlling the valve up to the three-quarters cut-off, would seem to combine many points of superiority of an engine on this class of work, and give service in reliability, economy and durability superior to any other type obtainable. Manufacturers and designers in this country are now rapidly developing this type of engine, which is being built by such manufacturers as the Lake Erie Engineering Works, Dickson Manufacturing Company, McIntosh & Seymour, Porter-Allen and others.

RELATIVE ADVANTAGES, COST AND ECONOMY.

The electric railroad manager says: This matter is very interesting, but where do I come out on the cost and as to economy? I will try to give him a few practical points in this regard. In general, the generators are being sold to-day for about 20 per cent. above the cost of belt driven machines of the same capacity. As we reach the larger units which are now being built, this difference will be considerably reduced. Allowing, though, for this difference in cost of the generator, we find, after carefully reviewing several cases in the writer's experience and that of others, that the cost of the power station complete, exclusive of real estate, but including the same electric plant and building, is not more on a direct driven plant than the older type of belted apparatus. This should settle the question beyond doubt, especially where new stations are being built. I feel that I cannot impress upon you too strongly the fact that many of the railroads are going to find it to their advantage to scrap and sell at the best advantage they can their present apparatus, and build a new and modern station. The economy gain will be a large one in every respect; more reliable service; satisfaction to the public; reliance in the operation of their car service, which they have never been able to realize with their old type of small belted generators; and a reduction in station force, which will be appreciated by every dividend loving stockholder. I have tried to obtain the best and most reliable data on this question of relative economy. Most of the railroad stations of the direct connected class have only been in operation a short time. We have a number of central power stations though, where questions of relative economy show up on a similar basis, where we have been able to obtain more reliable data. When we look around and see the present stations operating with all types of engines, connected to various sizes of generators and giving a result in economy on the horse power output of all the way from four pounds on the most reliable to eight and nine pounds of coal on the medium ones, we see that there is indeed room for improvement. We have beyond question doubled this economy through a better, larger and more economical type of engines, operated under better and more favorable conditions; also more economical, direct connected generators, saving in loss of belting, shafting, friction, etc.; also of a combined, direct and positive saving, bearing all the way from 10 per cent. to 50 per cent. These figures are not theory, but are results obtained from actual practice, as is shown by data in the hands of the writer. As to whether it is going to pay to overhaul your plant as herein proposed, I will give one specific instance of the careful review of the case of a power plant of about 5,000 horse power. The company has become convinced that they could build a new power plant and scrap their present apparatus, increase their fixed charges thereby $15,000 a year, and still have a net gain over their increased charges of $25,000 per annum, and in addition to this a far more reliable and better operating plant and increased capacity. I could continue enumerating examples of this kind, but believe if you give the matter careful consideration, you will be fully convinced on the subject yourself.

SUMMARY.

I feel that if any railroad man, either from a practical or business standpoint, after carefully considering the matter, looks around and sees the relative advantages of these plants, he will beyond question become an advocate of direct connection, and his only wonder will be that he could be satisfied with any other type. When we realize that electric railway work has all been developed from a practical commercial standpoint in the past five or six years, it is almost beyond comprehension to realize the progress that has been made in the development of all the different types of apparatus, and more especially in the generator, for if we look back at the 30 or 50

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* Abstract.

K.W. machine which was used in the early stages, and at the 80 K. W. which was the standard about three years ago, and then consider the 1,000 and 1,500 K. W. generators, we can but feel that we are in an age of rare development and progress almost beyond our comprehension. I feel that we have now reached what may be termed a point of standard commercial perfection on generators for power service of all descriptions, and that the next ten years will see very little change other than the perfection of minor details thereon, and instead of having a station operating from twenty to forty varying types and kinds of small generators, we will have a compact and modern plant of a few large units.

Trusting this report will lead to further consideration of the matter by all interested, it is

Respectfully submitted.

C. J. FIELD, *Committee.*

Current Items.

The Electro-Pneumatic Automatic Block System now being introduced on the Pennsylvania Railroad is working with perfect satisfaction, and is said to be a great success. The principle of the system is that signals are thrown to the danger position automatically by a train entering the block which the signal controls, and are returned automatically to the position, indicating that the track is clear as soon as the train leaves the block. When there is any failure in the operation of the automatic apparatus, the home signal inevitably assumes, through the action of gravity, the danger position. The new system is more expensive than the old one, the cost of installation being greater, although the cost of maintenance is less. A good deal of the danger through human fallibility is eliminated. A broken rail, which a towerman would never know anything about, is instantly reported by the signal, as is any other obstruction or interruption.

A plan for the distribution of electric power over a good portion of England is proposed by A. B. H. Thwaite. His idea is to burn the fuel at the mines, where it costs but little, and then transmit the power resulting from the combustion of the coal and gas by high pressure alternating currents of electricity. He proposes to use gas engines of not more than 500 horse power to generate the electricity. From one station he would supply the centres of industry of Lancashire and the area adjoining the ship canal; from a second those of Yorkshire; from a third those of Midlands and London.

A writer in the Pittsburg *Dispatch* describes a device which has been brought out to control the electric currents employed for lighting purposes. The arrangement is somewhat complicated, but its working is as follows: When the specified number of lamps have been lighted, they require an amount of current just sufficient to keep the circuit closed. But if an additional lamp be lighted, the excess of current passing through the mechanism of the tell-tale device magnetizes an electro-magnet strongly enough to attract an armature. The movement of this armature causes a wheel to revolve, and the revolution of the wheel breaks the circuit momentarily and turns the additional lamp off. This restores the normal supply of current, and the proper number of lamps continue to burn steadily. The clock motor employed in this apparatus runs a fortnight, and is constructed to give 2,700 interruptions, which number is deemed sufficient for practical purposes.

The Chicago Telephone Company now makes claim to having the most complete, as well as the busiest, telephone exchange in the world. Chicago has 10,400 telephones, operated in 11 exchanges. The number of "talks" really represents the business of the exchange, and they number over 145,000 a day. To accommodate this vast business the telephone company has put down 48 miles of underground conduit, containing 18,000 miles of wire.

Boston Notes.

To mitigate somewhat the privations of the laid-off employees connected with their Lynn factories, the management of the General Electric Company has determined upon a system of alternation by which those men who were discharged some time ago owing to the financial depression will be given employment a portion of the time, while those now working steadily will have to take even chances with the others. This is an arrangement which we think cannot fail to be appreciated all round by virtue of the old adage, "Half a loaf is better than no bread."

The town authorities of Medford, Mass , have granted authority to the West End Railroad Company of Boston to construct an electric railway through that town, connecting with Malden and Boston. A certain section of the road is to be in operation by January 1 next, and another year is granted for the company to complete the entire work. The West End Railroad Company accepts the conditions.

The Massachusetts State Board of Railroad Commissioners have been busy this week attending to various electric railway enterprises. They have granted authority to the Rockland and Abington Street Railway Company to issue its $60,000 additional stock at par; they have been to Fitchburg to try and settle a dispute about a grade crossing over the Old Colony road, and been over the territory in Cambridge which is in such hot dispute between the residents and West End Railroad Company. This latter dispute is becoming quite famous.

Professor Elihu Thomson is to deliver a lecture in Odd Fellows Hall, Lynn, November 16, on "High Frequency Alternating Currents," which will be illustrated by showing Professor Thomson's personal exhibition now at the World's Fair, Chicago. This lecture is sure to attract great attention, as do all addresses by the earnest and genial professor.

Lasell Seminary, Newton, Mass., is to be lighted by electricity from a private plant which Professor C. C. Bragdon, one of the faculty, is about to erect for himself.

There is a growing feeling in Newton, Mass., in favor of the City Government owning the electric light and gas plants. At present both gas and electric lighting are done by the local company, and while municipal ownership is considered desirable the Street Lighting Committee in a report that is being prepared does not favor the purchasing of the existing plants, but the establishment of an entirely new one.

The appointment of a new president of the West End Railroad Company, Boston, to succeed Mr. W. M. Whitney, retired, will not take place until the annual meeting next month. Meantime the affairs of the company are being well taken care of by the directors, who however are not just now extending the electric system.

The W. S. Hill Electric Company is to be congratulated on the unwonted prosperity it is enjoying 'mid all the depression and stagnation that abound, and it is a pleasure to us to be able to record the fact that this company is actually running its factory both day and night to keep pace with its orders. The company has recently secured a contract from the Philadelphia Traction Company which among the items calls for a number of switches aggregating 35,000 amperes capacity. One of these switches will be for 4,000 amperes, the largest ever made. Another contract includes a handsome marble switchboard 27 feet long, with several a trifle smaller. The goods, devices and apparatus manufactured by this company enjoy so high a reputation that they are coming into demand everywhere.

Mr. J. E. Talbot, for the past six years one of the managers of the Fort Wayne Electric Company's factory, Fort Wayne, Ind., and who is known and highly respected throughout all the East as well, has taken up his residence in Boston, and will practise as consulting electrical engineer and expert in patent causes. He will also edit *Elektron*, a monthly magazine devoted to electricity and its allied interests in their scientific and practical aspects. This magazine will be something entirely new in the literature or bibliography of electrical art and science: a high class monthly in which will appear articles of fine literary and scientific merit contributed by many of the first writers and most eminent specialists of the age. Mr. Talbot is a technical writer himself of considerable repute, has had journalistic experience, and with his scientific attainments, wide and varied practical experience cannot fail to win success. A long personal and professional acquaintance prompts us to speak only in the highest terms of him and to hope for a full measure of prosperity in the duties he has undertaken.

Mr. Winthrop Coffin, of the General Electric Company, and Mr. W. T. Rossell, of the Electrical Corporation, have been elected directors of the Concord Land and Water Power Company.

Messrs. Phillips, Leverett Saltonstall and Chas. C. Pierce have been appointed agents for the General Electric Company's railway department for New England.

General News.

What is Going on in the Electrical World.

Worcester, Mass.—The committee on sewers has voted to put in an electric light plant at the Quinsigamond Purification Works,

Richmond, Va.—Some of the papers are urging the council to put in an electric lighting plant to be owned and operated by the city.

Hillsdale, Mich.—The Jonesville Electric Light and Power Company have submitted a proposition to the city council for lighting the city.

Denver, Col.—A new electric company, the Economic, has entered the field against the Consolidated Company, and put in bids for lighting the city.

Savannah, Ga.—The Electric Railway Company has ordered a cut of 10 per cent. in the wages of all of its employees, to go into effect November 1.

White Fish Bay, Wis.—At a mass-meeting held here a few evenings ago, two-thirds of the people voted in favor of bonding the village to build an electric railway.

Canton, Ohio.—The Canton-Massillon Electric Railway Company is rebuilding its car-house and has ordered new cars, etc., to restore the plant destroyed by the recent fire.

Fond du Lac, Wis.—In spite of the business depression the electric street car company has gone on with work on its line and last week was able to begin carrying passengers on it.

Norristown, Pa.—There is talk here of changing the steam road to Lansdale into an electric road. The distance between Norristown and Lansdale is about ten and one-third miles.

Monroe, Mich.—The Toledo, Monroe and Detroit Electric Railway Company, having secured the right of way from Toledo to this city, are now after a franchise to operate their road on several streets here.

Troy, N. Y.—The E. G. Bernard Company has been awarded the contract for putting in the new power and lighting plant at the Watervliet Arsenal. The light plant will have a capacity of 5,000 or 6,000 lights.

Leavenworth, Kan.—It is reported here that the New York capitalists who are converting the horse car system of Atchison into an electric line are likely to apply for a franchise for an electric system in Leavenworth.

Montreal, Can.—The Ball Electric Light Company (limited) of Canada have sold to the Canadian General Electric Company (limited) their entire electric manufacturing business, including patterns and goodwill.

New York.—The Railroad Committee of the Board of Aldermen, after investigating the matter, have reported that the Second Avenue Railroad Company have the right to use the storage battery system on their road.

Sterling, Kan.—The Sterling electric light plant was destroyed by fire on the 14th inst., leaving the city in total darkness. The plant was the property of J. H. Ricksecker, of Kansas City. The loss is about $6,000.

Camden, N. J.—The work on the extension of the Camden, Gloucester and Woodbury Electric Railroad from Fancy Hill to North Woodbury is rapidly progressing, and cars will probably be running over the extension in the course of two weeks.

Erie, Pa.—Mayor Scott has affixed his official signature to the Edinboro and Erie railroad ordinance, which now becomes a law. The company is required to begin the work of construction within sixty days, and complete the road inside of a year.

Hartford, Conn.—At a public session of the joint convention of the common council held a few evenings ago, there was a preponderance of argument in favor of the use of the trolley in this city, but as there was not a quorum present there was no action taken.

Hamilton, Ohio.—The proposition to issue $50,000 in bonds for the erection of an electric light plant will be submitted to a vote of the citizens on November 7. If carried the city will be released from the contract entered into by council with the Hamilton Brush Electric Light Company.

Winona, Minn.—The Winona General Electric Company have remodelled their plant, and have placed their lighting and street railway interests under one roof. The Winona Company is a branch of the Northwest General Electric Company, and most of the stock is owned by the latter.

Allentown, Pa.—The Pennsylvania Telephone Company suffered a loss of $10,000 by the fire which occurred here on the night of the 13th inst. The fire broke out in the Telephone Exchange, and was caused, it is said, by the crossing of telegraph and electric light wires. The total loss was $200,000.

Manchester, Conn.—In the reorganization of the Mather Electric Company at Hartford last week, M. S. Chapman was elected president in place of B. A. Simmons, resigned, Charles B. Whiting vice-president, and C. T. Welles secretary and treasurer. The company has made a satisfactory basis of settlement with all its creditors and is now prepared to execute orders.

Martinsburg, Md.—The council has declared the franchise granted by it to the Martinsburg Electric Railway Company forfeited, and has served notice on the company to run no more cars or perform any work on the track or wires connected therewith. John B. Wilson, the president of the road, announces his intention of suspending operations until next spring election and then appeal to the people of the town for a settlement of the question by their ballots.

Chicago.—J. J. Brice, U. S. N., inspector Ninth Light-house District, reports that the electric buoys at Lake Michigan, installed by the Bishop Gutta Percha Company, and extending from the foot of Van Buren street to the World's Fair grounds have been running as regular as clockwork since their acceptance by the Government. None of them have failed for a single night. During the heavy storm of a few weeks ago the waves ran high, yet none of the lights went out.

Baltimore.—"The burning of the Brush Electric Light Works," says the Baltimore *Herald*, "is one of the most serious losses which Baltimore has sustained for some time. Not only has the electric company's entire plant been ruined, but the electric lighting facilities of the city are very much crippled. One or two lines of street railway also are hampered by the fire, and some time will elapse before the various facilities for travel and street lighting will be restored."

Detroit, Mich.—The city council has adopted an ordinance to the effect that any person or corporation carrying on a manufacturing business in the city of Detroit, and having surplus power applicable to the purpose, may apply to and receive a permit from the public lighting commission to lay conduits, erect poles and place thereon or therein wires or other conductors for the purpose of furnishing electric lighting to any person or persons desiring the same within the district to be designated in the application made for such permit.

Wilmington Del. — The Wilmington and Chester Electric Railway Company was organized here a few days ago. The following officers were elected to serve until the annual meeting next January: President, James C. McComb; secretary, E. T. Cooper, Dover; treasurer, J. Clayton Erb, Philadelphia; directors, William G. Hill, Philadelphia; S. F. Houseman, Philadelphia; John B. Robinson, Media; J. Clayton Erb, Philadelphia; Richard R. Kenney, Dover; Garret J. Hart, Wilmington; James C. McComb, Claymont, and Peter J. Hughes, Philadelphia. Work on the new road will be begun next March.

Newark, N. J.—A correspondent of the *Sunday Call* suggests the holding of an electrical exhibition in Newark some time in the coming winter. He says the electrical interests of the city are extensive enough to warrant such an exhibition, and has no doubt of its success. He gives the following list of manufacturers in the city and suburbs who would furnish exhibits: The Weston Electric Instrument Company, the Westinghouse Electric Company, the Edison Phonograph Works, Orange, N. J., the Edison Lamp Works, Harrison, N. J.; the Crocker-Wheeler Company, Bloomfield, N. J.; the Backus Electrical Company, the Newark Electric Light and Power Company, and others too numerous to mention.

Haverhill, Mass.—A "grand double-track electric street railway" between Haverhill and Nashua, N. H., is one of several such projects presented to the board of trade; the road would have connecting branches to Manchester through the Merrimack Valley, also from Salem Depot to Derry. Another line was mapped from Manchester along the north shore of Lake Massabesic to Auburn, Chester, Hampstead, Atkinson, Plaistow to Haverhill. Another proposed line is from Haverhill to Georgetown, and starting from the Haverhill and Danvers railway at Georgetown to Rowley, Ipswich, Essex, Salem and Gloucester. This shows the Merrimack Valley from Manchester, N. H., to Newburyport; also a wide range of the Atlantic coast from Gloucester to the Isle of Shoals.

Rochester, N. Y.—Tests are to be made shortly at Rochester of a method of electric propulsion for boats on the Erie Canal. The tests will be made by the Westinghouse Electric and Manufacturing Company, and will be, says the Rochester *Herald*, under the personal supervision of Lemuel Barrister, superintendent of that company. It is said that $20,000 will be expended in perfecting and introducing the invention. The power will be generated in a large storehouse at Pittsford, owned by J. M. Wiltse and leased to the Westinghouse Company. A boat owned in Buffalo has been secured and is to be fitted for use in making the experiments. The apparatus is now being manufactured at Pittsburg. It will be in readiness in two or three weeks, when it will be shipped to Buffalo, loaded upon the canal boat, together with dynamos for the power house and a 75-horse power engine, by which they will be operated, and with this cargo the boat will steam down to Pittsford and active work will begin.

Awards to the Dixon Company.

Judges appointed by the officials at the World's Fair at Chicago have made awards to the Joseph Dixon Crucible Company, Jersey City, N. J., for superior products in graphite, lead pencils, plumbago, crucibles, black-lead stoppers and nozzles, dippers, bowls, foundry facings and lubricating graphite.

These awards are a very proper recognition of the qualities of these goods, as the Dixon Company is known throughout the world as the pioneer in the graphite industry and its goods are always considered as the standard. The United States Government in its bids for supplies says, "Dixon's or equal."

Eureka Tempered Copper.

The Eureka Tempered Copper Company of North East, Pa., who are the only manufacturers of pure tempered copper, have found an extensive field for their well-known products in electrical work, as outside its value as an anti-friction metal for journals, etc., tempered copper has proved its superiority for commutators, brushes, contact springs, and many other parts of dynamos and motors.

The company make a specialty of commutator bars, which are cast of pure copper, rolled and hardened, and the metal thus finished has great toughness and pliability, so that in addition to the superior conductivity due to the absence of all alloys, its wearing qualities adapt it perfectly for use in commutators.

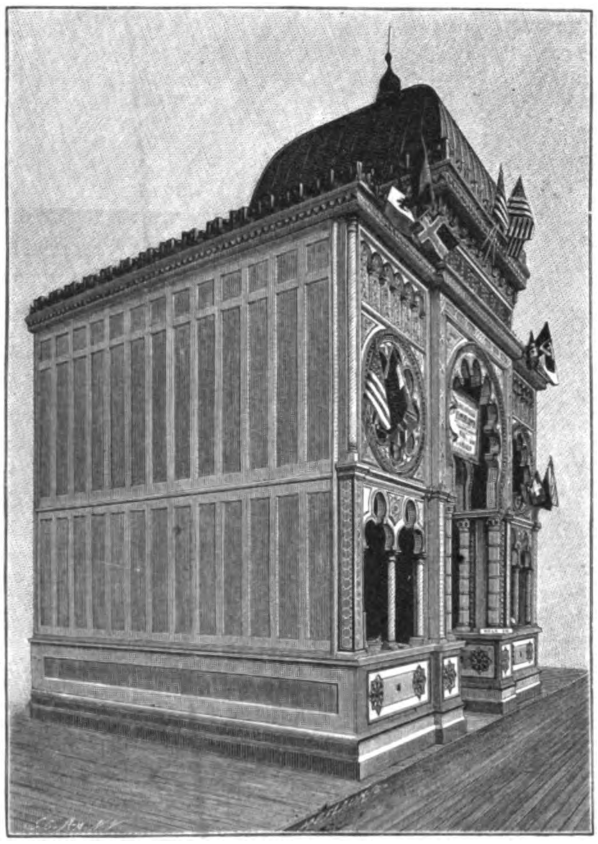


FIG. 1.

The illustration above (Fig. 1) shows the pavilion at the World's Fair in which this company have an elaborate display of their copper goods, whose merits have been recognized by both the Franklin Institute of Philadelphia and the Jury of Awards of the World's Fair. By the former, tempered copper was awarded the John Scott Medal and Premium after a thorough investigation, and the World's Columbian Exposition has also awarded the Medal for Copper for Electrical Purposes, the award reading as follows:

"Tempered copper for use in electrical construction, consists of cast and wrought copper for use in the electrical industries. The mechanical strength and wearing qualities of this copper have been shown to be considerably superior to ordinary copper, cast or rolled.

"The treatment which the copper receives is a distinct advance upon ordinary copper working, as through it sound castings of commercially pure copper are secured without failure.

"The castings may be tempered to any degree of hardness between considerable units, and they may be made forgable by the ordinary processes. The exhibit is worthy of an award for excellence in cast, tempered and forged copper."

Fig. 2 shows a view of the interior of the Eureka Company's pavilion, in which is displayed some of the numerous tempered copper goods which they manufacture. Among these are commutators, contact springs, bearings, trolley wire, lathe steps, soldering irons, dynamo brushes, pinions and other articles too numerous to mention.

One of the most important points in the copper so prepared is its chemical purity, of which the examining committee of the Franklin Institute speak as follows:

"The chemical examination shows that the samples are commercially pure copper. Mechanical examination bears out the statements of the applicants as to the purity of their metal. We are of the opinion that the Eureka Tempered Copper Company has made a decided step in advance in the preparation of copper for many industrial uses."

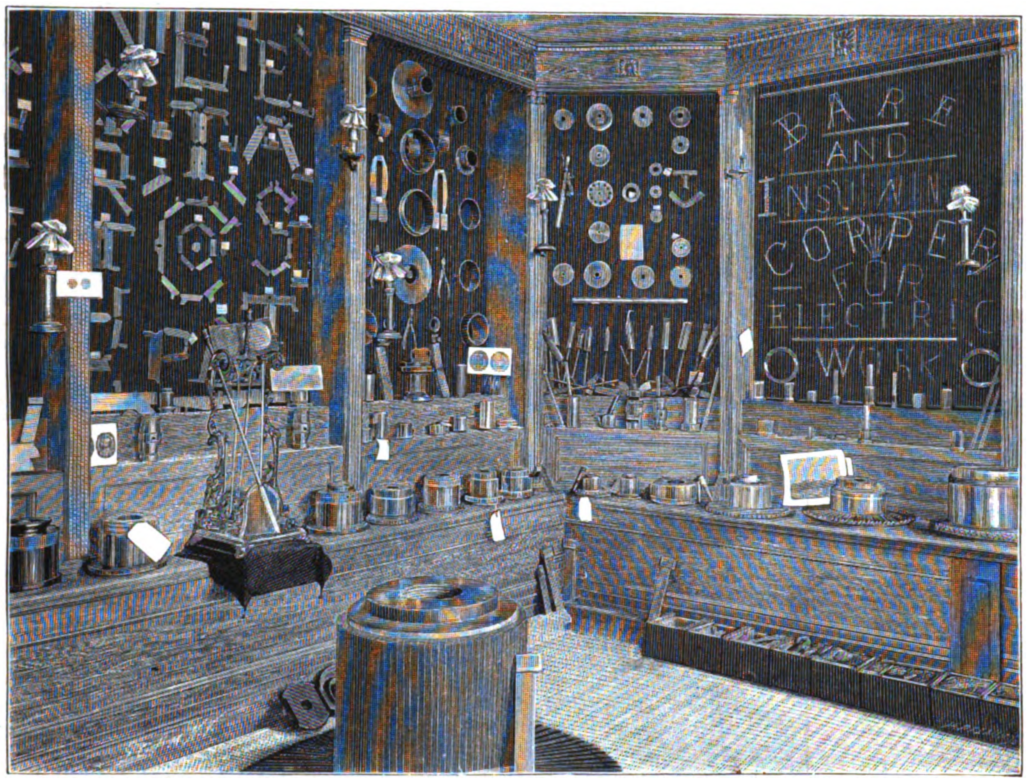
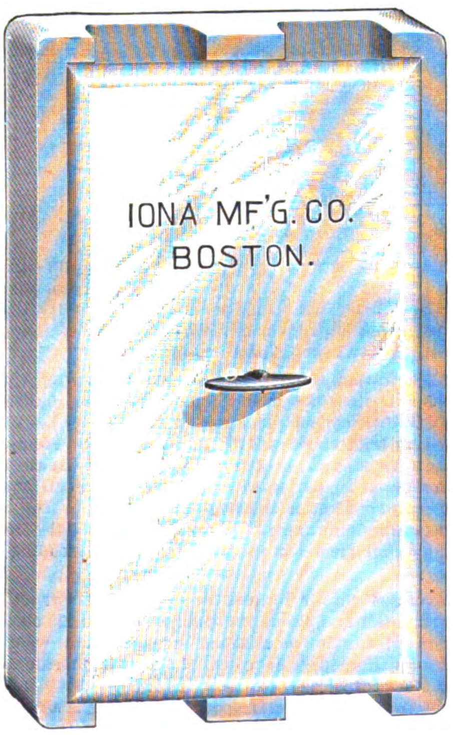


FIG. 2.

The Iona Covered Cut-Out.*

We illustrate below a new style of covered main cut-out which is being introduced by the Iona Manufacturing Company, of Boston, which possesses several features desirable to the practical wireman. The wire contacts are large and very strong. The porcelain cover can be readily removed by unscrewing the thumb nut when it is necessary to replace the fuses. The Iona Manufacturing Company will soon have a full line of these cut-outs, both branch and main, ready for delivery, and already report a brisk inquiry for them.



COMMERCIAL PARAGRAPH.

Probably the largest single order for Insulated Wire ever placed in this country was recently given the Washburn & Moen Manufacturing Company of Worcester, Mass., by the Brooklyn City Railway Company. This order included 180 miles of 500,000 C. M. Stranded Weatherproof Feed Wire, together with thirty miles of another size. The order amounted to nearly $300,000, and represented a weight of about 2,000,000 lbs. They have also obtained nearly all of the Brooklyn City Railway business during the last year, and the securing of this immense order was due wholly to the very satisfactory manner in which the orders have always been handled. The business of the Insulating Department of the Washburn & Moen Company is daily increasing, and they have recently erected a large and well-equipped factory, which during the recent depression in business has been running nearly full time.

INCORPORATIONS.

The Carpenter Electric Power and Light Company, East St. Louis. Capital stock, $2,000,000. Incorporators: Hiram H. Carpenter, Ephraim C. Dawes and James C. Brush.

The Safety Trolley Improvement Company was organized in Brooklyn, N. Y., on the 18th inst. Carl Peterson was elected president, Thomas I. Williams secretary and treasurer, and Vincent A. Strawson general manager. The capital was fixed at $200,000. Among the men interested are John F. McNamee, William R. Tinsley, a Texas capitalist, President Lewis, of the Brooklyn Heights Railroad, and Dr. Weld. Patents have been secured in this country, England, France, Germany and Belgium.

Pacific Coast Printing Telegraph Company, Los Angeles, Cal.—to manufacture and deal in printing telegraph machines and electrical appliances and operate lines and exchanges. Capital stock, $1,000,000. Promoters: Forbes Parker, Daniel Potter, Daniel Stone, San Diego, Cal.; Cleveland F. Dunderdale, Chicago, Ill.; Matthew T. Aller, Los Angeles, Cal.

The North Scranton Transit Company, Scranton, Pa.—to construct and operate an electric railway in the city of Scranton. Capital stock, $9,000. Promoters: Louis Morel, Jno. H. Fellows, H. Weinschenk, Scranton.

The Empire Electric Company, Chicago, Ill.—to manufacture and sell electric lamps and electric appliances. Capital stock, $15,000. Promoters: David A. Bennett, Henry G. Hinkle, Gustave Schroeder.

The Taylor Switch and Signal Company, Chillicothe, Ohio—to manufacture and sell railroad switches and signals and electrical and other machinery for operating same and for various purposes. Capital stock, $24,000. Promoters: John D. Taylor, Richard Enderlin, Chas. A. Smith, John M. Vanmeter, William M. Tulleys.

The Charles S. Solomon Company, Camden, N. J.—to manufacture, construct, erect and repair machinery and apparatus for electrical and mechanical purposes, etc. Capital stock, $30,000. Promoters: C. S. Solomon, W. S. Griffiths, J. S. Mount, Philadelphia, Pa.; A. H. Gangewer Burlington, N. J.

The Jamaica Electric Light Company, Jamaica, L. I.—to furnish heat and power to villages of New York State. Capital stock, $15,000. Directors: George R. Culling, Mount Vernon; William S. Williamson, Jamaica, and Alonzo B. Pettitt, Jamaica.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED OCTOBER 10, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

506,468. Electric Railway Trolley. George H. Benjamin, New York, N. Y., assignor to Siemens & Halske, Berlin, Germany. Filed June 30, 1893.

506,492. Trolley. George F. Green, Kalamazoo, Mich., assignor of one-half to Oliver S. Kelly, Springfield, Ohio; Martha L. Green executrix of said George F. Green, deceased. Filed April 28, 1892.

506,617. Trolley Support for Electric Railways. Johan M. Anderson, Boston, Mass., assignor of one-half to Albert Anderson, same place. Filed April 14, 1893.

ELECTRIC LIGHTS AND APPLIANCES.

506,287. Electric Car Lighting System. Frank E. Kinsman, Plainfield, N. J. Filed Sept. 18, 1890.

506,459. Carbon for Electric Arc Lamps. Royal E. Ball, New York, N. Y. Filed April 28, 1892.

506,488. Electric Light. George Fitch, Millvale, Pa. Filed April 18, 1893.

506,503. Electric Arc Lamp. Carl Hoffmann, Berlin, Germany, assignor to Siemens & Halske, same place. Filed April 5, 1893.

506,650. Carbon Electrode for Arc Lamps. Joseph M. Lacombe, Paris, France, assignor of one-half to Louis G. Dreyfus, Santa Barbara, Cal. Filed Aug. 27, 1892.

DYNAMOS, MOTORS, ETC.

506,208. Electric Motor. Job A. Davis and Robert A. Fowler, Philadelphia, Pa., assignors to the International Printing Telegraph Company, Camden, N. J. Filed Dec. 23, 1892.

506,209. Electric Motor. Job A. Davis and Robert A. Fowler, Philadelphia, Pa., assignors to the International Printing Telegraph Company, Camden, N. J. Filed Dec. 23, 1892.

506,282. Electro-Magnet. Illius A. Timmis, London, England. Filed Feb. 1, 1893.

506,358. Electric Locomotive. Johan F. S. Branth, New York, N. Y., assignor of two-thirds to Edward H. Johnson, same place. Filed March 23, 1892.

506,481. Fan Motor. Chaimsonovitz P. Elieson, New York, N. Y., assignor of one-half to Francis A. Pellas, Ogebbio, Italy. Filed July 16, 1892.

506,482. Regulator for Dynamos. William H. Elkins, Cambridge, Mass. Filed Feb. 27, 1893.

506,577. Electrical Transformer or Induction Device. James M. Adams and Martin Adams, Elkhart, Ind. Filed June 22, 1893.

BATTERIES, ETC.

506,281. Apparatus for Casting Battery Plates. Edgar W. Timmis, London, England. Filed Jan. 23, 1893.

506,353. Electric Battery Cell. Bloomfield J. Wheelock, New York, N. Y. Filed Sept. 23, 1893.

TELEPHONE AND TELEGRAPH APPARATUS.

506,223. Telephone Tablet and Arm Rest. Joseph S. Gold, Columbus, Ohio. Filed May 13, 1891. Renewed March 9, 1893.

506,269. Printing-Telegraph. Robert J. Sheehy, New York, N. Y., assignor, by mesne assignments, to Wendell Goodwin, same place. Filed March 11, 1886. Renewed March 15, 1893.

506,270. Printing-Telegraph. Robert J. Sheehy, New York, N. Y., assignor, by mesne assignments, to Wendell Goodwin, same place. Filed Jan. 10, 1887. Renewed March 15, 1893.

506,271. Apparatus for Securing Synchronous Movement. Robert J. Sheehy, New York, N. Y., assignor, by mesne assignments, to Wendell Goodwin, same place. Filed Dec. 31, 1887. Renewed March 15, 1893.

506,272. Printing-Telegraph Exchange System. Robert J. Sheehy, New York, N.Y., assignor, by mesne assignments, to Wendell Goodwin, same place. Filed Dec. 31, 1887. Renewed March 15, 1893.

506,273. Printing-Telegraph. Robert J. Sheehy, New York, N. Y., assignor, by mesne assignments, to Wendell Goodwin, same place. Filed Oct. 31, 1890. Renewed March 15, 1893.

506,274. Telegraphy. Robert J. Sheehy, New York, N. Y., assignor, by mesne assignments, to Wendell Goodwin, same place. Filed Dec. 23, 1890. Renewed March 15, 1893.

506,275. Autographic Telegraph. Robert J. Sheehy, New York, N. Y., assignor, by mesne assignments, to Wendell Goodwin, same place. Filed March 3, 1891. Renewed March 15, 1893.

506,294. Telegraph-Transmitter. Charles Willoughby, San Francisco, Cal. Filed Dec. 6, 1892.

506,305. Magneto-Telephone. James A. Brown, Moline, Ill. Filed July 26, 1893.

506,415. Telephone-Transmitter. John V. Capek, New York, N. Y. Filed July 19, 1893.

506,627. Variable Resistance for Microphones and Method of Manufacturing same. Alfred C. Cousens, Boston, Mass. Filed Jan. 9, 1893.

506,646. Telephone Attachment. Christian H. Dorenwend, Toronto, Canada. Filed June 3, 1892. Renewed May 27, 1893.

MISCELLANEOUS.

506,297. Electric Switch. William W. Alexander, Kansas City, Mo. Filed Feb. 16, 1891.

506,311. Molding for Electrical Conductors. Reginald A. Fessenden, Pittsfield, Mass. Filed Aug. 16, 1892.

506,347. Electric Cigar Lighter. Charles B. Struble, Minneapolis, Minn. Filed Jan. 10, 1893.

506,367. Electric-Elevator Switch. William Hochhausen, Brooklyn, N. Y. Filed Sept. 9, 1891.

506,449. Method of Treating Diseases Electrically. Samuel Silsbee, New Utrecht, assignor to himself and Andrew P. Van Tuyl, Jr., Brooklyn, N. Y. Filed June 30, 1893.

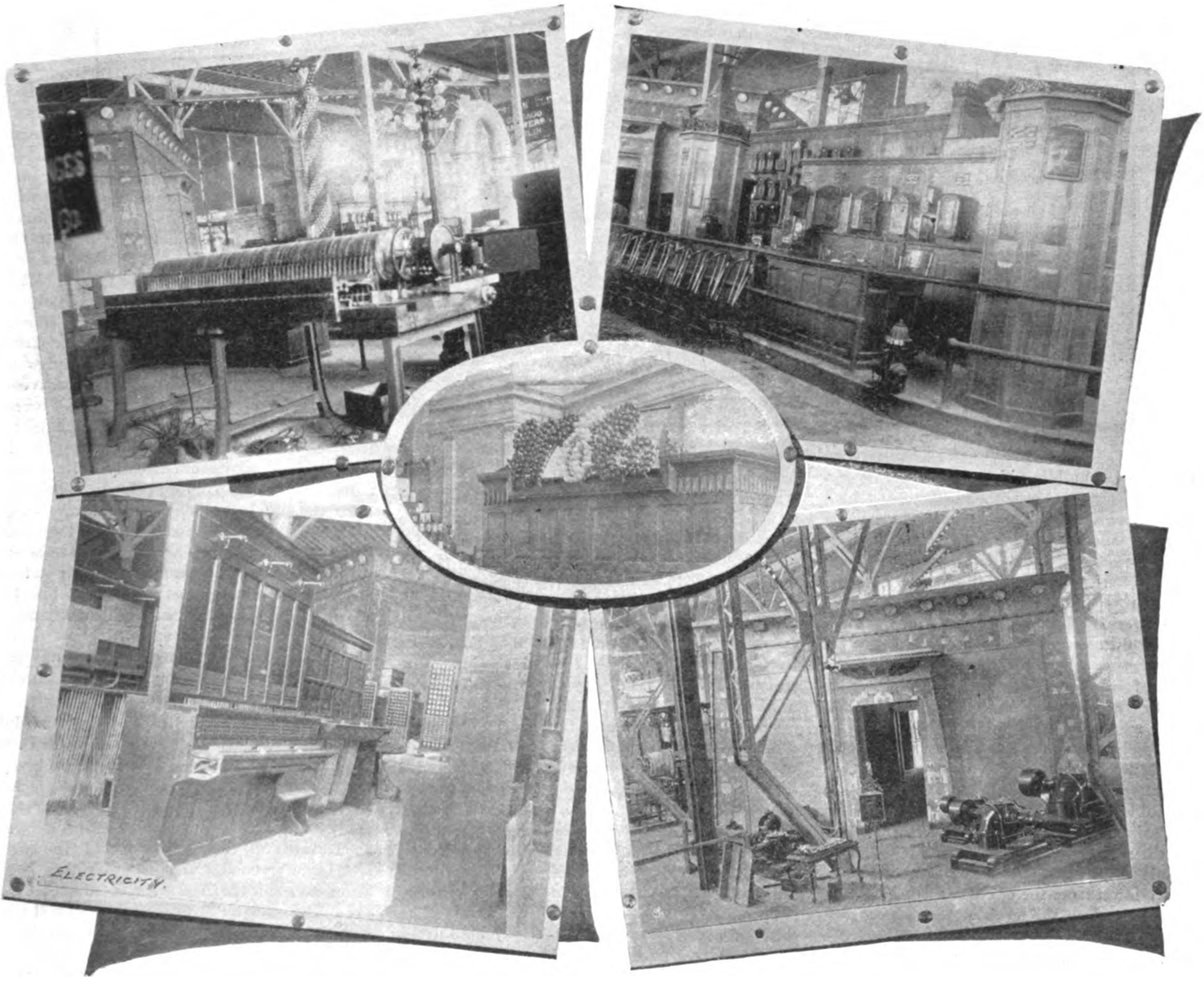
506,516. Electrical Head-Clamp for Relieving Pain. Lizzie Lane, Dunellen, N. J. Filed May 27, 1893.

506,563. Electric Switch. Frank Stevens, Philadelphia, Pa., assignor of one-half to Samuel Welsh, same place. Filed April 21, 1893.

506,582. Automatic Fire-Alarm System. Gilman W. Brown, West Newbury, Mass., assignor of one-half to Haydn Brown, same place. Filed Sept. 1, 1892.

ELECTRICITY.

Vol. V. New York. NOVEMBER 1, 1893. Chicago. No. 16



Column of Light. Incandescent Sign. Fire Alarm Instruments.
Telephone Switchboards. Egyptian Temple.

WESTERN ELECTRIC COMPANY'S WORLD'S FAIR EXHIBIT. (See Page 186.)

World's Fair Notes.

Western Electric Company's World's Fair Exhibit.

ELECTRIC LIGHT APPARATUS AND ELECTRIC LIGHTING.

The exhibit of the Western Electric Company may be divided into two classes, one of which is used by the Exposition itself for lighting its own grounds and buildings, and the other is operated by the Western Electric Company for use in its own exhibit in Electricity Building.

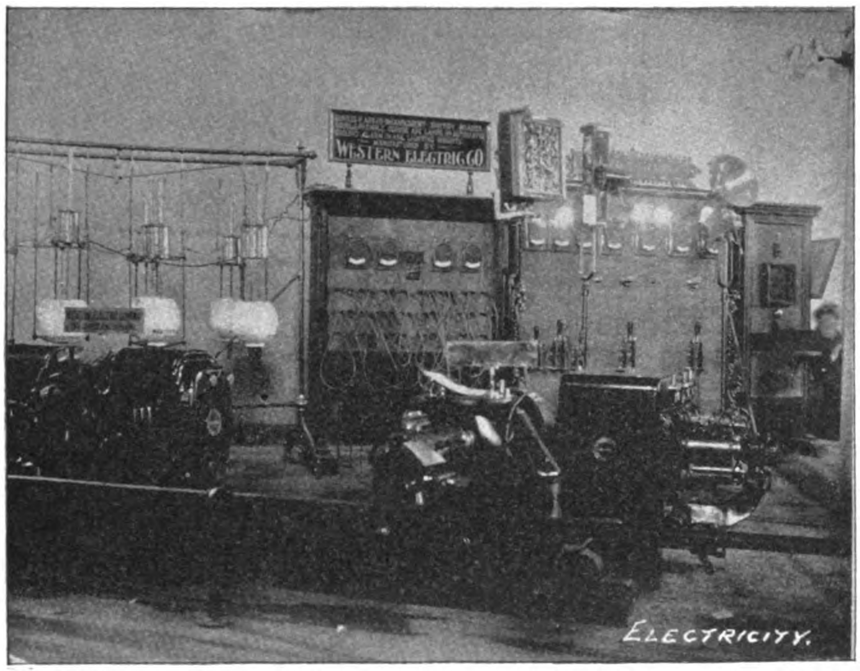


Exhibit of Switchboards.

In order that this article may be more comprehensive, we will begin by describing the portion which is operated by the Exposition. Their plant consists of ten Western Electric arc dynamos, each having a capacity of fifty nominal 2,000 c. p. arc lamps. These machines are built with the latest improvements, being entirely automatic in their action, permitting of change in load from nothing to full capacity without injurious heating or excess of sparking. The machines are of constant current type, operating the lamps in series. In building these machines it has been the design to use a construction which would require a minimum amount of attention from the operator, and in order to do this it is necessary to discard oil cups and provide a means for lubricating the commutator. To accomplish this end, self-oiling ball and socket bearings were designed, which not only lubricate their own bearings but also take perfect alignment with the shaft, thus preventing the bearings from becoming hot. The old-style copper brushes are done away with and carbon brushes substituted in their places which in themselves lubricate the commutator sufficiently to permit it to run 24 hours without attention. The automatic regulator, which is at all times connected with the machine, will operate to detect the variation of ¼ ampere from the normal output of the machine and correct the same at once, the result being a machine which requires little or no attention from the operator. By means of a switch located on the machine the normal output of the dynamo can be varied from 10 amperes to 8 or 7, as desired, so that with the same dynamo and the same lamps any candle power desired can be produced. The machines are also constructed so as to make each part accessible, and with this in view the bearing seats are so constructed that one bolt is sufficient to hold a bearing rigidly in place. It is possible with this construction to stop a machine which is doing full duty, and place the armature upon the floor, in not to exceed three minutes' time. The regulation of this machine is accomplished by shifting the brushes around the commutator as the load changes, thereby producing a constant current output from the machine. Any variation in the current output is immediately remedied by a small electro-magnet through which passes the full current of the machine. The dynamo is mounted upon a wooden sliding adjustable belt tightener, the wooden frame serving to insulate the machine from the foundations. The commercial efficiency of these machines at full load is not less than 90 per cent., and the heating, when operated for any length of time, will not exceed 90° Fahr. above the surrounding atmosphere.

The dynamos are connected to the lamps through a Western Electric arc lighting switchboard made of Tennessee marble. Upon this marble are mounted springjacks, to which are connected the various circuits. Half the jacks in this board are devoted to the service of the Exposition and the other half to that of the exhibit of the Western Electric Company in Electricity Building. These springjacks are constructed in such a manner that any circuit can be short-circuited at the switchboard by means of a disconnecting plug. With this device any circuit can be cut into or out from service while the dynamo is in operation without interfering with the lamps not intended to be affected by this operation. In connection with this board is a testing device by means of which the insulation resistance to ground of any circuit can be measured while the lamps are burning.

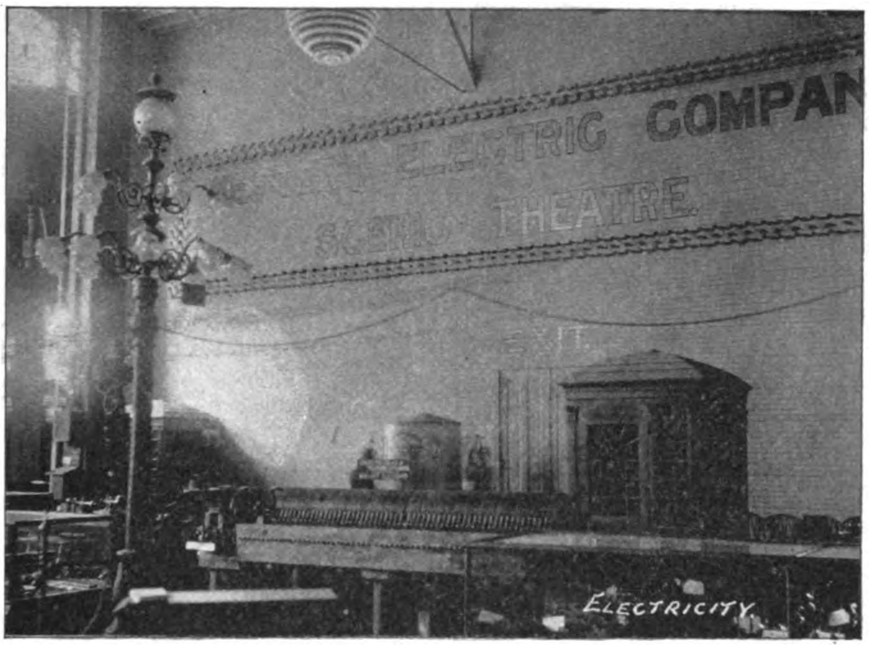
This switchboard consists of brown Tennessee marble 14 feet long and 6 feet high, surmounted with Japan lacquered cap and a handsome eight-day clock in grille work which is located in the centre of the board. The front of the board is finished in the most perfect style of art, no detail being overlooked to make the board complete. The back of the board is not less highly finished. All connections for the arc circuits run up through the floor and are fastened to small porcelain insulators which are held to the board by means of small brass brackets, and thence run to their respective springjacks. All the connections for the incandescent apparatus are made of heavy brass castings, which are finished in Japan lacquer, to which all the circuits are connected beneath the floor. This board is held rigid by means of large grilled bronze brackets, making on the whole a very perfect piece of work.

The apparatus in Machinery Hall which is devoted to the use of the Western Electric Company in Electricity Building consists of two dynamos each operating 50 nominal 2,000 c. p. arc lamps.

It was agreed between the World's Columbian Exposition and the Western Electric Company, prior to the opening of the Fair, that the Exposition should furnish foundations for engines, dynamos, and free steam during the period of the Exposition, and that the Western Electric Company should provide engines, dynamos and operators. As a result of this agreement the Russell Engine Company, Massillon, Ohio, installed two 200 h. p. engines and one 100 h. p. engine for this service, and the Graton & Knight Manufacturing Company, Worcester, Mass., supplied the belting.

These generators and dynamos are directly connected to the switchboard heretofore described. The distance between the power plant in Machinery Hall and the exhibit of the Western Electric Company in Electricity Building measures a trifle over 2,500 feet. It was decided that the 220 volt direct current system would give the best results, and this system was adopted by the company. The circuits extend in the subway between the floors, and the wire was made in 1,500 and 1,000 feet lengths, so that only one joint was necessary to make a complete circuit to the Electricity Building. This arrangement brought all the joints beneath the floor in Machinery Hall, where it is perfectly dry. Special clips were made for fastening these circuits to glass insulators, the old style tie wire being abandoned. The result of this is that the insulation resistance to ground, even in a very wet tunnel, has at all times been over or about a megohm, and grounded circuits rendered an impossibility. The circuits are all run into a switchboard in Electricity Building, which is similar to that in Machinery Hall, being composed of brown Tennessee marble, 12 feet long and 6 feet high. It is designed to be as perfect a piece of switchboard distribution as it is possible to construct. The back of the board is finished in an elaborate manner, all brass and copper trimmings being polished and copper plated. The positives and negatives of the incandescent circuit are connected directly to bus bars, from which distributing circuits run through double-pole knife switches and ammeters directly to the lamp circuits. The accompanying photograph shows the arrangement of one side of the board. One end of the board is devoted exclusively to the distribution of arc circuits, there being 150 arc lamps of the Western Electric Company's manufacture in Electricity Building. Seventy-five of these lamps are devoted to the service of lighting various portions of the building, and thirty of them are placed on Columbian lampposts, manufactured by the Western Electric Company, which are located in the galleries and main floor.

The Western Electric Company's exhibit in Electricity Building consists of a display of artistic effects produced by electric lighting, as well as wares manufactured by its various factories. The exhibit is located in the southeast corner of the building, Section A, Spaces 3, 4 and 5. Located at the north end of the exhibit is a large glass sign reading "Western Electric Company, Chicago, New York, London, Antwerp, Paris and Berlin." This sign is 22 feet long, 8 feet high and 4 feet wide, reading on both sides. The interior of the sign is lighted with 14 arc lamps. The letters are formed of various colored glass crushed into small pieces, and the lamps, swinging continually, cause a scintillating effect resembling that of diamonds, rubies, sapphires and emeralds, making a very attractive display. The office of the company is located in the northwest corner of Space 4. It is of Grecian style of architecture. The interior is divided into two rooms, the front one being a drawing-room and the rear one a private office. The illumination of this office is novel in the extreme, the front room being the green room and the rear one the yellow room. The lighting is entirely concealed behind a frieze of paper over which is placed a light cloth of the same tint as the room. The paper forms a design back of which are placed the lamps, thus giving an appearance of an illuminated wall, and bringing out the design in an artistic manner. The effect is novel and original. In the front portion of the building is placed an elegant painting on glass, nine feet high and six feet wide, entitled "Fairy Queen," the lighting of which shows the evenness with which light can be distributed over a surface of this size. In the front room are also located two miniature fountains placed in glass globes three feet high and sixteen inches in diameter. Six colors are reflected through the water, which is thrown in small jets to the tops of the globes. The action of the fountains is entirely automatic, being regulated by clockwork.



Automatic Switch for Lighting Effects.

Upon entering the south entrance of Electricity Building the visitor is attracted to the Egyptian Temple. The exterior of this building is covered with interesting allegorical figures representing Egyptians in the performance of all kinds of electrical work. The inside of the building serves as a show room for the display of various electrical instruments. The building is divided into two rooms. The larger room has a ceiling composed of stencil cut paper and covered with a fine texture of cloth, while the coves are studded with ruby glass jewels behind which shine incandescent lamps. The tint of the room is green and the walls are frescoed in stencil work apparently representing Egyptian decoration, but a close examination reveals the fact that the figures themselves are composed largely of electrical apparatus. In the four corners and in the centres of the sides are green glass columns about two feet in diameter, the walls of which are three inches thick. These columns are lighted from the interior by incandescent lamps, giving a brilliant effect. Built into the walls of these rooms are recesses which serve for show cases which are lined with red plush and lighted from above. In these cases may be seen all kinds of electrical apparatus and instruments. On the walls of the room there are numerous medals which have been awarded to the Western Electric Company at the Paris, Philadelphia, Australia and a number of smaller Expositions.

Passing through this building the observer is attracted to a rapidly rising band of light around a column two feet in diameter and over twenty feet high, which is studded with red, white and blue lamps, and from the top of which extend four radial zigzag arms typical of lightning. At the end of two of these arms are large revolving spheres forty two inches in diameter, studded with 300 lamps each, and revolving at a high speed. At the ends of the other two arms are conical clusters of lamps of different sizes. Periodically, throughout the day and night, bands of light three feet wide rise from the base of this column, to the summit and then pass out through the arms into the balls and cones, producing a novel effect. The balls are at one instant filled with red light which suddenly changes to white and again to blue. The controlling switch is placed beneath the floor and automatically produces all these various changes. This switch consists of 137 circuits, which are connected and disconnected by means of a revolving cylinder upon which are placed cams so arranged as to make contacts at the proper time. This roller is driven by a $\frac{1}{4}$ H. P. motor. The current furnished to the column is 110 volts; it is reduced to this pressure in order to avoid arcing at the revolving switch. This change of pressure from 220 to 110 volts is made by means of a motor generator of 40 H. P. capacity which receives current directly from Machinery Hall and delivers it at 110 volts.

At the north end of the exhibit is a large cabinet, upon the top of which are placed the letters "W. E. Co." in 16 C. P. lamps, shown in the centre of the Frontispiece. Behind these lamps is a pointer operated by means of a controlling mechanism placed inside the cabinet. This arm commences at the beginning of the letter "W," passes across the cabinet, apparently writing each letter, after which it retraces its course and extinguishes the lamps in the same manner in which they were lighted.

Near this exhibit is placed another exhibit which spells the words "Western Electric Co." by moving a lighted lamp through the air.

One of the most attractive exhibits installed by the Western Electric Company is a Scenic Theatre, which is located in the extreme southeast corner of the building. (See Frontispiece.) After several plans had been discussed it was decided to reproduce in as realistic a manner as possible the natural transitions of light during a period of twenty-four consecutive hours of night and day. The scenery employed to produce these effects represents the Alps. The stage opening is ten feet wide and nine feet high. The front portion of the scene represents a village consisting of several houses and a church. During all the changes of light which occur from sunrise to sunset, including a storm followed by a rainbow, music is arranged to correspond with the different scenes and to interpret as far as possible the time of day. The circuit used is 110 volts pressure, which is furnished by means of a motor generator similar to that described for lighting the column. The scenery was designed and painted by Sosman & Landis, of Chicago.

A 20-light arc machine located directly under a sign on the Egyptian Temple illuminates this sign. It is driven by means of a 220 volt motor. This motor is of the slow speed type.

In the immediate vicinity of the dynamo display are two sample switchboards, one being for arc circuits and one for incandescent circuits, similar to those heretofore described, but intended to show the distribution of current for the various systems employed by the Western Electric Company.

Immediately in the rear of the office of the Western Electric Company is placed a large oak partition 12 feet high, on either side of which are placed counters and show cases. The partition serves as a means for displaying the large line of hotel calls, annunciator and burglar alarms of all kinds manufactured by this company.

In the main aisle, on the western side of this exhibit, and between the Egyptian Temple and the office, is an operative machinery exhibit in which is displayed special machinery invented for the purpose of meeting special demands arising in the manufacture of electrical apparatus. The first of these machines is the automatic nut machine, which manufactures nuts from brass strip, all polished, drilled, tapped, and faced off on one side and chamfered on the other. This machine has a capacity of from 8,000 to 10,000 per day, large quantities of which are used in switchboard apparatus, bells, etc., that are manufactured by this company. Next to this is a multiple drill press, consisting of 24 adjustable spindles. The machine is connected to a line shaft by means of belting, and this line shaft receives its motion from a 220 volt slow speed 10 H. P. motor of the Western Electric Company's system. In addition to this machine are seven other machines connected to this shaft, two of which are metal working machines and the others wire insulating machines. The product of this drilling machine consists of a small souvenir of white holly wood, $\frac{1}{8}$ inch thick, $1\frac{3}{16}$ inches wide, and 2 inches long. Through these small blocks are drilled $24\frac{1}{8}$ inch holes simultaneously. These holes are drilled at a uniform distance from each other, which is equal to $\frac{3}{16}$ inch; they are drilled in two rows near and around the outer edge, leaving a blank space in the centre; in the blank space on one side is stamped the inscription, "Western Electric Co. 1893," and on the other side is stamped "Drilled by one operation."

Next to this machine stands the double turreted automatic screw machine, made to work on both sides of a piece before it leaves the machine. The stock is fed in through the lower head, and the work at one end is finished, after which it is cut off and picked up by an automatic finger and placed in the upper head where the opposite end of the piece is finished at the same time that the machine performs the operation on the first end of the next piece, after which the piece is thrown out into a receptacle made to receive the finished work.

In this space are also found spooling and insulating machines, which are used in the manufacture of annunciator and magnet wire, as well as telephone cable. The cotton yarn used in covering the wire is wound upon spools, and then put on revolving heads where it is wound upon the wire, which is in turn wound upon spools ready for shipment. Magnet wire is covered in the same manner, silk being used in the place of cotton, and the heads being made to take in any size wire from the smallest up to any size desired. Here is also shown the first process of insulating wire for telephone cables, paper being used in place of cotton.

Near the centre of the southern end of the exhibit is a historical display, the special features therein being work done by Moses Gerrish Farmer, an excellent portrait of whom overhangs the exhibit. Here is shown a reproduction of what is supposed to be the first reversible motor ever produced, it having been built and put on exhibition by Mr. Farmer in Dover, N. H., in 1847. Next to this stands an old mantelpiece which was taken out of the Farmer house in Salem, Mass. The principal objects of interest on this mantelpiece are the small incandescent lamps placed upon it in exactly the same manner as arranged by Mr. Farmer in 1859. In this space is also shown a dynamo-electric machine which was made by Mr. Farmer about the year 1859.

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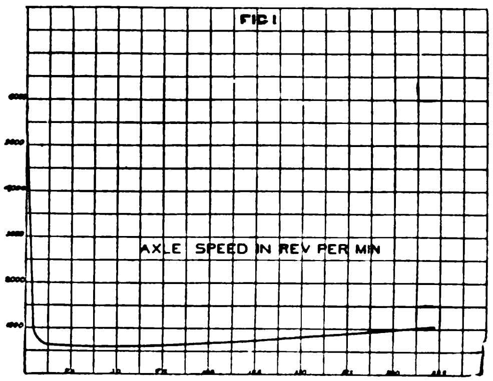

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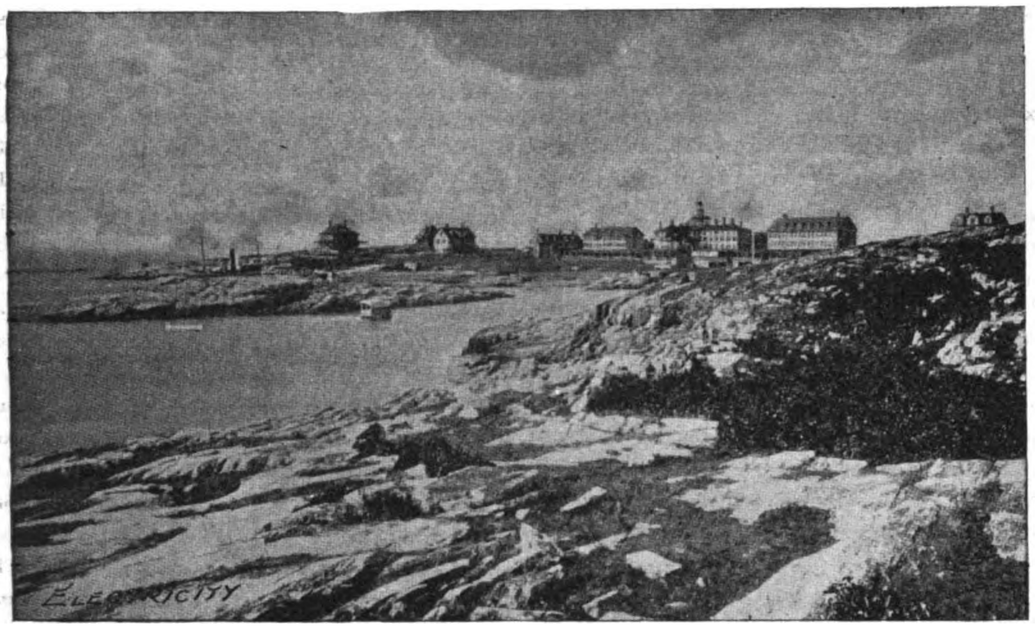

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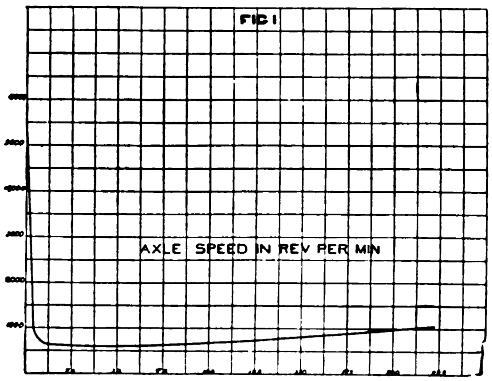

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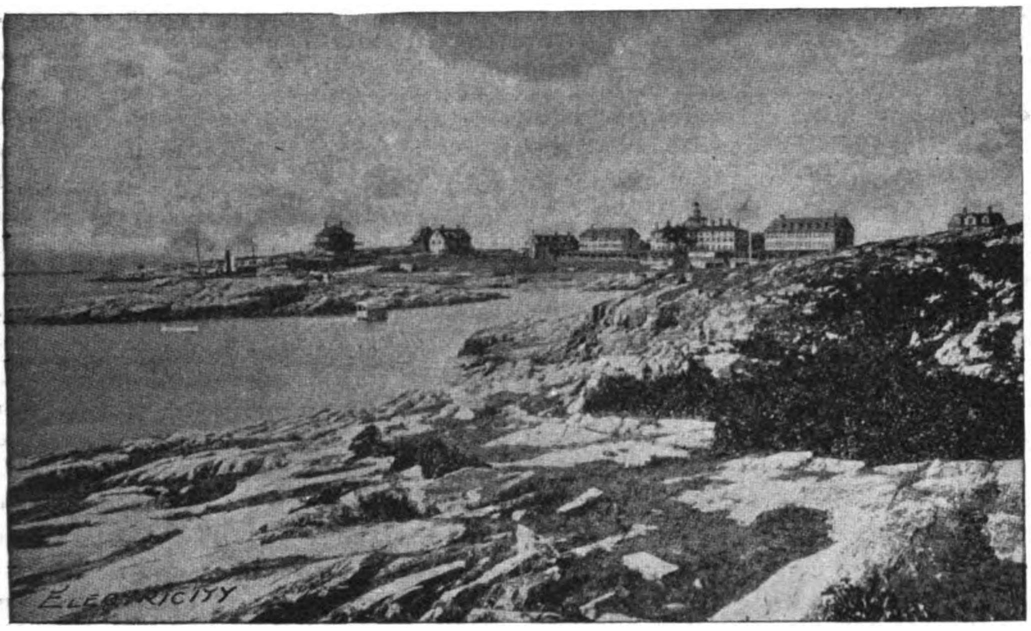

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Telephone Patents Again.

We still continue to receive inquiries from a great many quarters as to the status of the telephone patents, and while we wish to oblige our readers as far as possible by answering any questions on which information is obtainable, it is manifestly impossible to authoritatively answer a number of inquiries which involve questions that are as yet undecided by the United States Supreme Court; nor can we undertake to invent or adapt a system of telephony which avoids infringing all existing patents; yet it is not impossible to do so and will be less difficult on the expiration of the Bell receiver patent, next year.

In regard to establishing exchanges to compete with systems already existing in different places, operating under the patents of the American Bell Telephone Company, it is very doubtful if such an attempt would prove successful, as the established business would for many reasons have great advantages over its rival. From the nature of the business there is hardly room for more than one telephone service in any city, as there would be naturally no connections permitted between the subscribers of the rival companies, a condition which would be as unsatisfactory to the subscribers as the divided service would be to the telephone companies.

In a city without this service, where a new system is be installed, the conditions are different. The only trouble in this case would be in arranging the details of the exchange so as to avoid infringements of patents on minor points, of which there are quite a number. For example, the switch on the magnets for ringing up the central, which is normally closed by hanging the receiving instrument on its forked handle, is patented, and without this an extra switch would need to be manipulated. Many of the details of the central station switchboards are also patented, and considerable work would be involved in arranging the details of a system which would both secure an efficient service and avoid all infringements on these patents.

Concerning the manufacture of telephone instruments there is less difficulty in the way, and for private lines there are no important obstacles in the way of patents which have not already been overcome.

It is well known that the art of telephony and the Blake transmitter are public property, and that the first patent on the Bell receiver will shortly expire. The Edison patents and the Berliner patent relating to microphones with variable surface contact are still in force, and although the validity of the latter patent has been called into question, no decision on this point has been handed down by the courts. The use of a permanent magnet in the transmitter is also patented, but this is not of much importance as an electro-magnet may be used there with equally good effect. The variable contact microphone is also not an absolute essential, although it is undoubtedly the most convenient device that can be adopted. This can be replaced, however, by a microphone in which the conductivity is varied by the changes of density in the carbon or other material due to varying pressures but with a fixed contact surface. This has been accomplished in various ways, among others by the compression of a carbon spiral.

As the matter stands now, telephones of the pattern at present used by the Bell Company cannot be generally manufactured, but enough of the patents on these instruments have expired to permit the free manufacture of very serviceable and effective instruments for this purpose.

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Electric Line Construction.

There is no branch of electrical work that has undergone such a radical change as that of construction work both in the department of house wiring and outside lines. With the former the change has been brought about largely by the increasing demands of fire underwriters, while in the matter of street lines the improvement in construction is due chiefly to the demands of æstheticism, although in a few cases accidents on overhead lines have accelerated the movement in the direction of underground construction.

The experience of a number of illuminating companies in New York City at the time all overhead wires were ordered to be buried was, in many respects, a trying one, as at that time very little experience could be brought to bear on what was then a practically untried problem. In time, however, most of the overhead wires were buried, and in spite of the large expense which this involved, it is safe to assume that not one of these companies would willingly return to the old and poorly insulated aerial lines which were abandoned only under compulsion. For large cities, underground lines are now generally specified by municipal regulations, and for these the standard of insulation is maintained at a figure unthought of for overhead lines. The cost of conduits and of the extra insulation for this work is enormous in comparison to the cost of overhead lines, and it is only in a few of the largest cities that sufficient business is done to warrant such an investment. In a good many places, it must be admitted, the companies operating overhead lines have brought this extra expense of burying their wires upon themselves by permitting the overhead lines to remain in a most disgraceful condition, both as to insulation and general appearance, and in order to prevent the demand for underground wires from becoming general, which would mean bankruptcy for a good many companies, it behooves them to take the greatest care in the construction and maintenance of their overhead lines. Although in a large system this change may prove economical in the long run, the first cost of it is enough to warrant almost any company in avoiding it if possible, and in order to do so the overhead lines must be made as unobjectionable as possible. The public are now assured of the feasibility of underground construction, and will be pretty sure to demand it if overhead lines are not kept in thorough order.

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THE General Electric Company on October 27 made a formal announcement that the November dividend would be passed, but failed to state when dividends would be resumed.

The Packard Lamp Factory Reopened. By reference to our news columns our readers will see that the Packard lamp factory at Warren, O., which was closed in July by injunction, has been reopened, and that the company is prepared to supply standard incandescent lamps in any quantities, guaranteed to be entirely independent of the Edison patent.

Thus the long coveted monopoly of the General Electric Company in incandescent lamps recedes farther and farther from their grasp.

The field is open, and we welcome the Messrs. Packard, who also announce a new style of lamp, the "Mogul," which is to be made in sizes hitherto unattempted.

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THAT was an interesting circular sent out by Mr. Coffin a few days ago, announcing that the common stockholders in General Electric might share in the benefits of the much-talked-of syndicate which has bought about $12,000,000 of General Electric securities for $4,000,000. The circular failed to explain how it came about that the stockholders are compelled now, in order to protect themselves, to buy something which already belongs to them and for which they never received any compensation. Mr. Coffin's literary effort would have been far more interesting to electrical people if he had included a list of the securities sold. The fact that the rights to subscribe to the stock of this syndicate are selling at a premium of ¼ of 1 per cent. only would indicate that a few gems from Syracuse, Little Rock, Pueblo or Fort Worth have been sandwiched in with the really good securities.

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WE HAVE remarked several times that, in our judgment, Mr. R. T. McDonald is a slicker man than Mr. C. A. Coffin. There are many who agree with us, and many who do not. The opposition has gained strength in the last few days, because Mr. McDonald has been arrested first for crime, while Mr. Coffin has only been indicted. We, however, stand by our original opinion, as we believe Mr. McDonald to be an unfortunate and innocent victim of adverse circumstances. He fell among thieves when he became a stockholder in the Madison Square bank by borrowing the money from the bank with which to pay for his stock. We hope the courts will take our view. Ravvy and Caddy have worked the public too long in company to be separated now by prison walls. We prefer to have *both* of them at large, contributing, as they always have, to the gaiety of life. But if Ravvy must go to jail, by all means let Caddy go with him.

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THE HUMOROUS editor of the *Electrical World*, in supplying titles for the illustrations of the Milwaukee Convention exhibits, apparently attempted to escape criticism by making them as indefinite as possible. In one instance, however, his humor is almost too subtle to be easily explained. In an illustration entitled "The Largest Belt in the World in Actual Operation," a large belt is shown closely coiled and standing on the floor.

Is this the "actual operation" for which this belt was designed, or have we missed the joke?

THE General Electric Company announced some months ago that they had practically secured the Niagara contract. But "things got by fraud abide not," and the theft of the blue-prints miscarried.

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RECENT events indicate that Mr. R. T. McDonald, like Mr. C. A. Coffin, regrets his attempt to soar as a capitalist in this great and bustling metropolis. He was very successful when the scene of his activities was confined to the rural districts, and scores of aldermen throughout the land remember with pleasure and profit his warm and substantial handshake. New York is no place for a pious and unsophisticated countryman like Mr. McDonald. There are too many newspapers here, always ready to blast a man's reputation whenever the opportunity rises. And the worst of it all is, we fear, Mr. McDonald has utterly ruined his chances of succeeding Mr. Coffin in the Presidency of the General Electric Company.

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IT IS said in Chicago that the once placid features of Mr. B. E. Sunny have taken on a troubled look since "Stockholder" began a series of articles for ELECTRICITY. Important instalments may be looked for shortly.

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THE wrong blue-prints were stolen. The General Electric Company should have stolen the drawings of Dr. Sellers and Prof. Forbes.

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THE FINANCIAL editor of the *Daily America* believes the recent advance in General Electric is unwarranted by the actual value of the stock. He says:

> Taking the present earnings of the property, and allowing for the debenture bonds and capitalizing the earnings on a basis of 6 per cent., the present issue of stock is just about worth 30 and no more, and when the facts concerning the property are made public previous to the reorganization of the property, which is inevitable, the stock will go to just about that figure.

Legal Notes.

By a decision of the Court of Appeals at Albany, John W. Cleary obtains $3,500 from the Municipal Electric Light Company of Brooklyn and an additional $855 for costs. The plaintiff was a lamp trimmer in the employ of defendant, and February 9, 1888, received a shock that threw him to the ground. Two weeks after he received $250 from the company and afterwards his wages for four months. He at that time executed a general release, but claims he did not understand it at that time, and subsequently brought suit for $50,000. The release executed by the plaintiff was the chief point in appellant's argument.

The Bidwell electric patent case, now in the courts at Toledo, is an interesting one, as it attacks the right of the use of the trolley pole and stand in the transmission of electricity from the single overhead wire in the supply of power to street cars. A similar application for the lighting of cars is also involved in the same suit. "Mr. Bidwell, the complainant, claims," says the Toledo *Blade*, "to be the first and original discoverer of this manner of utilizing electricity, and alleges that any use of his principle is an infringement. In late years this method of street locomotion has become exceedingly popular, and wherever electric street railroad systems have been established the single wire trolley is in use. This means a big fight, as the opposition to the Bidwell claim is unlimited, and millions of dollars are involved."

In the United States Circuit Court, New York, Judge Lacombe has granted a preliminary injunction to the American Bell Telephone Company against John S. Steenburg for an infringement of Letters Patent Nos. 186, 187, granted to Alexander Graham Bell, January 30, 1877. A similar order has been asked for against Lewis H. Multer and William Harvest for violating the same patent, and a hearing has been fixed for November 3. The patents were granted to Mr. Bell for a period of seventeen years, were subsequently by assignment vested in the American Bell Telephone Company, who since have, it is claimed, the sole right to manufacture and authorize others to use telephones embracing the invention. It is said that 150,000 instrumonts are now in use, from which the American Bell Telephone Company obtains royalties.

In appointing H. C. Adams receiver of the Newton Electric Light and Power Company, whose capital stock was claimed to be $150,000, while the whole plant, it is alleged, cost but $28,000, Chancellor McGill, at the hearing of counsel in Jersey City, remarked: "There must be some pretty rough handling of these companies by the courts. They issue millions of stock, and thus deceive poor people by conveying the impression that there is abundant capital behind the concerns, but when the end comes the assets have no value. They have issued stock for patent rights that have no real or attachable values to them. These corporations are but little more than partnerships as organized under the General Corporation act, and the courts and Legislature will be soon forced so to consider them."

The Niagara Contract Closed.

The Westinghouse Company is the Winner.

End of a Long Struggle.

The Cataract Construction Company on Saturday, the 28th ult., awarded to the Westinghouse Electric and Manufacturing Company the contract for building the immense generators, etc., for the transmission plant at the Falls.

The machines are to be built from designs prepared by Messrs. Coleman Sellers and George Forbes, the engineers of the Cataract Company, and will be many times larger than any that have been built heretofore.

The apparatus will be built in units of 5,000 horse-power. The revolving field of the generators is to be constructed with inwardly projecting poles, and will revolve in a horizontal plane, being mounted upon the vertical shaft of the turbine.

The weight of the shaft, turbine and armature is to be carried by the upward pressure of the water-columns producing the heads for the turbines. The electromotive force generated will be 2,000 to 2,400 volts, and will be increased by step-up transformers for long distance transmisson and lowered by reducing transformers for distribution. The motors will be the two-phase Tesla motors, which have been found to be well adapted for power purposes. The system adapts itself readily to the use of motor generators or rotary transformers, so that it is possible to develop either single phase alternating currents or continuous currents of any desired electromotive force as may be required for the uses of individual customers.

The officers of the Cataract Construction Company include the following well-known business men: Edward D. Adams, who is president, Francis E. Stetson, Edward A. Wickes, Wm. B. Rankin and Dr. Coleman Sellers as engineer, with Prof. George Forbes, of London, as consulting engineer.

Power House Engines.*

The subject of Power House Engines for Electric Railways embraces one of the most important and interesting subjects that street-railway companies have to consider in the equipment of a power plant.

The subject represents the vital part of a street railway; as the heart forces the life current through the arteries of the body, and an impairment, or weakness of this vital organ, will produce impaired health, so also is the power house engine the vital part of the street railway, as it produces the power that creates and forces the electric current through the arteries (the trolley wire) of the electric railway, and, like the heart, if the engine regulates badly, it produces a bad circulation of varied potential, which impairs the service of the road.

The variety of opinion as to the best kind of an engine for street railway power makes the subject a difficult one on which to reach a conclusion that would not be criticised, and your committee will therefore endeavor to treat the subject impartially, and in such a manner as will result beneficially to the Association. The most essential points to be considered are as follows:

First—Perfect Regulation.
Second—Highest Economy.
Third—Greatest Durability.
Fourth—Division of Power into Units.

Good service and uniform speed of cars can only be maintained by a constant, unvarying potential, and in order to do this the engine must regulate practically perfect, so that there will be no variation of speed as the load varies The varying power required on an electric railway is unquestionably considerable, caused by cars constantly stopping and starting, going up and down grade, rounding curves, using resistance in order to run slow through crowded streets (which necessarily increases the load), and in order to have perfect service, and uniform speed of cars, the engine must be constructed so as to maintain a constant and uniform speed under any variation of load. This variation of load amounts to a very considerable fraction of the whole maximum load; in small plants it may read 95 per cent. of the maximum, and in large plants is frequently 50 per cent.

If the speed of the engine decreases when a heavy load comes on, the potential is reduced, which consequently reduces the speed of the cars, heats the car armatures, and creates an extra strain upon the machinery, which of course means an increase in the consumption of fuel, and in various other ways produces imperfect and expensive service. If the speed of the engine increases when the load diminishes, it consequently increases the voltage or potential, which is liable to result disastrously to the generators and car motors. Moreover, if the engine regulates badly, and the load diminishes suddenly, the engine is liable to "race," which is nearly always attended with more or less disastrous results.

The governor or regulator to be mechanically perfect should be made of the best material and workmanship, and should be so constructed as to control the engine under any variation of load, with a variation of speed not to exceed two per cent. An engine that will regulate within two per cent. is practically perfect for street railway work, though there are engines on the market that, on electric railroad service, can be held to one per cent. deviation from the mean speed. The governor should be constructed so as to be easy of access to all of its parts, and capable of being oiled while the engine is running. Particular attention should be given to the construction of the governor to see that there are no weak parts, and it should be so constructed as to make it the least intricate and complicated. The range of cut-off must also be larger than in engines for less variable load. This cut-off should be easily regulated between the limits of $\frac{1}{10}$ and $\frac{7}{10}$ of the stroke.

The severe conditions of high speed and sudden and extreme variations of load make it especially important that the engine have the best possible construction, with extra weight in the fly wheel and bed plate, and that the foundation be more than usually substantial.

One of the most important features to be observed, in order to maintain perfect regulation, is to place the engine in the hands of a competent engineer, who is capable of adjusting and keeping the engine in good running order; a good engine, or piece of machinery, placed in the hands of an incompetent person will never give good service or economical results, and no doubt a large number of cases where engines do not give good service, the expense of maintenance high, and perhaps a large number of the frequent casualties, are attributable to incompetent, careless or negligent engineers.

The matter of economy has been exhaustively discussed from a scientific standpoint in the various periodicals, as well as before the learned societies, and your committee feels inadequate to the task of presenting a report that will not be a repetition of the records on the subject. The committee will, therefore, not undertake to deal with the subject in an elaborate and scientific manner, but will endeavor to give a few practical hints that will be of interest to the Association.

The economy of an engine is dependent to a great extent on the other parts of the power plant, and it will therefore be proper to discuss the matter in all of its phases, even though it may be a slight digression from the subject proper, as economy is the most important factor in the operation of a power plant.

In order to obtain the highest economy in the operation of an engine, it is necessary to have the engine properly adjusted to its load. It is a fixed principle that the highest engine efficiency results in working the engine constantly at its maximum rated capacity; underloading or overloading are each, therefore, undesirable, though the compound condensing engines of the larges stations will stand underloading better than the simple high-speed engines, and both classes of engines will stand underloading better than overloading; there should then be ample power both in boilers and engines to obviate excessive overloading as well as to provide for contingent breakdowns or needed repairs. Whatever the style or type of engine adopted, it should be kept scrupulously in the best possible working condition. The packing should be kept intact, valves free of leaks, cylinder perfectly smooth and true in diameter, so that there will be no loss of live steam. The cylinders and bearings should be kept well lubricated, and one of the most important factors is to have the steam enter the engine at a steady pressure at all times, as good service cannot be obtained when a steady steam pressure is not maintained. Careful attention should be given to the setting of the valves so that the cut-off will be the same at both ends of the cylinder. The engines should be set in the closest proximity to the boiler so as to require the least amount of steam pipe, as the longer the steam pipe the greater is the loss by condensation. The steam pipe should be covered with one of the best non-conducting materials, of which there are several on the market, so as to reduce to the minimum the loss by conduction, radiation and consequent condensation. Flexible joints should be used to prevent leaks at the joints from expansion and contraction. It should be borne in mind that wherever there is a leak of steam there is a loss of dollars and cents.

We are so accustomed to consider the reciprocating engine as the only steam motor within our reach that it is not surprising that a new form of steam motor should have quietly been developed without our notice. The committee refers to the steam turbine, one form of which, the Parsons steam turbine, has recently been subjected to rigorous and searching trials and tests by Prof. A. D. Kennedy, of London, England, who has developed power at the rate of $20\frac{3}{10}$ pounds of water per electrical horse power per hour in a turbine using steam at 97 pounds per square inch and making 4,600 revolutions per minute, the turbine having a capacity of about 165 horse power. The small size of this motor, absence of reciprocal motion and consequent independence of heavy foundation; high speed of rotation and consequent availability for gearing direct to generator; simplicity of construction and consequent low cost, and its very high efficiency as a motor, all tend to make this a strong rival to the reciprocating engine as a steam motor for electric power and light stations.

The next point to consider is the boiler room, where the steam is generated. Engines may be of the very best type, and, together with the steam pipe, may be in perfect condition, but unless the boiler room receives the proper attention there will be dollars lost where cents are saved in the engine room. The design and proper construction of the boiler plant are quite as essential to economy as is the case with the engine. The boiler plant should have ample capacity, as there are few cases when the draft and setting are so excellent as to allow heavy forcing without a serious loss of economy. A raising of the evaporation from $6\frac{1}{2}$ to 7 pounds of water per pound of coal represents the saving of about seven per cent. of the coal bill, which would warrant the incurrence of an expenditure for improvements equal to one whole year's coal bill. The boilers should be equipped with good boiler cleaners, and should be inspected regularly and kept free of scale; the flues should be kept clean and boiler walls intact. With the boilers in proper condition, and with proper draft, the very best results should be obtained, but in order to do this the boiler room must be in charge of a competent man.

Fuel is one of the largest items of expense attached to a power house, and the waste of fuel by incompetent firemen is one of the greatest leaks attached to the operating expenses; it is a safe proposition to state that an incompetent fireman will waste enough fuel in a year to assist very materially in paying a dividend. Simply the act of pitching a shovel of coal does not qualify a man as a fireman, it requires skill and intelligence. There is a natural disposition among the laboring classes to endeavor to do their work with the least amount of labor, and as a rule the fireman will fill his furnace half full of coal at one time, give it a stir with a poker, and then sit down and rest until time to fill it up again, instead of firing frequently, maintaining a light fire, and scattering each shovel of coal evenly over the grate bars, by which the maximum amount of heat can be obtained from the least amount of coal.

The use of oil as fuel in place of coal is a live question with power and light station engineers and managers. Probably the most complete evidence of this kind comes from a recent and exhaustive test of the power plant of the Twin City Rapid Transit Company of Minneapolis and St. Paul, Minn., made by Messrs. Wm. A. Pike, of Minneapolis, and T. W. Hugo, of Duluth, Wis., on the comparative value of the two fuels, coal and oil. This test showed that with ordinary Lima oil weighing $6\frac{8}{10}$ pounds per gallon, and costing $2\frac{1}{4}$ cents per gallon, and coal that gave an evaporation of $7\frac{1}{2}$ pounds of water per pound of coal, the two fuels were equally economical when the price of coal was $3.85 per ton of 2,000 pounds. With the same coal at $2 per ton the coal was 37 per cent. more economical, and with the coal at $4.85 per ton the coal was 20 per cent. more expensive than the oil.

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* Abstract of Committee Report read before the American Street Railway Association.

The loss of power between the engine and switchboard terminals is from 15 to 25 per cent., which is attributable to the inefficiency of dynamos, and also to the friction of countershafts, belts, idlers and attachments, which are simply power consumers, representing a waste of power without any resultant benefit. Besides the loss of power, the expense of maintaining the various arrangements for the transmission of power is quite considerable. This waste of power can be overcome by connecting the generator direct to the shaft of the engine. While machinery of this class is more expensive than the other because it demands a slow speed for the generator, necessarily increasing its size, the saving in power and maintenance of the machinery of transmission will be sufficient to compensate for the slightly reduced dynamo efficiency, due to slower rotation, and will warrant the recommendation of the direct driven equipment for moderate or large sized plants. The direct coupling of engine and generator gives also an important advantage, particularly in the large stations in crowded cities, by the considerable saving in floor space.

The committee look with favor upon compound engines for street railway work, especially so with engines having ranges of cut-off wide enough to keep the low pressure cylinders from ever expanding below atmosphere. When this is the case, there is no doubt that the compound engine is very economical, as it carries the expansion of steam to a greater limit. Where it is possible to condense in connection with the compound engine, there is not the slightest question as to economy. In fact, where condensing is possible, there is no reason why the expansion should not be carried to a further limit.

When electric traction was first introduced for street railways, engine builders were not cognizant of the actual requirements for this kind of service; they did not anticipate fully the extraordinary variation of load and the liability of a short circuit, which so severely test the strength of an engine. They proceeded to build engines from theoretical plans and specifications which have proved by actual practice to be entirely inadequate for this class of work. Engine builders, however, are endeavoring to overcome mistakes which were made at the outset, by strengthening and making all of the parts more durable and to make such improvements as will meet all the demands for this extraordinary class of work.

DIVISION OF POWER INTO UNITS.

When electricity was first introduced as a motive power for street railway transportation the largest type of generators were small units as compared with those manufactured at the present time, and, as a rule, high-speed engines, from one hundred to two hundred horse power, belted direct to the generator, were in most cases adopted without regard to the size of the plant. Local surroundings and conditions will, to some extent, govern the division of power into units, but, as a rule, the following principle will be safe to follow: The size of the proper unit of subdivision should be such as to give the required relay or reserve above the maximum power adopted. This will apply equally to boilers, engines and dynamos. The accompanying table will serve to show approximately the proper proportion.

Maximum H. P. Required to Operate Road.	Number of Engines Required.	H. P. of each Engine.
200	2	200
400	3	200
600	3	300
1,000	3	500
1,500	4	500
2,000	4	750

It will be observed from this table that enough engines are provided to furnish the maximum horse power required to operate a road and have a surplus of one engine. This is very essential, as it enables the engineer to keep his engines in perfect adjustment and repair, having at all times an extra engine to work on, or, in case of a breakdown, the extra engine is ready to take the place of the disabled one.

In selecting a type of engine, the size of the installation must largely govern, as well as local conditions, such as water supply and price of fuel, though some consideration may be given to opportunities for station room and arrangement. For small plants to run ten or fifteen cars, simple high speed engines belted direct to generators are unquestionably the proper choice. For twenty to fifty car plants, compound engines, with condensing apparatus where it is possible, with tandem compound engines for the smaller plants and cross compound engines for the larger ones, geared direct to generator, will probably be found most economical, while for the larger systems compound or triple expansion condensing engines, using steam at a high initial pressure and either driving a countershaft or coupled direct to generator, whichever the conditions of the case will warrant, will be found a proper selection. In every case, except for small plants, where engines are belted direct to generator, the vertical type of engine is recommended.

In conclusion, the committee desire to impress the importance of keeping the steam plant as near as possible to the conditions that exist when the engines are installed and being run under the supervision of the mechanical engineer who installed the plant. This, perhaps, is of as much or more economic importance as the design of the engine, as the plant is then run by the expert in charge with a view to attain the highest degree of efficiency and economy.

Respectfully submitted.

E. G. Connette, *Chairman of Committee.*

Heavy Gradient Compensator.

One of the most ingenious contrivances for assisting tramcars up and down a short length of stiff gradient is described in the *Engineering Review* for September. The plant has been in successful operation for some time at Seattle, Washington. For a distance of 1,000 feet there is a gradient varying from 11 to 16 per cent. Two counterbalance weights aggregating six tons run on rails laid in a conduit beneath the track. These weights exactly balance an empty car, and are attached to wire ropes running over pulleys. At the top of the gradient on its way down the car picks up the rope and in descending hauls the weights up, thus checking its own speed, so that the car brakes will hold the load without difficulty. At the foot of the gradient the conductor disengages the rope by means of a hand-lever. Going up, the connection is made automatically and disengaged in a similar manner. A gradient of 20 per cent. may be readily overcome by means of this simple and admirable expedient. It will be evident that since the action is cyclical the only loss of power is that due to the small friction of the gear and tackle, while the only condition necessary to continuous working is that cars going up the gradient shall alternate with those coming down. In a horse traction system such a device means humanity; in a system of electric traction it means smaller motors per ton of rolling stock and a greater annual saving of energy which would otherwise be spent in raising cars up hill or in brake-power on the down trip.

BOOK REVIEWS.

Drum Armatures and Commutators. By F. Marten Weymouth. The Electrician Printing and Publishing Company, Salisbury Court, Fleet Street, London, Eng. 273 pp. 152 illustrations.

This work treats in an elementary manner the subject of drum winding, and describes the principal methods of winding in use on armatures of this type. Commutators are also treated in the same general manner, which is essentially descriptive.

The first nine chapters deal with the various styles of drum windings in use in different types of machines, and the construction of these armatures. The four following chapters are devoted to the description and construction of various commutators, and the remaining chapters treat of armature reactions as affecting sparking at the commutator.

The scope of this work is limited to the discussion of the general principles of construction and to descriptions of drum armatures, and avoids mathematical treatment as far as possible, as well as all reference to the calculation of the windings and capacities of armatures. For this reason the book is necessarily elementary and is adapted to the instruction of the beginner rather than to the use of the practical designer of electrical machinery.

Within the range covered by this work the information is complete and accurate. The general principles laid down for the design of armatures and the best methods of construction, as well as the precautions to be observed in the matter of insulation, are all carefully explained at considerable length and in language intelligible to the non-technical reader.

The Book of the Fair. By Hubert H. Bancroft. The Bancroft Company, Publishers, Chicago, Ill. Twenty-five parts, 40 pp. each. Price $1.00 a part.

We have before us Part IV of this serial which is being issued at the rate of about two parts monthly. The object of this work is to present in print the Columbian Exposition entire, and the name of its well known author is a guarantee of its excellence.

Too much cannot be said of the artistic features of this work. The illustrations, which are well chosen, are profuse and handsomely executed. The work is printed on heavy enameled paper, with imperial folio pages 12 x 16, and the typography is unsurpassed. When completed, the volume will form an interesting as well as an elegant souvenir of the Exposition. Rhude, Thomas & Company, 24 Park Place, New York, are the sole agents for the work this section.

Personal.

Mr. Charles Wirt, late electrical engineer of the Ansonia Electric Company, has opened an office as consulting engineer at 56 Fifth avenue, Chicago.

Mr. W. H. McKinlock, president of the Metropolitan Electric Company, who has been in the East for a couple of weeks, has returned to Chicago.

Mr. B. J. Arnold, who was connected with the Chicago office of the General Electric Company for a long period, has established himself as a consulting engineer, with offices in the Rookery.

Mr. H. W. Weller, who has a wide reputation in the trade through his connection with the Sprague and Edison Companies, is now general manager of the United Columbian Electric Company, 280 Broadway, New York.

The Ansonia Electric Company's Affairs.

Application was made in the Superior Court at New Haven two weeks ago for the removal of John B. Wallace as trustee of the insolvent Electrical Supply Company of Ansonia, on the ground that Mr. Wallace owes the concern more than $100,000. The court was also asked to order the books of Wallace & Sons, of Ansonia, inspected by an expert. The petition states that John B. Wallace is indebted to the firm from $25,000 to $100,000.

New President of the West End Railway Company, Boston.

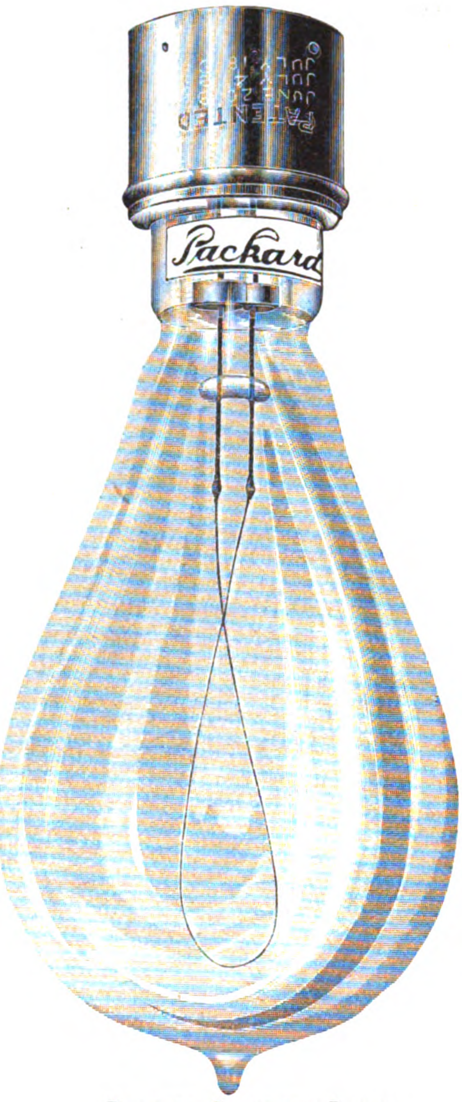
To the surprise of many people the announcement appeared in the Boston morning papers on Thursday that Mr. Samuel Little had been appointed president of the above road in succession Mr. H. M. Whitney, who resigned a few weeks ago.

Since Mr. Whitney's retirement several names had been mentioned as those of his prospective successor. These names included that of Mr. C. A. Coffin, president of the General Electric Company, and Mr. Nathan Matthews, Mayor of Boston. Both have shown much interest in street railway concerns and were thought very eligible for the office. It was stated only a few days ago that no successor to Mr. Whitney would be appointed until the annual meeting in November, but the directors decided otherwise, and on Wednesday one of their own number was chosen.

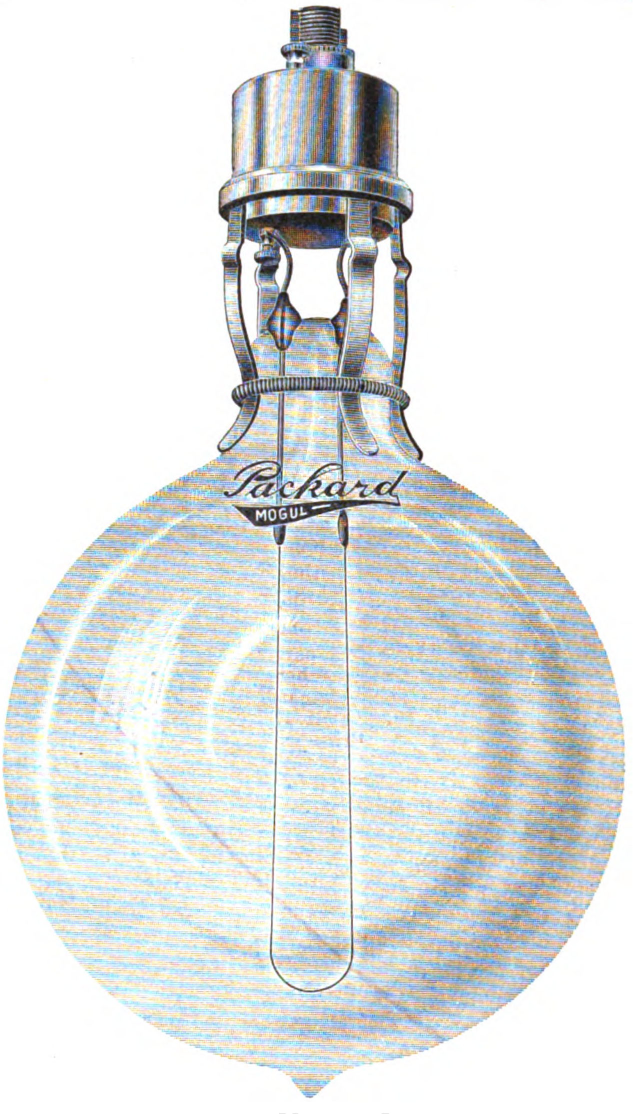
Mr. Little has been identified with the road since its inception. He was one of the original organizers of the Highland Street Railway in 1872 and its treasurer until its consolidation with the Middlesex Company. From the time when all the Boston roads were consolidated and became the West End system, Mr. Little has been a director of the company.

The new president is one of the best known men of affairs in mercantile Boston, and has for years taken a prominent and active part in the management of several large concerns. At the present time he is president of the E. T. Howard Watch and Clock Company, the National Rockland Bank, the Bay State Gas Company and the Boston Lead Manufacturing Company. He is also a director of the Boston, Dorchester and South Boston Gas Light Company and a trustee of the Roxbury Institution for Savings. For more than twenty years he took an active part in public life, having been a member of the State Legislature and of the Boston Board of Aldermen, as well as one of the Board of Directors of Public Institutions of Boston. Mr. Little is a prominent Mason, having filled several important positions in that ancient order, and stands high in the regard of all who know him. In looks, training and genealogy, he is a thorough New England man, having been born, August 15, 1827, in Hingham, Mass., where his ancestors settled after they arrived from Hingham, England, in 1637.

The new president is thoroughly well posted in railway matters as the outcome of a long and active experience, and while he has not as yet outlined the policy he will pursue, his long and close connection and endorsement of Mr. Whitney's policy warrants the belief that the same policy will be pursued under the new president.



Packard Standard Lamp.



Packard "Mogul" Lamp.

PACKARD LAMPS.

The Factory at Warren Running on Full Time.

The "Mogul" Lamp to be Made in Sizes up to 1,000 Candle Power.

The Packard "Mogul" lamp illustrated above is something different from any other lamp heretofore attempted commercially in the United States, and at present they are being manufactured in sizes of 200, 300 and 500 candle power, while other sizes up to 1,000 candle power are in preparation. Special quality of carbons of very low resistance is used in the manufacture of these lamps, and combined with a treatment with gas it produces a lamp of very high efficiency and one that maintains its candle power nearly constant during its normal life.

An efficiency of two and one-half watts per candle power may be attained, and consequently with the same dynamo and engine power nearly double the light of ordinary lamps can be obtained with the Packard Moguls. As compared with small incandescent lamps or with arc lamps in opal globes they give far more light for the same watt expenditure and are absolutely steady. The light never falls momentarily in brightness as does the arc lamp, and its color is much pleasanter and casts no objectionable shadows; it gives no hissing noise and requires no attention from the time it is first installed until the lamp gives out.

Packard Moguls are made in two classes, A (high efficiency) and B (longer duration), but they can be made especially for any efficiency. When they are run at the usual efficiency of the ordinary incandescent lamp their life exceeds that of the latter, but for lighting large spaces it is found more economical to run them at the higher standard.

As their cost is small compared to a group of small incandescent lamps, the extra light gained will on the average pay for the cost of the renewal of the lamp after 150 hours of life.

A special porcelain socket and shade must be used with these lamps. These are permanently attached to the fixture or suspending cord and do not have to be renewed with the lamp.

Packard Moguls are especially adapted for lighting stores, large halls, exhibitions, reception rooms, etc., and in short, wherever a large, steady and efficient light is required.

Packard Standard Lamps.

The Packard factory is now in full operation turning out their new style 6 to 50 candle power lamps of the pattern illustrated. These lamps are protected by about twenty patents besides a number of applications for additional patents.

The neck of the lamp is closed with cement and mica, and iron is used in the in-leading wires, which are not sealed into glass. By this method of manufacture they sacrifice none of the merits of the old style lamp, but all of the good qualities are retained and several new ones added which are genuine improvements.

The Niagara Power House.

The Cataract Construction Company at a recent meeting closed a contract with Stewart & Company, of St. Louis, for the construction of the immense electrical power house at the Falls, and work will be commenced immediately. The contracts for the electrical apparatus, dynamos and other large machinery were discussed at the same meeting, but no awards made.

Current Items.

The tallest building in Stockholm, says the London *Daily News*, is the huge iron latticework tower of the central telephone depot. Myriads of wires run from it, darkening the air. Every one in Sweden uses the telephone, and uses it, moreover, very much. A writer in *The Cornhill*, who has been sojourning in a boarding house in the Swedish capital, declares that the most significant feature in the routine of the establishment was its never-ending telephone babble. When he awoke in the morning it was to hear the jingle of the bells in the corridor outside his room and the iteration of the word "hvad?" (what?). One morning he asked the landlord, who was at the machine, what it all meant. His wife, he replied, was buying some stores, and was telling him about them and their prices, and he on his part was shouting back to tell her in which particulars the prices seemed reasonable and in which unreasonable. Another day the writer's landlord went for a sleigh drive into the country. When he had gone two hours the telephone began to be annoying, and his wife stayed at it for a long time, crying, "oh!" and "ah!" and "yes" and "no." "It is monsieur," explained a young lady who happened to be standing by. "He is resting for dinner at ——, and is informing madame about the incidents of his excursion and the details of the meal that is being prepared for him."

A suggestion having been made of telephonic connection between churches and the houses of lazy or infirm parishioners, in order to supplement the attendance at services, the Rev. Arthur Ritchie is quoted as favoring the scheme, while a number of other clergymen oppose it on one ground or another, principally because the personal influence or individuality of the preacher would be lost. A Roman Catholic clergyman asks: "Can a person receive the full benefit of the presence in the body of the Divine Presence at a mass through telephone? Oh, no; it is necessary for a personal attendance at church and for the eye to see as well as the ear to hear the priest when he celebrates mass, if a person is to receive the full benefit."

To meet the requirements of the numerous large establishments engaged in the manufacture of ready-made garments, in which many hundreds of yards of fabrics of various kinds are cut to pattern every day to be fashioned into articles of wearing apparel, a new electric cloth cutter has been devised. These machines are said to be used in large numbers in New York, Boston, Buffalo, Rochester, Chicago and elsewhere. One machine, it is affirmed, will do the work of eight men. As an example of its serviceability, the statement is vouched for that in a certain New York clothing manufactory one machine is doing the work of cutting 1,000 pairs of trousers per week of five and a half days.

Carl Peterson, a native of Sweden, now residing in Brooklyn, N. Y., is the inventor of a safety trolley device, for the manufacture of which a company has been formed in Brooklyn, with Mr. Peterson as president. He claims that it will do away with all danger of falling trolley wires. The invention consists of a number of brackets, one of which is fastened on the support of the main trolley wire. The brackets are fastened together by a clamp. When a wire falls, or even sags, the clamp opens and the current is stopped. At the same time the system can be operated so that there will be no blockades. The road is only affected between the two supports where the break occurs. The cars can be run up to the break, shifted across the intervening space of about 100 feet, and continue trips.

The question of long distance submarine telephone cables is one which has of late attracted much attention. The idea that a merchant in New York could converse directly with his correspondent in London is a captivating one, especially as questions could be asked on both sides and explanations given to a degree not possible in practice with telegraphy. That the time will shortly arrive when this will be done is the opinion of some of the foremost electrical engineers of the day. An authority of such weight as W. H. Preece, the electrician-in-chief of the English postal telegraph service, has already expressed his belief in its feasibility, and Prof. Silvanus Thompson now concedes that ocean telephony is possible. He says: "The means of attaining it are within our grasp. Compensated cables of the new type are entirely practicable. It may be needful to begin with some shorter line than an Atlantic cable in order to gain experience. But an Atlantic cable constructed on the new plan will not cost much more when laid than one of the old type, and whether or not it is successful in conveying telephonic speech it will certainly transmit telegraphic messages at a greatly accelerated speed of signaling. If one Atlantic cable can be constructed to do the work now requiring eight cables that cable will be constructed. Acceleration of ocean telegraphic service is in itself a desirable step in advance, but the advance will not be complete until telephonic speech is transmitted also from shore to shore."

L'Electricien, Paris, gives the following pedigree of a word which has attained importance in electrical phraseology: Most persons who use the word "trolley" probably do not know the origin of this term, or why this name was given to that apparatus by which the electricity is conveyed from an aerial wire. Twenty years ago the word was used to designate "a form of truck which can be tilted, for carrying railroad material or the like." This is the only definition of the word in Webster's Dictionary of the edition of 1848. In the edition of 1892 of the same work, three other definitions are added. 1. "A narrow cart that is pushed by hand or drawn by an animal." It is noted that this meaning of the word is in use in England, not in the United States. 2. "A truck from which the load is suspended on some kinds of cranes." This meaning is technical, according to Webster, and employed only in speaking of machinery. 3. "(Electric Railway.) A truck which travels along the fixed conductors and forms a means of connection between them and a railway car." It is easy to see how the primitive form of the electric trolley, which travels upon the wires, came to receive its name from its resemblance to other types of trolley; and the name, having been immediately given to this primitive form, was naturally retained when the method of connection was changed from a little truck moving on a wire to a mast having at its end a wheel pressing on the lower surface of the wire.

The latest application of electricity in marine work is to a deep sea fishing boat. A vessel has been fully equipped in England with facilities for utilizing electricity, not only for propulsion but for hauling nets and every other purpose where power is required in the fishing industry.

General News.

What is Going on in the Electrical World.

San Francisco.—The Baden extension of the San Francisco and San Mateo Railway Company is completed.

Indianapolis.—It has been decided to convert the street railway that runs out Kentucky avenue into an electric line.

Plainfield, N. J.—The Plainfield Electric Street Railway Company is building an extension of its line to reach New Market.

Wilmington, Del.—The track of the New Castle and Wilmington Electric Railway will probably be laid this fall, and the wiring and other work be done next spring.

Westbrook, Me.—The Westbrook Electric Light Company has strung wires for the incandescent circuit to Deering and expect to have that city lighted by the last of the present week.

Grand Haven, Mich.—The electric light plant here has been sold by the Greenwich, N. Y. owners to Andrew J. Ernlaw and Geo. W. Miller, of Grand Haven. The plant is valued at $20,000.

Emporia, Kan.—At a late meeting of the city council resolutions were passed looking to the purchasing of an electric plant, and the committee on gas and electric lights was instructed to take such steps as were necessary.

New York.—The east and west driveways in Central Park are to be lighted by incandescent electric lights, served probably from underground conduits, as the park commissioners have so recommended to the Board of Electrical Control.

Hagerstown, Md.—The engineers of the South Mountain Electric Railway, between Keedysville and Boonsboro', have resurveyed the line, making some corrections and shortening the route. The road must be finished in three months.

Ottawa, Can.—An electric dynamo has been placed on a special car at the Canada Atlantic Railway workshops for the purpose of furnishing electric light to the workmen on the Parry Sound road above Arnprior, where the work of laying the steel is to be pushed forward night and day until Renfrew is reached.

Warwick, N. Y.—The Greenwood Lake Railroad Company is considering the scheme of building a trolley line from Greenwood Lake to Warwick, with a view to attracting travel to the railroad. A fine water power at Hewitt's station will, it is claimed, generate all the electricity needed for the operation of the road.

Toronto, Can.—The present year will see all the street car lines within the city converted to the electric system, and next year will likely witness a big development of suburban lines, which will either work in a close alliance with the city system or become part of it. This development will probably cater not so much to the passenger as to the freight traffic.

Chicago.—The Chicago City Railway Company has asked permission of the council to apply the overhead trolley system to all its horse lines.—The Board of Underwriters has decided that hereafter the introduction of electric light into a building, or electric power, or any change in electrical connections, must be approved first by the insurance companies, or the policy will be vitiated.

Sioux City, Iowa.—The creditors of the Sioux City Street Railway Company, which is being operated by a receiver, are preparing a plan for the reorganization of the company. It owns forty miles of electric road, the chief system of the city, and the appointment of a receiver was necessitated by its inability to pay interest on the $1,500,000 of bonds it has out. A meeting of bondholders and other creditors will be held soon to adopt a plan.

Leavenworth, Kan.—Newman Erb, L. M. Erb and M. Summerfield have registered the transfer by the Leavenworth Suburban Street Railway Company of its real estate franchises, cars, equipments, machinery, etc., to the Leavenworth Electric Railway Company, the consideration being $193,000. Electricity will replace the present motive power (dummy and horses) on the greater portion of the line if Mr. Erb's application to do so be granted by council.

Baltimore, Md.—The Southern Electric Company, which made a voluntary assignment in July last because of temporary embarrassment arising from inability to make collections during the financial depression, is about to resume business under its former management. At a meeting of the creditors in New York, the Roebling's Sons Company of Trenton, N. J., the Safety Insulated and Wire Company, the Interior Conduit and Insulation Company, the Okonite Company Limited, and the Western Electric Company of New York, all creditors, were named as a committee to confer with the Southern Electric Company as to the details for the resumption of business.

Tacoma, Wash.—The new Tacoma-Spokane long distance telephone, the second longest line of the kind in the world, has been completed and is now in operation. The line is 600 miles long and extends from Tacoma to Portland, via Tenino, Centralia, Kalama and Vancouver; thence up the Columbia River, across to Colfax and Garfield, and thence along the line of the Spokane and Palouse branch of the Northern Pacific to Spokane. From Portland there is a branch west to Forest Grove, thence south to Independence, Albany and Corvallis, with another branch line to Oregon City and Salem. From Tacoma there is a branch line to Olympia and Hoquiam, another to Orting and another to Seattle and Everett.

Boston Notes.

The Pittsfield, Mass., Electric Railway Company has recently held its annual meeting, at which a very satisfactory report was submitted. The treasurer's report showed that the company had enjoyed a very prosperous year. A new track had been laid nearly the entire length of the road at a cost of $17,000.

The Edison Electric Illuminating Company of Boston has declared a quarterly dividend of 2 per cent. payable November 1. This company is now doing an enormous business in every part of the city, and just as soon as the present financial depression ceases they expect to still further largely increase their business.

Mr. George A. Marden, who is Treasurer for the State of Massachusetts, has just returned from the World's Fair, and in speaking of the great Exposition he said to an acquaintance: "The thing about the World's Fair that struck me most forcibly is the important part that electricity plays in making it the perfect Exposition it undoubtedly is. Without electricity the Fair would be a totally different thing. Eliminate the illumination of the Court of Honor and the Wooded Island, take away the electric railway and the electric launches, close the Electricity Building and remove the electric lights from the grounds and buildings, and one-third of the Fair has disappeared. If we have made this Exposition immeasurably greater than the one of 1876, electricity is greatly to be thanked for it."

The New England Telephone and Telegraph Company has declared a dividend of 75 cents per share payable November 15.

The big new power station erected by the Union Railway Company, Providence, R. I., is nearing completion, and one of the powerful engines was started up for the first time on Thursday last. The plant that is being installed consists of 3 Greene compound engines of 750 H. P. each, run by the batteries of 6 Babcock & Wilson boilers of 1,500 H. P. aggregate capacity. These engines are belted directly to the electric generators of 500 K. W. each, built by the General Electric Company. There are two more engines contracted for of 1,100 H. P. each, which will also be coupled directly to generators. The interior of the engine room is 170 x 72 feet, and the boiler room 104 x 72 feet. The company will use its own electric current on the street cars from November 1.

Col. John T. Wheelwright, a well known Boston lawyer and novelist of repute, has been appointed a member of the State Board of Gas and Electric Commissioners to take the place of Commissioner McDonald, resigned. Col. Wheelwright is noted for his ability and fearlessness, and his accession to the Board is considered to promise advantage to the community.

The Framingham Union Street Railway Company is discussing the question of electricity as a substitute for horse power on its system.

The Quincy and Boston Electric Street Railway Company has declared a 6 per cent. dividend and carried $3,000 to its reserved fund. This company is one of the most prosperous in New England.

It was hoped by the manipulators on the inside that the jumps of 7 or 8 points in General Electric stock which occurred Wednesday and following days, after receipt of repeal news from Washington would tend to restore confidence in the Trust, but it didn't. Conservative men are as shy of it as ever, and it is impossible to find a man who believes anything but that the Trust is nearing its fate—collapse and reorganization. It is equally difficult to get an intelligent expression of opinion as to how matters are working on the inside, but an evening or two ago a gentleman standing very, very near to the president was frank enough to admit that his own opinion and that of others connected with the company both as stockholders and officials was that the only hope of salvation is in the appointment of a receiver, and that the sooner such a step is taken the better for every one interested.

A petition signed by 8,000 prominent citizens came up for hearing before the Board of Aldermen Wednesday afternoon, the petition praying for a reduction of street railway tracks and cars on Washington and Tremont streets. The hearing was a lively one, the petitioners being ably represented by Messrs. Arthur T. Lyman and T. L. Gargan, Mr. H. D. Hyde being in attendance as counsel for the West End Company. For the petitioners it was shown that they represented $180,000,000 of property, and claimed to voice the sentiments of most of the best people in Boston. Mr. Lyman stated that as many as 400 cars per hour passed along parts of Tremont street, while at the Park Street Church over 100 cars were shifted in the hour to the obstruction of the general traffic and with great danger to the crowds of foot passengers in that district. It was urged that only a single track should be allowed along the northern or busy downtown sections of Tremont and Washington streets, and that a circuit should be formed whereby all cars should run round in one direction. It was urged that the public could be properly accommodated under the suggested system, while the inconvenience and dangers would be minimized. Both prominent ladies and gentlemen supported the petition, and warmly urged prompt and decisive action on the part of the aldermen. Mr. Lyman in alluding to the number of accidents that were always occurring, said: "Wonderful street railroading, but a disgrace to the city! It is a magnificent nuisance!" The hearing will be continued Friday evening.

The West End Railway Company's estimated earnings for twelve months ending September 30 were about $385,000 larger than last year, and net about $200,000 larger. Earnings are now about the same as last year. The customary increase of $1,000 per day has not been realized for two or three months.

COMMERCIAL PARAGRAPHS.

The Newton Rubber Works, whose chief offices are in the John Hancock Building, Boston, and factories at Newton, Upper Falls, Mass., is a wealthy firm possessing almost unlimited facilities for the manufacture of rubber goods, including car springs, buffers, rubber-covered rolls, and other devices for use on street railways. The company makes a specialty of storage battery cells, which are now in use everywhere. These cells are of hard rubber, moulded to shape and size as required, and occupy a leading place in storage battery work. They have been on the market for some time, and give splendid satisfaction, the company having received many repeat orders. They are at present busy on some good contracts, and the outlook for business is most promising. Recently they have had to largely increase their facilities, and under the careful yet enterprising care of Mr. Edwin R. Rand, general manager, the company is very prosperous.

The Stirling Company has closed contracts since the 1st of October, 1893, with the following firms for their well-known and efficient boilers: L. A. Riley & Company, Centralia, Pa., 250 H. P.; Simpson & Watkins, Scranton, Pa., 300 H. P.; J. I. Case Threshing Machine Company, Racine, Wis., 300 H. P.; Adriance, Platt & Company, Poughkeepsie, N. Y., 250 H. P.; Midland Steel Company, Muncie, Ind., 400 H. P. This company is to be congratulated for the fine reputation it is making with its specialty, which reputation has just been still further increased by receiving the very highest award given for boilers at the World's Fair. As will be remembered, the Stirling Company had a hard legal battle to fight with competitors before they were admitted to the Fair, but they won their fight, and have captured the highest honors, and now a genuine boom has started up for Stirling Water Tube Safety Boilers.

H. Ward Leonard & Company have placed their name prominently before their friends by distributing an advertising blotter containing a long list of the most important plants installed by them during the past year.

INCORPORATIONS.

The Carbondale and Dundaff Street Railway Company, Scranton, Pa.—to construct and operate an electric railway. Capital stock, $30.000. Promoters: Michael Moran, Carbondale, Pa.; Jos. O'Brien, Jno. P. Kelly, Scranton, Pa.

The Ongley Company, Hoboken, N. J.—to purchase, manufacture and sell electrical and other devices and appliances, patented or otherwise. Capital stock, $25,000. Promoters: G. M. Keasbey, Newark, N. J.; C. E. Ongley, G. B. Hopkins, W. P. Dixon, Jr., W. Miller, G. J. Schoeffel, New York City.

The Forest City Electric Railway Company, Scranton, Pa.—to construct and operate an electric railway. Capital stock, $30,000. Promoters Michael Moran, Carbondale, Pa.; Jos. O'Brien, Jno. P. Kelly, Scranton, Pa.

The Green Electric Signal Company, Kittanning, Pa.—to manufacture and sell articles of commerce made from wood or metal. Capital stock, $50,000. Promoters: M. D. Wayman, Ford City, Pa.; Ira L. Green, G. M. Fox, Kittanning, Pa.

The South Mountain Electric Railway and Power Company has been incorporated at Hagerstown, Md., by George W. Jacobs, Jr., of Philadelphia; Theodore E. Bowne, of New York; Edgar L. Miller, Elmer J. Smith, of Frederick; Charles J. C. E. Shafer and George A. Davis, of Boonsboro. The company will construct and operate twelve miles of electric railway in Washington County, three miles of which will be between Boonsboro' and Keedysville, Md. They will also light the towns of Boonsboro' and Keedysville.

The West Baltimore Passenger Railway Company, incorporated at Baltimore, Md., on the 18th inst., intends to build a suburban electric line through Mount Winans and Camden Junction to the Relay and finally to Ellicott City. Connection with Baltimore lines will be made probably through the Columbia avenue line of the City and Suburban Company. The directors of the proposed road are Wallace Stebbens and Harry O. Stebbens, of Relay: W. H. O'Connell and Henry W. Bennett, of Baltimore, and Barton W. Fenton, of Findlay, Ohio. The capital stock is $100,000.

The Tacoma Gas and Electric Company. Tacoma, Wash.—to erect and operate gas and electric light and power works and sell and dispose of their products. Capital stock, $500,000. Promoters: Wm. H. Elliott, Edmund Rice, Wm. A. Rice, Tacoma.

The Mather Electric Company has filed a certificate with the Connecticut Secretary of State certifying to the issue of preferred stock to the amount of $81,000 and the reduction of capital stock from $200,000 to $120,000.

The Suburban Street Railway Company, Harrisburg, Pa.—to construct and operate an electric railway. Capital stock, $5,000. Promoters: W. H. Seibert, Steelton, Pa.; E. K. Meyers, C. L. Brinser, Harrisburg, Pa.

The Jonesville Electric Light and Power Company, Jonesville, Mich.—to furnish electric light and power to the village of Jonesville. Capital stock, $15,000. Promoters: Geo. F. Avis, Hudson, Mich.; Geo. S. Pomeroy, Enos A. Pomeroy, Victor Hawkins, Jonesville, Mich.

The Gladstone Electric Lighting and Power Company, Gladstone, Mich.—to manufacture and sell electricity for light, power or otherwise. Capital stock, $20,000. Promoters: Jno. W. Kendrick, Jno. Wood, Minneapolis, Minn.; Edwin S. Tice, Gladstone, Mich.

The Gibbs Electric Company of Milwaukee has filed notice increasing its capital from $2,000 to $10,000.

The Connecticut Dynamo and Motor Company, Hartford, Conn.—to execute electrical and mechanical engineering and do all things incidental to said business. Capital stock, $6,000. Promoters: Roscoe W. Ney, Robert E. Dunston, Hartford, Conn.; Donald W. Durand, Middletown, Conn.

The Jamaica Electric Light Company, Jamaica, N. Y.—to manufacture and use electricity for light, heat and power. Capital stock, $15,000. Promoters: Geo. R. Cullingworth, Mt. Vernon, N.Y.; Wm. S. Williamson, Jamaica, N. Y.; Alonzo B. Pettit, Jamaica, N. Y.

The Bryan, Marsh Company, New York City—to manufacture and sell electric batteries, lamps, etc. Capital stock, $40,000. Promoters: Converse D. Marsh, 202 W. 74th street; Thos. C. Hughes, 206 W. 52d street, New York City.

The Natchez Light, Power and Transit Company, Natchez, Miss.—to do a general light, power and transit business. Capital stock, $200,000. Promoters: Maurice Moses and Abraham Moses.

People's Power Company, Rock Island, Ill.—to manufacture and furnish light, heat and power to citizens of Moline and Rock Island. Capital stock, $300,000. Incorporators: Thomas B. Davis, Samuel S. Davis and Charles V. Nason.

Simpson Electrical Supply Company, Chicago, Ill. Capital stock, $12.000. Incorporators: George A. Gloeman, Henry R. Pebbles and Thomas Fahey.

Electric Car Ventilating Company, Portland, Me.—to manufacture and deal in ventilating apparatus and machinery of all kinds. Capital stock, $500,000. Promoters: Wm. Y. Ober, Lynn, Mass.; L. B. Haskell, F. W. Homans, Gloucester, Mass.

Inman Brothers Construction Company, Jersey City, N. J.—to construct, buy and sell water works, gas works, electric light works, etc. Capital stock, $75,000. Promoters: G. B. Inman, W. F. Inman, A. C. G. Williams-Foote, all of 136 Liberty street, New York City.

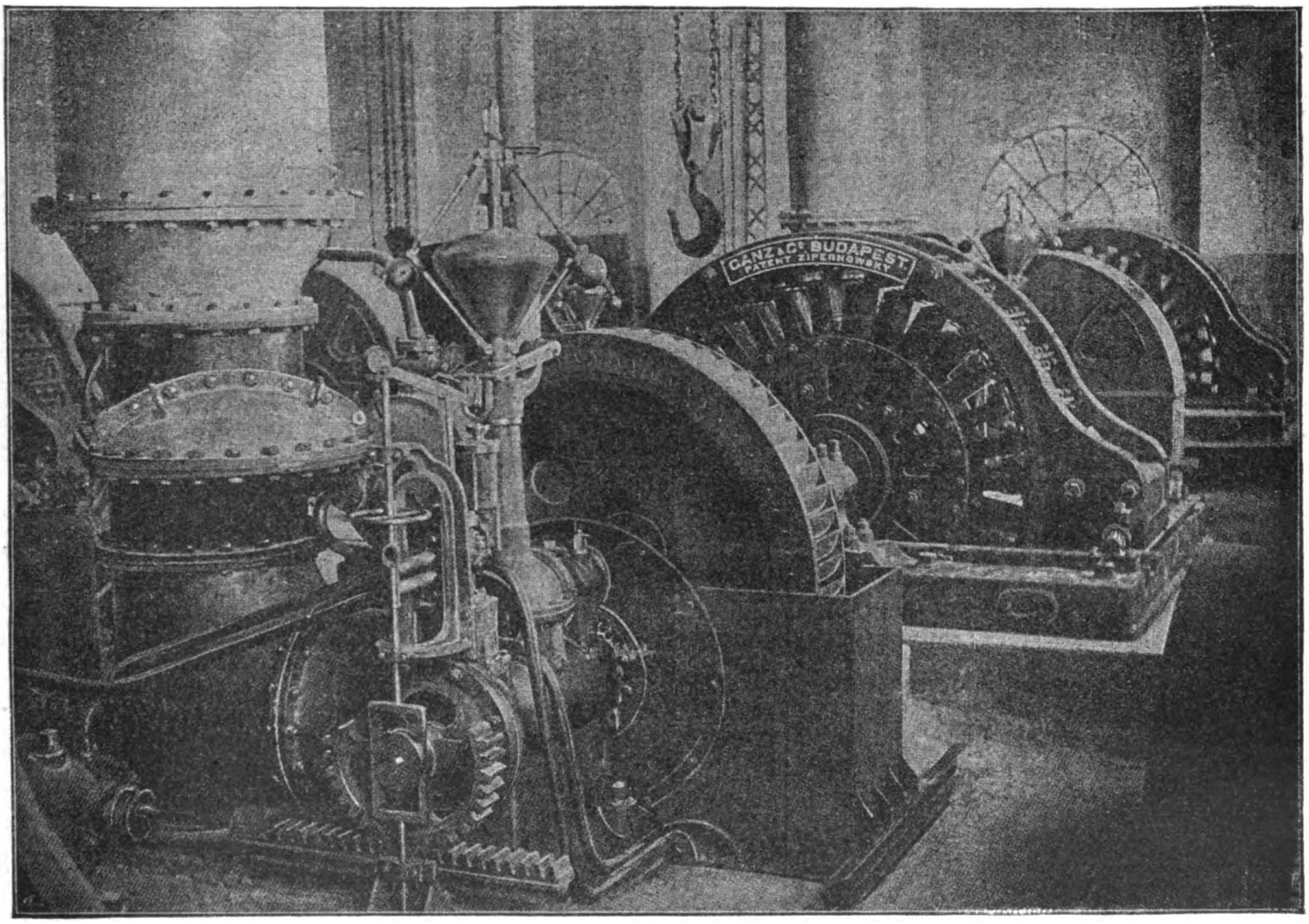
The Muncy Electric Light, Heat and Power Company, Muncy, Pa.—to furnish light, heat and power by electricity to the borough of Muncy. Capital stock, $20,000. Promoters: E. R. Noble, D. B. Dykins, I. B. Painter, all of Muncy.

The Connecticut Royal Arc Company, Elizabeth, N. Y.—to manufacture, operate and deal in apparatus for producing and transmitting light by means of electricity. Capital stock, $500,000. Promoters: G. H. Squires, Plainfield, N.J.; A. Bellamy, C. B. Harris and A. H. Patterson, New York City; F. C. Marsh, Elizabeth, N. J.

The Pullman Electric Company, Chicago—to manufacture, deal in and operate electrical machinery and general electrical business. Capital stock, $25,000. Promoters: F. A. Pullman, David Reid, J. M. Atkinson.

ELECTRICITY.

VOL. V. NEW YORK. NOVEMBER 8, 1893. CHICAGO. No. 17



THE TIVOLI HYDRAULIC-ELECTRIC STATION. (SEE PAGE 198.)

Fraud is Charged.

The General Electric Company Said to Have Been Robbed of $200,000 at Omaha.

Mr. E. A. Kilbourne, formerly assistant auditor in the Chicago office of the General Electric Company, and who has been discharged at various times and reinstated, has given publicity to the charge that he discovered a shortage of something over $200,000 in the accounts of the Omaha office, and was discharged for calling attention to the matter.

Mr. B. E. Sunny, and Messrs. S. L. Wiley and H. E. Chubbuck, of Omaha, it is charged, were the principals. Mr. Kilbourne says the stealings may reach a far larger total.

Mr. Sunny denies the shortage, but admits the truth of all the rest of Kilbourne's statement.

The Tivoli-Rome Transmission.

The large hydraulic station which is operated by the cascades of Tivoli, from which power is transmitted to Rome, Italy, has now been in operation for some time, and has attracted considerable attention among engineers.

The waterfalls which supply this power, it will be remembered, were illustrated in ELECTRICITY, Vol. II, No. 12, and the following description of the plant by means of which this power is utilized will be found of interest :

The origin of the present work may be traced back as far as 1887, when a local company received a charter to divert a certain amount of the water from the falls and to utilize the total fall in several hydraulic stations, for the local industries, for transmitting electric power to Rome and for irrigating purposes.

At that time this company utilized a small falls for lighting in Tivoli, the system being that of Gaulard & Gibbs transformers, with high potential alternating currents.

For several years this was the only work undertaken, but more recently the question of light and power transmission to Rome was revived and the present plant was constructed.

The main features of this are the generating station at Tivoli, the large canals, the transforming station in Rome and the system of wiring.

The main canal, which delivers twelve cubic meters of water per second, has two branches, one of which supplies the power to the generating station, the latter discharging four cubic meters per second. This water is first used for small stations in Tivoli and then passes into a reservoir of 300 square meters surface and two meters deep, from which it is carried to the large station by a series of reservoirs and large pipes. At the station a horizontal pipe 1·6 meters in diameter branches from the main conduit, and runs parallel to the length of the building. From this three smaller pipes run into the building near the roof, and from each of these three vertical columns supply water to the nine turbines.

Of the total fall of 110 meters only about 50 meters is utilized at the station, the remaining fall being utilized further on. The available power, however, provides a total capacity for the station of 2,600 horse power.

The nine turbines, built and installed by Ganz & Company, of Budapest, are of the horizontal axle type, and to each of these is coupled an alternator and an exciter.

A general view of the turbines and alternators is shown in the Frontispiece, which is taken from *Electricité*. Each of these turbines has a special distributor and regulator, both of which are shown in the illustration.

The alternators are of the Zipernowsky type, which is well known. These run at 170 revolutions per minute at full load, generating at that speed 42 amperes each at a pressure of 5,100 volts. The armatures have a diameter of 2·2 meters, and have thirty poles. The efficiency of the machines is 93·5 per cent.

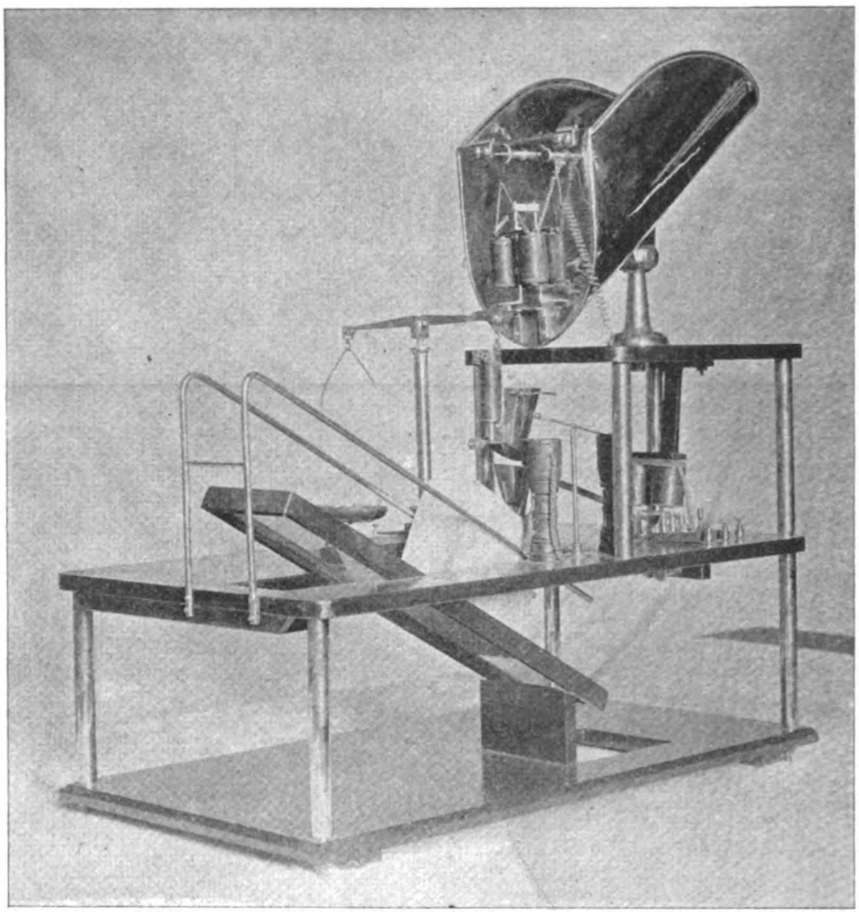
The exciters are four-pole direct current machines with a capacity, at 375 revolutions per minute, of 150 amperes at 180 volts.

An Electric Weighing Machine.

The facility with which electricity lends itself to automatic operations has suggested its use for running weighing machines of this character. One of the latest and most ingenious of these devices has just been completed by Mr. C. F. Wood, of Richmond, Va., and the particular machine described was designed for use in the seed business, in which Mr. Wood is engaged. It is apparent, however, from an examination of this model that but slight modifications are needed to adapt the machine for use with a wide range of materials, and its capacity may be varied to meet almost any requirement.

The object of the invention is to provide an automatic machine that will weigh and deposit in bags, boxes or packages seeds or groceries, such as coffee, tea, spices, baking powder, etc., drugs, or anything else of a granular nature that is offered in commerce. In the seed business the amount of labor and money expended in this work is considerable, some of the larger firms putting up from ten to twenty-five millions of small packages, weighing from one-tenth of an ounce to one ounce, which cost from twenty to thirty-five cents per 1,000 to put up. The way this is generally done is by measuring. This method is inaccurate, and the machine to be described overcomes this inaccuracy by weighing each package, besides doing the work four or five times more rapidly than can be done by hand. The cost of power to run it does not amount to over one dollar per month, as this can be obtained from a gravity battery; or a power circuit divided up with resistance boxes would run fifteen or twenty machines for weighing small packages. The machine can be made of any size, and will weigh practically any quantity from five grains to a thousand pounds or more. It is so arranged that when a weight is placed in the scale pan it regulates the size of the orifice in the reservoir hopper, so as to give the weighing as much speed as possible consistent with accuracy. For instance, take a machine built to weigh packages of from one-fourth to one pound. For a one-pound package there should be a larger opening in the hopper than for a quarter-pound one, as otherwise the former would be too long in weighing, so it is regulated so that when a large weight is put on the scale pan the orifice is large, and as the balance is gradually reached by the merchandise flowing into the receiving vessel the orifice is gradually made smaller until it reaches a certain size, which allows but a small quantity to run in to complete the exact weight.

The machine, illustrated herewith, consists of a reservoir hopper tilted forward so as to give momentum to the materials inside, and having an aperture cut out of its front at the bottom, which is opened and closed by a door sliding in grooves and actuated by electric magnets. The magnets are suspended on a spring and move freely up or down. When the scale beam swings up it strikes a projecting arm fastened to these magnets, and raises them to a height in proportion to the weight on the other end of the beam. At the same time the electric circuit is completed through them by means of a contact piece on the scale pan and a mercury cup, so that the door, being of iron, is drawn towards the magnets, and raised by the pressure of the scale arm. As the weight is gradually balanced the magnets and door move down to a certain point, and as soon as the requisite quantity of material is obtained the contact is broken, and the door, leaving the magnets, cuts off the small stream flowing in. The scale then swings down, and a plunger enters a mercury cup and closes a circuit which operates to open the bag. The seed is deposited in it by the action of another insulated plunger, which operates the door on the weighing receptacle. As soon as this is done the scale swings back, the door in the receptacle closes, the bag is lifted up over a projection and slides away to be sealed, and the door on the reservoir hopper opens again to repeat the operation. The working is entirely automatic, and each package put up is sure to contain the same quantity. The bags used are ordinary seed envelopes, and are placed on an inclined plane with a roller behind them which forces them into position. As fast as one is filled and removed, another moves down into its place. The machine in its present construction is built only for small bags, and an apparatus is now being perfected that will seal them as they are filled. In the form that boxes are made it can readily be seen that the filling of them will not be nearly as difficult as what has already been accomplished.



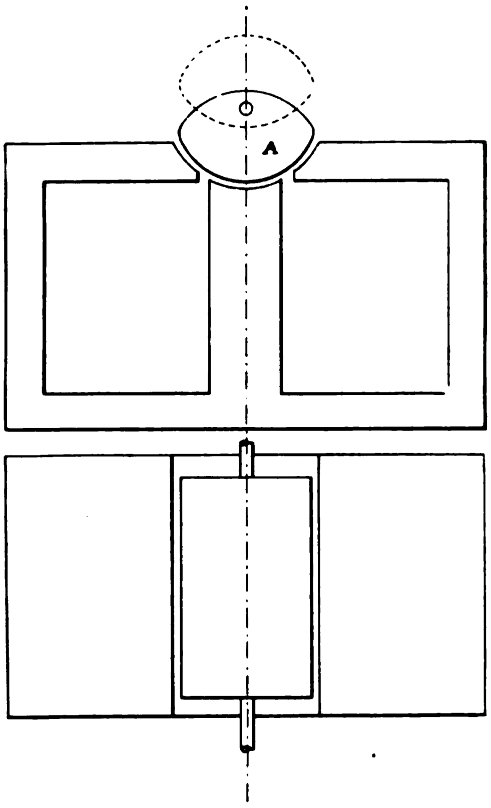
AN ELECTRIC WEIGHING MACHINE.

Transformer Diagrams Experimentally Determined.*

BY DR. FREDERICK BEDELL,

Assisted by A. W. Berresford, W. M. Craft and B. Gherardi, Jr.

Of the various experimental methods used in alternating current work, those are most valuable which ascertain the phase relations of the different currents and electromotive forces, inasmuch as without a knowledge of these relations a full understanding of the phenomena is not possible. Phase relations may be shown by plotting curves representing instantaneous values; or they may be shown by polar diagrams if the currents are harmonic or are assumed to be the equivalent of certain harmonic currents. The representation of the results of alternating current experiments by polar diagrams has an advantage in the fact that such may also be constructed according to theoretical considerations, thus enabling us to compare experiment with theory. The work which is described in the following paper was undertaken with the object of experimentally determining polar transformer diagrams for comparison with similar theoretical diagrams, with particular reference to the effects caused by the variation of the constants of the transformer, as described in a current series of articles entitled the "Theory of the Transformer."†



Arrangement of Transformer. (Half Size.)

FIG. 1.

Experiments were made upon a small transformer, with an output of about 500 watts, constructed and used by Dr. Crehore and the writer for experimental work. This transformer was particularly adapted for the present investigation since it was provided with means for varying the reluctance of the magnetic circuit and thereby the coefficients of self and mutual induction. This variation was produced by the moving of an iron tongue in and out of a gap in the metallic circuit. Figure 1 shows in diagram the magnetic circuit of the transformer and the arrangement of the movable tongue. A laminated iron tongue, A, is arranged so that it may be rotated about an axis occupying the central line of the circular gap which it fills. In the position in which the tongue is represented in the figure, the magnetic circuit is as nearly complete as it can be made. When the tongue is moved through 180° to the dotted position in the figure, the magnetic circuit is most imperfect and the reluctance is highest. The tongue may be moved by an arm and secured in any desired position, and the position is indicated by a pointer moving over a graduated scale.

The essential dimensions of the transformer are as follows:

Length of core (perpendicular to lamination)	2¾ inches.
Width of each plate	5 "
Length of each plate	8 "
No. turns large coil	128.
No. turns small coil	90.
Size of wire in both coils	No. 10 B. & S.
Resistance of large coil	.2272 ohms.
Resistance of small coil	.160 ohms.
Cross section magnetic circuit	12 sq. c.m.

Either coil may be used as primary or secondary.

TABLE OF CONSTANTS.

No.	Arm.	L_s.	L_L.	M. Observed.	M. Computed.	ω = 863. $L_s\omega$.	$L_L\omega$.	$M\ \omega$.	ω = 566. $L_s\omega$.	$L_L\omega$.	$M\ \omega$.	$\frac{L_L}{L_s}$
1	0	.00908	.01743	.0122	.0126	7.83	15.04	10.53	5.15	9.87	6.91	1.92
2	70	.00988	.01924	.01258	.0138	8.52	16.6	11.08	5.58	10.78	7.26	1.95
3	90	.01111	.02199	.01501	.0156	9.60	18.95	12.95	6.30	12.45	8.50	1.98
4	120	.01247	.02525	.01774	.0179	10.73	21.8	15.30	7.05	14.30	10.08	2.02
5	150	.01427	.02918	.0209	.0204	12.31	25.32	18.05	8.09	16.65	11.83	2.05
6	180	.01578	.03310	.02338	.0229	13.6	28.6	20.17	8.93	18.73	13.24	2.10

Changing the position of the tongue alters the reluctance of the magnetic circuit and alters the coefficients of self and mutual induction accordingly; these coefficients increase as the reluctance decreases, and have the highest values when the tongue is all in.

DETERMINATION OF THE COEFFICIENTS OF INDUCTION.

Preliminary to the experiments proper upon the transformer, the values of the coefficients of self and mutual induction of the coils were determined for the different positions of the tongue.

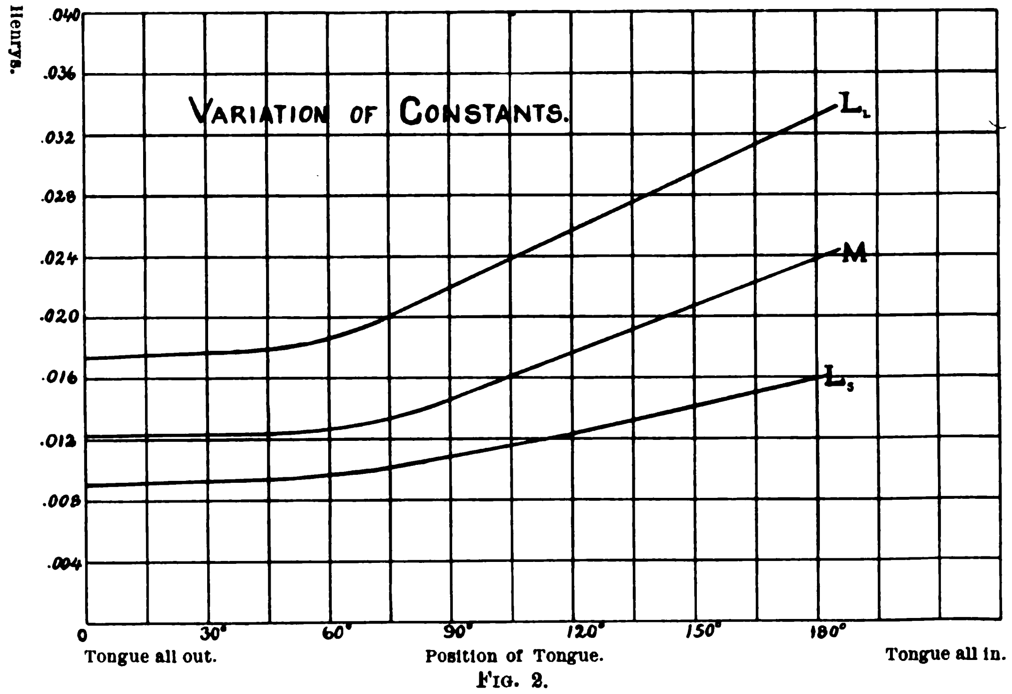


FIG. 2.

For alternating current work, when a reliable voltmeter and ammeter are at hand, the coefficient of self-induction may be readily determined from a determination of the impedance. Measuring the current which flows through a coil when a certain measured electromotive force is impressed, we obtain—

$$\text{Impedance} = \sqrt{R^2 + L^2\omega^2} = \frac{E}{I},$$

where R = ohmic resistance,
L = coefficient of self-induction,
E = electromotive force,
I = current,
ω = 2 π × frequency.

When the ohmic resistance is small as compared with the effect of self-induction, as is usually the case in transformer coils, the value of L becomes

$$L = \frac{E}{I\,\omega}.$$

The coefficient of mutual induction was found by passing an alternating current through one coil and measuring the electromotive force induced in the other. The primary current was measured by a Thomson balance, and the secondary electromotive by a Cardew voltmeter connected across the open circuited secondary. The secondary electromotive force is

$$E_2 = M\,\omega\,I_1,$$

whence the coefficient of mutual induction is

$$M = \frac{E_2}{\omega\,I_1}.$$

As a matter of convenience, the values of the coefficients of self and mutual induction were obtained by simultaneous measurement. The values of these coefficients for six different positions of the tongue are given in the accompanying table.

The position of the tongue is indicated in degrees by the reading of the pointer over the graduated scale, the tongue being all out at 0° and all in at 180°. The two coils of the transformer,

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[*] Read before the International Electrical Congress, Chicago.

[†] Bedell and Crehore, *Electrical World*, Vol. XXI., No. 12, March, 1893, et seq.

either of which may be primary or secondary, are distinguished as the "large" and the "small" coil, and by the subscript letters $_L$ and $_s$, respectively.

In obtaining the coefficients of self and mutual induction for different positions of the tongue, observations were made for different values of the current. The values obtained for the coefficients decreased as larger currents were used, this variation extending through a range of five or six per cent. Mean values were taken corresponding to the currents used during the experiments and the coefficients were considered constant.

The coefficients increase steadily as the arm is moved in from 0° to 180°, but not by equal increments. The positions 0°, 70°, 90°, 120°, 150° and 180° were afterwards used as giving approximately equal increments to L and M. The values of L and M for different positions of the tongue are plotted in Fig. 2.

The column headed M (computed) in the table gives the values of the coefficient of mutual induction computed from the values of the coefficients of self-induction of the two coils, according to the formula based on the assumption of no magnetic leakage,

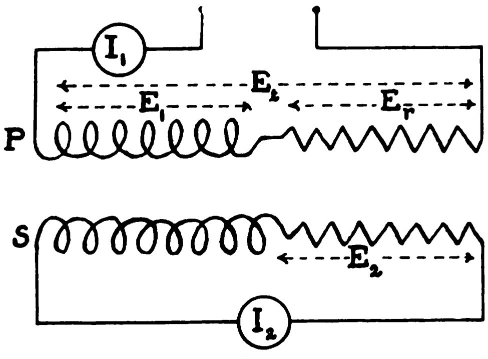

Diagram of Connections.

FIG. 3.

$$M = \sqrt{L_1 L_2}.$$

The values of M thus computed agree very closely with the observed values.

The column headed $\frac{L_L}{L_s}$ gives the ratio of the coefficients of self-induction for the two coils, which we would expect to find equal to the square of the ratio of the number of turns of the respective coils, or

$$\left(\frac{128}{90}\right)^2 = 2.$$

The observed ratio approximates quite closely to this.

Experiments were made with the transformer on constant potential and also on constant current. The constant potential circuit was supplied with a current of such a frequency that $\omega = 2\pi n = 863$; while for the constant current, $\omega = 2\pi n = 566$. In the table are given the values of the inductance obtained by multiplying the coefficients of induction by ω.

METHOD OF MEASUREMENT.

In the experiments proper with the transformer the connections were as shown in Fig. 3. In series with the primary was placed a non-inductive resistance consisting of incandescent lamps. The three-voltmeter method was used to determine the primary power and the angle of lag θ_1 between primary current I_1 and electromotive force E_1. This necessitated a measurement of the primary current, obtained by a Thomson balance, and the differences of potential between the terminals of the transformer, around the non-inductive resistance, and around resistance and transformer together. The secondary load was non-inductive, and the secondary current and electromotive force measured directly.

The quantities observed in making the runs were:

E_1—The E. M. F. around the primary.

E_r—The E. M. F. around the external resistance.

E_t—The total E. M. F. around the primary and resistance.

I_1—The current in the primary.

E_2—The E. M. F. in the secondary.

I_2—The current in the secondary.

From this observed data the following results were computed:

θ_1—The angle of lag between the primary electromotive force and current.

W_1—The watts supplied to the primary.

W_2—The watts in the secondary.

R_2—The secondary resistance.

θ_2—The angle of lag of secondary current behind the secondary impressed electromotive force. The primary angle of lag is calculated by the formula for the three-voltmeter method

$$\cos\theta_1 = \frac{E_t^2 - E_1^2 - E_r^2}{2 E_1 E_r}.$$

The primary power is $W_1 = E_1 I_1 \cos\theta_1$.

The secondary power is $W_2 = E_2 I_2$.

The secondary resistance, being non-inductive, is calculated by the fall of potential, thus

$$R_2 = \frac{E_2}{I_2}.$$

The tangent of the secondary angle of lag is

$$\tan\theta = \frac{L_2 W}{R_2},$$

from which θ_2 can be readily obtained.

(To be continued.)

Tramways for Cairo.

Mr. Frederic C. Penfield, United States Agent and Consul General, notifies to the State Department that the Egyptian Government has decided to authorize the establishment of a system of tramways in Cairo and its environs, and the matter is already attracting the attention of European capitalists and engineers. The introduction of tram lines, Mr. Penfield says, would improve to a great extent the methods of transportation and communication in Cairo, and, if demonstrated a public convenience, a similar concession for Alexandria would doubtless be early decided upon, consequently it may safely be predicted that there will be some competition to secure the franchise. Bids will be received by the Minister of Public Works, Cairo, until the 1st of February, 1894. The permanent population of Cairo is roughly estimated at 500,000, of which 30,000 are Europeans. In the winter season the latter figures would be greatly augmented by the influx of travelers.

"The death of Joseph Creighton last week," says the Omaha *World-Herald*, "recalls one of the most stupendous enterprises ever crowned with failure," for it was he and his brother Edward who planned the prodigious enterprise of connecting Europe, Asia and America by telegraphic communication by way of Alaska, Behring Strait, through Siberia to Russia and across Europe, which the success of the ocean cables, at the time dubious, put an end to.

Lamp Bank Rheostats.

BY C. W. SWOOPE.

It is the prevailing custom with all electrical manufacturers to subject every piece of machinery, instrument or apparatus to a special test before it leaves the factory, the purpose being twofold, to insure the customer satisfaction and to protect the manufacturer. These tests are designed to duplicate as far as possible the the actual working circumstances and conditions in which the apparatus would be placed when on regular duty. Sometimes the current from a dynamo under test, or ammeter being calibrated, is switched onto the shop circuits and utilized, while at other times it is run into any resistance which will absorb it, such as water boxes, iron rheostats or lamp banks. Water boxes answer quite well in many cases, but the objection is the constant regulation required, owing to the change in the temperature of the water, thus producing a varying resistance. The lamp bank, or a series of rows of lamps connected up and switched on the circuit by various devices, is the most satisfactory, as the resistance is constant and the load varies only with that of the main source of supply. They are built and connected up in many forms for different conditions, and the combinations that can be obtained, similar to a rheostat, are quite numerous.

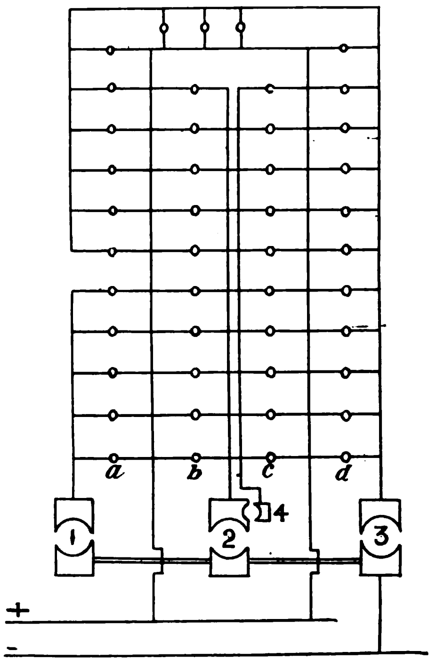

FIG. 1.

Several forms are given herewith, and some combinations showing the range of resistance when properly designed. An ordinary bank is illustrated in Fig. 1, showing connections for four rows of lamps to a single pair of mains. Keyless sockets or receptacles are mounted upon a framework, and the wire terminals from each row brought to lugs made of copper or brass; and for any connection all that is necessary is the insertion of a brass plug, usually mounted on wood or hard rubber handles.

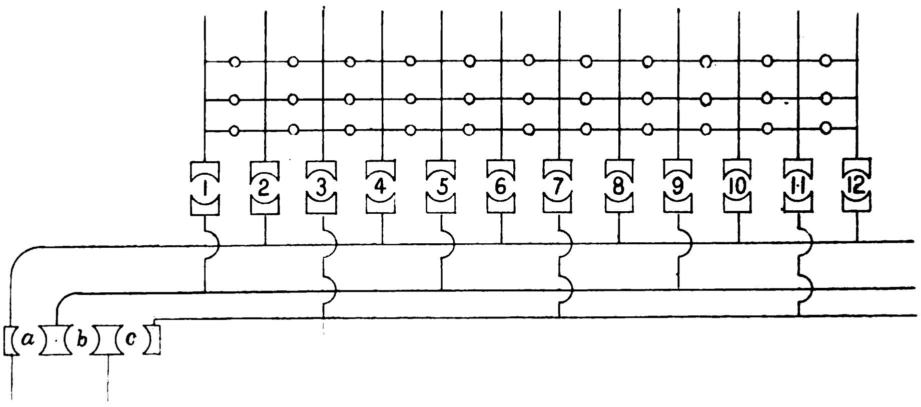

FIG. 2.

In Fig. 1, which is a multiple bank only for use with large loads and voltages not exceeding that of one lamp, quite an even ascending scale

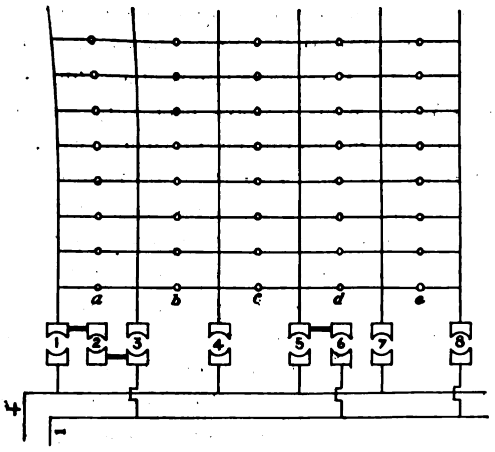

Fig. 3.

of variations can be obtained by choosing the proper number of lamps in the various rows. Connecting 5 lamps on row a, 10 on b and c respectively, and 20 on d, we get the following range of lights:

No. of Lights.	Combination. Plug in.	
5	1	
10	2	4 out
15	1 and 2	4 "
20	3	4 "
25	3 and 1	4 "
30	3 and 2	4 "
35	3 2 1	4 "
40	3 2	4 in
45	1 3 2	4 "

For more variations lamps of different candle power requiring a different amount of current could be used, and for larger loads increase the number of lamps per row, or the number of rows, the latter of course being preferable, thus increasing the combinations. Multiplying each row by 10, the range would be from 50 to 450 lights, the amperes depending on the amperes per lamp.

A multiple or series bank is illustrated in Fig. 2, operated from a single pair of mains, the voltage of the circuit being limited only by the number of rows in the bank. It is well adapted for 125 volt, 250 and 500 volt circuits. For all rows in multiple, on 125 volts or less, insert plugs in b and c on mains and plug 1 2 3 4 5 6 7, etc., on branches. With only one lamp in each row of eleven rows, at 1 ampere, it would give a range from 11 amperes, all in multiple, to $\frac{1}{11}$ all in series, with all the series multiple and multiple series arrangements between these limits. For 250 volts, plug a and c on mains, and 1 3 5 7, etc., on branches—10 rows, range 5 amperes to $\frac{1}{2}$ ampere. For 500 volts, plug b and c on mains, 1 6 11, etc., on branches—range 2 amperes to $\frac{1}{2}$ ampere. 1 and 11 would be plugged for 1,000 volts and so on. Figure 3 is an especially good form for loads not extra large and accurate loads requiring many gradations. To give some idea of its flexibility the following combinations have been calculated, giving the resistance in ohms and current for each combination. Only *one* lamp, 110 volts, was placed in each row, and each one of a different size or candle power. Of course with the same size lamps some combinations would be identical :

Row	a	16 C. P.	.5 amp.	220 ohms.
"	b	20 "	.75 "	145 "
"	c	25 "	1.0 "	110 "
"	d	32 "	1.2 "	90 "
"	e	50 "	2. "	55 "

The table is given in the order of the increasing resistances :

Nos.	Combination.	Plug in.	Resistance of Combination.	Current with Combination.
			Ohms.	Amperes.
1	a, b, c, d, e in multiple	1 3 4 6 7 8	20	5 5
2	b, c, d, e " "	3 4 6 7 8	21	5 4
3	a and b in series, c, d, e in multiple	2 4 6 7 8	23	4.7
4	c, d, e " "	4 6 7 8	24	4.5
5	a, b, c in series, d, e " "	1 6 8	30	3.6
6	a, b, c, d in multiple	1 3 4 6 7	31	3.5
7	d, e " "	6 7 8	32	3.4
8	b, c, d " "	3 4 6 7	36	3.05
9	a, e " " b, c in series	1 3 5 7 8	37	2.9
10	a, e " " b, c, d " "	1 3 7 8	39	2.8
11	b, e " "	3 4 7 8	40	2.7
12	c, d " " a, b in series	2 4 6 7	43	2.5
13	e " " a, b " "	2 4 7 8	44	2.5
14	e " " a, b, c " "	2 5 7 8	45	2.4
15	a, b, c " "	5 2 or 1 6	47	2 3
16	a, b, c in multiple,	1 3 4 5 6	48	2.2
17	e " " a, b, c, d in series	2 7 8	49	2.2
18	a, b " " d, e " "	1 3 5 7 8	53	2.07
19	e " "	7 8	55	2.
20	b, c " "	3 4 6	61	1.8
21	a, d " " b, c in series	1 3 6 7	62	1.7
22	a, b " "	1 3 4	87	1.2
23	b " " c, d, e in series	3 4 8	89	1.2
24	d " "	6 7	90	1.2
25	c " " a, b in series	2 4 6	106	1.03
26	a, b, d, e " "	2 4 5 8	108	1.01
27	c in multiple,	4 6	110	1.
28	a " " b, c in series	1 3 5	118	.93
29	a " " b, c, d " "	1 3 7	134	.82
30	b " "	3 4	145	.75
31	a " "	1 3	220	.5
32	a, b in series	2 4	365	.3
33	a, b, c, d " "	7 2	565	.19
34	a, b, c, d, e " "	1 8	570	.19

The following three combinations might also be added but they give values similar to some in the table :

Like 6.	a, b, e in multiple.	plug	1 3 4 7 8.	31 ohms.
" 17.	c, d " "	"	4 6 7.	49 "
" 21.	a, b " " c, d, e in series	"	1 3 4 8.	62 "

Another form of bank, Fig. 4, is admirably suited for many variations, it being used considerably on bridges, resistance boxes, connecting batteries, etc. Most any combination is readily attainable, and an examination of the figure will be sufficient to explain the method of connections by which the various degrees of resistance may be obtained.

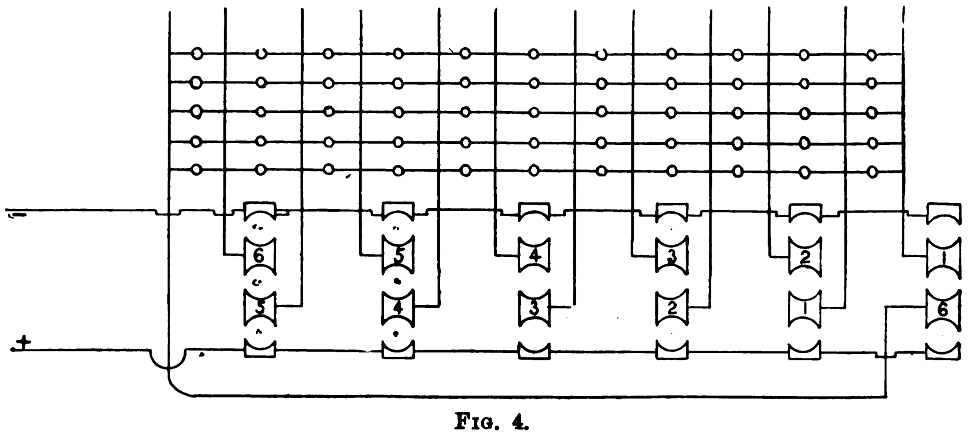

Fig. 4.

The Hydrograph.

The remarkable property possessed by water for conducting sound is well known, but we are not aware that any successful attempt has hitherto been made to turn that property to account for signalling purposes. Its utilization in that direction, however, seems to have been effected in a practical manner by Captain Neale, who has devised a system by means of which signals can be given, messages exchanged, and conversation held between ships on the sea or on rivers, whether moving or stationary, or between ships or lighthouses and harbors, forts, or piers on the shore, or vice versa. Communication, moreover, is effected, without any connection whatever between the two objects except the body of water in which the ships float or the lighthouse stands, the water being the sole medium through which the message is transmitted. The system depends for its action upon harmonics, and its principle will be understood by a reference to the well-known fact that upon a musical note in a given key being sounded an object capable of emitting sound in the same key will, under certain conditions, sympathetically respond by emitting a sound similar to that which awakened its vibrations. It is, of course, a primary condition that the two objects shall be normally tuned in unison. Working upon this fixed principle, and utilizing the high conductivity of water for the transmission of sound, Captain Neale has constructed a signalling apparatus, which consists of a transmitting and receiving instrument, which, when in operation, are in no way connected with each other except through the medium of water. The apparatus as described by the London *Electrical Engineer* is mounted on two punts, the transmitter on one and the receiver on the other. The transmitter consists of a bell about 16 in. diameter attached to the lower end of a framing which is fixed to the side of the punt, the bell being submerged about 6 feet. At the upper end of the framing is a crank handle, which is worked from the punt and actuates a double-beat hammer which strikes and sounds the bell. The Morse code is employed, and signalling is at present carried on by hand, but electricity is intended to be used. The operator gives the handle a quarter turn for the dots of the code, and a whole revolution for the dashes. The receiver, which is on the second punt, consists of a pair of metallic drums, about 10 in. diameter, open at one end and fixed, mouth to mouth, upon a piece of board which is sandwiched in between them. These drums are suspended in the water, and are connected up with a small battery, and through it with a tape recording instrument. As at present arranged, the operator has an acoustic apparatus connected with the drums, by means of which he hears the sounds from the bell as they are received by the drums, and, by a manual arrangement, he records each sound on the tape. Upon the occasion of the inspection, the two punts were moored in the Thames at Kingston, about two-thirds of a mile apart, and signalling was successfully carried on from one to the other. Messages were correctly transmitted and recorded, although naturally somewhat slowly, owing to the apparatus being at present worked by hand. The trial, however, is said to have demonstrated the practical character of the invention and the correctness of the principles upon which it is based.

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Electric Railway Legislation. The State Railroad Commissioners have for some time been collecting information to enable them to frame regulations for the speed of electric railway cars in thickly settled districts, as well as to recommend the most approved appliances on these cars for the safety of pedestrians.

In the last issue of ELECTRICITY we pointed out the fact that the antagonism to electric railways which is frequently expressed is directed more particularly against the speed of the cars than the method of propulsion. If the list of trolley car accidents that have occurred be examined carefully, it will be seen that almost without exception these have resulted solely from collisions. Accidents from contact with the current are almost unheard of.

Admitting the justice of this view, which is unquestionably established by the statistics of several years, the problem of regulating the speed of street railway cars, and not the motive power to be used, presents another consideration of interest to the public.

The conditions of street traffic are so different in different cities that the question of making a general rule to limit the speed of street cars is not easily determined; nor can such a rule be very strictly enforced.

It is reasonable to assume that the interests of any railway company are best conserved by acceding as far as possible to the demands of the public, from whom its income is derived, but it is also evident that in regard to speed public opinion is divided, as residents and pedestrians along these routes object to just the conditions which the travelling public call for. The rapid and extensive introduction of trolley roads has been undertaken in almost every city where they are found for the purpose of building up outlying districts for which a horse car service has proved inadequate.

In this respect trolley roads have been eminently successful, and this result is due entirely to the rapid and regular service rendered by them. If safety, therefore, compels a reduction in car speed to that of horse cars, the trolley loses its chief advantage over the latter, and the main object for which it was installed is defeated.

In every large city there is, of course, a certain maximum speed which should not be exceeded, and this should practically depend upon the distance within which a car may be brought to rest from full speed. A car running at the rate of twelve miles an hour which is capable of being stopped within one hundred feet is obviously safer than one running at six miles an hour which requires a longer distance before it can be brought to a standstill, and this introduces the subject of electric-car brakes, which are now almost invariably inadequate in cases of emergency. On probably more than ninety per cent. of all our trolley cars the same pattern of brake is employed that has been in general use on horse cars, consisting essentially of a set of brake shoes hung at one side of a pair of wheels which are brought into contact with the latter by winding a chain around the brake rod. As a rule, only one set of shoes acting on one side of a single pair of wheels is brought into play by the action of the brake handle on either platform, and no matter what the leverage may be the time required to give the chain three or four turns around the brake rod is too long to admit of a sudden stop. This point seems to have been very generally ignored in the equipment of electric cars; and although it is easily possible to provide a brake which by a simple short motion of its handle will lock the wheels almost instantly and cause the car to slide, hardly any attempts have been made in this direction. The brake is certaintly the most important and effective safety device with which a car can be equipped, and had this received the same amount of attention that has been bestowed upon guards and fenders, which generally effect more accidents than they avert, trolley cars would have escaped much of the censure which has fallen upon them.

The most cursory glance will suffice to show that the power required to overcome the momentum of a horse car within a given time is far less than a trolley car requires for the same time. The weight of the latter is approximately three times and its average speed about double that of the former; therefore six times the force necessary to stop a horse car would be required to stop a trolley car in the same time.

As an ounce of prevention is universally held to be worth a pound of cure, the safety device for trolley cars most satisfactory to the public should be designed to control the cars rather than to rescue the victims, and the average pedestrian would unquestionably prefer avoiding a collision to being deposited intact on the most efficient style of fender in the market. Life guards may prove of service in some cases, but suitable brakes would constitute a much more acceptable remedy.

Where a human life is at stake the motorman on an electric car has at his disposal a last resort, which is to reverse his motors at full speed without using the brake. This method is, of course, liable to wreck the machines, but under the circumstances that would be of little consequence. As a rule the machinery would stand the shock, and in that case the car would reverse its direction without advancing much more than its own length. If running at a moderate speed it would be stopped almost instantly.

The most thorough precautions possible, however, will not prevail against the carelessness of individuals, and the person who heedlessly steps directly in front of a moving car puts it beyond the power of the motorman, however alert or careful, to avert accident. Over fifty per cent. of the casualties on electric railways reported last month occurred under these conditions. This is about the only class of people a fender is needed for, and if a suitable one can be found it would probably reduce the number of fatalities of this kind.

Where reasonable care is taken by pedestrians, however, the speed of the cars seems of secondary importance to their controlling apparatus, and in this respect most electric cars are deficient. With brakes of suitable capacity provided, a person crossing the tracks at a reasonable distance from the car would be perfectly secure from danger with a careful motorman. There are a few blocks in almost every city which during certain times of the day are so crowded with cars that only a very moderate speed is practicable, but excepting for these short distances it is not necessary for safety to reduce the speed of cars below the usual figures.

A restriction of that kind prevents the cars from making up time after delays and makes it impossible to maintain schedule time on a road, and safety is as well if not better assured by the use of proper brakes in the hands of careful motormen, without defeating the cause of rapid transit.

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Cause for Rejoicing. It is unnecessary for ELECTRICITY to call attention to the fact that business in our trade is stagnant; that collections are slow; that the demand for small supplies has been reduced to meet the actual necessities of consumers, and that large contracts for extensions and for new plants are unheard of—if we except the single instance of the Niagara Falls plant.

It is, however, proper, and it ought to be wholesome, to point out that the present lethargic condition is only temporary, and that the trade at large—leaving out the General Electric Company—is in far better shape to-day than it would have been if the plans of the sham Trust had not miscarried.

It is doubtful if any one, not excepting the organizers and promoters of the General Electric Company themselves, have given a more careful study to the situation, from the organization of that company up to the present time, than we have; and we refer not alone to the internal affairs of the would-be Trust, but to the possible effects of the scheme on the smaller concerns and on the business as a whole.

ELECTRICITY was the first to raise the danger signal, and though few were found a year ago to admit the correctness of our judgment, there were some. Our original supporters and advisers were not among those who came into the business but yesterday; they were old-timers, men who had watched every move in the game for ten years, who knew just what might be expected of Mr. Coffin and the T.-H. coterie if the power to crush out competition ever came to them.

And as there were few who appreciated the dangers of the situation then, there are many now who believe, in all honesty, that the danger never existed, since it has apparently passed away. Nevertheless, the danger did exist, in a marked degree, and the General Electric organization had in it all the necessary factors for temporary success, save one, a competent man at the head of the concern. With that man, one who had the breadth of perception to see the situation as it actually was, and the masterly patience to wait until it was time to strike, monopoly might have been established and maintained for a number of years.

The General Electric Company started off with ample financial backing, and the glamour of mystery thrown around its business was such as to attract additional capital. New England believed Mr. Coffin to be invincible, and the New Yorkers accepted as real prospective extensions of business which had no more basis of fact than Ferdinand Ward's "Government contracts." Money was plenty in the early months of the company. With competent management, and with a disorganized and scattered opposition, it might have secured a strong position.

A series of blunders, an unbroken course of mismanagement, has forced the General Electric Company into a condition worse than bankruptcy, and left the opposition well prepared, as general conditions improve, to take an overwhelming proportion of the business.

We know not whether association with the rapid men of Wall Street was too much for Mr. Coffin, or whether his head was turned by the frequent references in the daily press—references which are now only a reminiscence—to "Young Coffin, the Napoleon of Electrics"; whether, in fact, the errors of judgment have been his or should be charged to his advisers. Certain it is that the company overreached itself; that it claimed the earth before it had cleared the underbrush from its own land; that it disregarded utterly the strength of the opposition, was wholly oblivious to the perils to itself of the campaign it began; that it ignored all precedents in its overweening confidence, and seemed to prefer enemies to friends.

There is, therefore, honest cause for jubilation on the part of the independent concerns who trimmed their sails in the early days of the present financial storm, and who are thus prepared to take early advantage of improving conditions.

The grip of the General Electric Company is forever broken, and the dark clouds which hung over the trade are clearing away, to be remembered only as a temporary object-lesson of what might easily have been a prolonged period of gloom.

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THE *Electrical World* still keeps up the bombardment of Messrs. Stump, Martin et al. with mud. Our contemporary stands in a unique position, and not at all an enviable one. It is forcing on its unfortunate readers page after page of petty personal matter which only one man in the world is reading, and that one man the writer of the stuff. It is guilty of a serious offence against newspaper ethics in this, and a more serious offence in printing a garbled and distorted report of legal testimony. If any one is in doubt as to whether or not this is legitimate newspaper matter, let him ask himself the question, How much space would the *Electrical World* have given to this lawsuit if it had been between Messrs. Martin and Phelps, or Messrs. Stump and DeGraw?

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SPECIAL attention is called to the announcement on page 207 of the establishment of a Patent Bureau by this paper. Correspondence on patent matters is solicited. Questions of general interest will be answered in these columns, and other matters will receive an individual reply. In the procuring of patents, good service on the part of the solicitor is essential, and that ELECTRICITY guarantees.

Dishonesty in the Profession.

BY G. EMIL HESSE.

Every engineer knows that there is a great deal of dishonesty practised in some branches of the technical profession, and in the front rank stands what is called commissions, which in this instance is another word for bribe.

This underhanded business flourishes both in Europe and here, and it seems as if to a greater extent in this country amongst first-class manufacturers and engineers. The fact is that the engineer is almost flooded with corrupt proposals from manufacturers and sales-agents as soon as it becomes known that he has secured an order of any importance. It is hardly necessary to analyze the question in order to find whether it is right or wrong to serve two masters—your client and the manufacturer.

Every honest man who gives it a minute's thought will condemn it, and his attention should therefore continually be drawn to the baseness of the habit, which in many cases is nothing but a custom.

It seems so natural to accept a percentage from the man who has been favored with the order that it hardly ever crosses the mind that there is anything wrong in the transaction.

To an engineer with an elastic conscience no such appeal as the above would have any effect, but the picture has also another purely practical side that touches the pocket. The system is as well known to the client as to the engineer, and he is consequently on the lookout. The result of such a transaction is very often disastrous, and I know personally one case where a man was employed at a salary of over $5,000 a year, and who probably drew as much in commissions from various manufacturers, but with the inevitable result of losing the former and consequently the latter. This is by no means a rare instance, and many others could be mentioned, but it goes to show that honesty pays in the long run.

Another pernicious custom is the appropriation of other people's ideas and inventions that is constantly taking place. This is generally practised by engineers in the employ of manufacturers. As an example I could mention an incident that took place about a year ago in one of the largest electrical concerns in the country. An inventor sent them a model of a machine that would do a certain thing cheaper and better than the old method. The company at once set a man to copy the machine and applied for and obtained a patent. They then returned the model with a polite letter saying that they had no use for it, as they already had similar machines working themselves.

I happened to know the draughtsman who copied the machine, and this was not the company's only experience in that line.

It should be the ambition of every man to raise his profession to a high moral level and meet every attempt to drag it down with contempt. The sooner an engineer realizes that he has a reputation to work for besides a living, the better for himself and for the profession that he belongs to.

The Wyandotte Squabble.

The Wyandotte, Mich., electric light litigation, noticed several months ago in ELECTRICITY, has been settled by the courts. The contract with the Wyandotte Electric Light Company to light the city for five years is held to be invalid, and the city is enjoined from recognizing the local company's contract or paying any money on account of it. The contract for the municipal plant is also declared invalid, leaving the city to go ahead and make a new bargain for one.

The decision is without prejudice to the Western Electric Company, which retains the right to sue to recover the price of the plant it has put in for Wyandotte.

Special Paper on "Traction and Street Railway Trucks."—II.

BY ELMER A. SPERRY.*

As to gearing between the axles, the bevel gear presents by far the simplest solution. This form of gearing, however, has been looked upon as wasteful of the power transmitted. The criticism is probably just for some power transmissions employing this gearing. The question is, How much more power does a bevel gear and pinion absorb than a spur gear and pinion in transmitting the same amount of power, with the conditions identical? There seem to be almost no conclusive or carefully made tests of merit as to the comparative losses in transmission of power by these two classes of gears. Fig. 2 shows a diagrammatic view of an apparatus designed by the writer for testing this feature, with which an exhaustive series of tests covering this point has been made. B is a car axle mounted in journals, D D. E is a hydraulic dynamometer, with lever arm, E, and weight, F. A is an electric motor delivering its power to a pinion co-operating with a gear mounted upon the car axle, B, C being a flexible connection between the motor and the pinion shaft. The car axle was three and three-eighths inches in diameter, and two kinds of gearing were employed between the axle and the motor. A bevel gear and pinion (shown in the diagram) inclosed in an oil housing, G, were alternately tested with a spur gear and pinion, also mounted within an oil housing. When the spur gear was used, the motor was set at right angles to its position as shown in the diagram, and parallel with the axle, B, and connected with the shaft of the spur pinion. It will readily be seen that the conditions under which these tests were made were as nearly alike as it was possible to make them, and at the same time the transmissions took place under the same conditions that obtain on a street car truck. Numerous curves were plotted, showing total losses between the electrical terminals of the motor and the dynamometer, showing gear losses losses resulting from shoulder and journal strains produced by the gearing and all the bearings, in each test through the entire range from starting to about sixty horse power input. Submitted herewith, in Figs. 3 to 8, inclusive, are curves showing that under practical working conditions, when the bevel gear is properly made, the losses are almost identical with spur gear, the small difference, viz. 1.74 per cent., in favor of the cut gear, probably being due to the fact that the surfaces were somewhat rougher in the cast than in the cut gear. The great care exercised in these tests and the clearness of the results certainly speak volumes in favor of the bevel gear transmission, and constitute the first comparative tests of large transmissions under heavy strains which to the knowledge of the writer have been made.

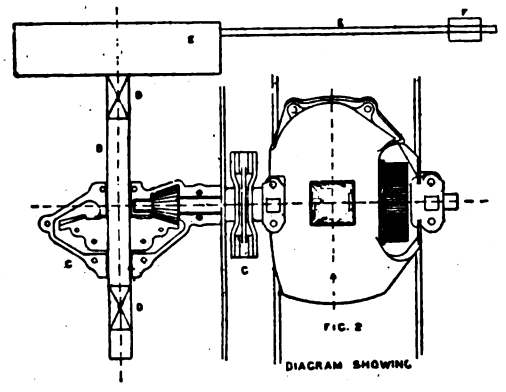


FIG. 2.

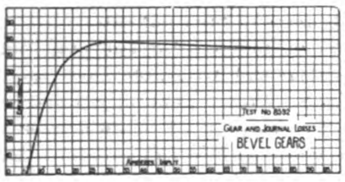


FIG. 3.

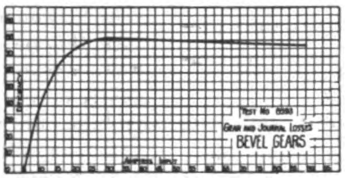


FIG. 4.

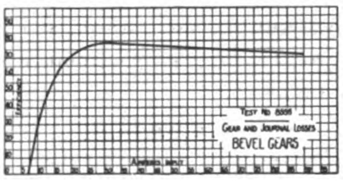


FIG. 5.

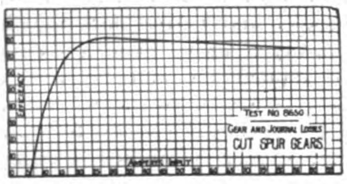


FIG. 6.

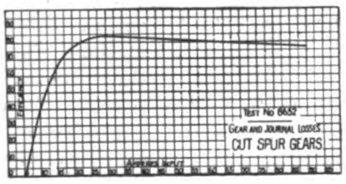


FIG. 7.

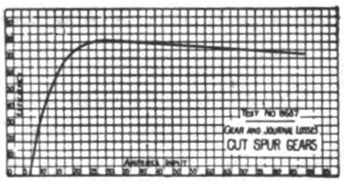


FIG. 8.

Another feature bearing directly upon the all important question of traction is that of axially mounted masses. Locomotive drivers and axles are as light in themselves as is consistent with required strength. The inertia of a large mass axially mounted does not allow the drivers to follow the surface irregularities of the track with anything like equal pressure, especially at high velocities. The wear and tear of the roadbed are also due in large measure to the heavy masses attached directly to the axle. All weights of magnitude should be spring supported.

Referring now to the tests, a track was built consisting of forty-five pound T rails rising from a spur of level track, having a mean grade for the two rails of 12.4 per cent. Upon this grade was run, first, a double motor equipment weighing 17,935 lbs. A dynamometer was attached to the drawbar and back to the track in such a line as not to either lift the car or drag its rear end downward in the test. Current was then applied through a variable resistance, gradually allowing the car to strain upon the dynamometer until finally the wheels slipped. Care was especially exercised on the point of gradual application of the strain so as to eliminate all elements of inertia or lunging forward upon the dynamometer; after slipping had commenced it was observed that the car would slide in each instance to the bottom of the grade. The following table gives the mean of four sets of readings:

INDEPENDENT AXLE, TWO MOTOR EQUIPMENT.

Drawbar pull on dynamometer. Car standing on 12.44 per cent. grade. Weight of equipment, 17,935 lbs.

Group of Tests.	Average Amperes.	Average Drawbar Pull.	Ratio of Drawbar Pull to Weight.
1	1,625	200 lbs.	9 per cent.
2	2,250	280 "	12.5 "
3	2,150	240 "	12 "
4	2,075	230 "	11 "

This car was run off the grade and replaced by one in which all the wheels were compelled to revolve in unison, but of much lighter weight, viz. 12,685 lbs. The dynamometer was attached in the same way and the same rheostat and source of current were used as in the previous experiment, the axles in the equipment being coupled by bevel gears.

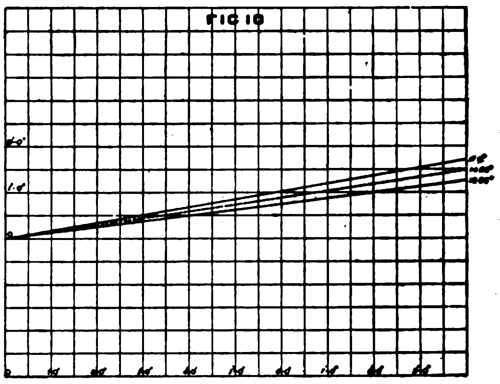
The following table gives the mean of five sets of readings taken on this car:

COUPLED AXLES, SINGLE MOTOR EQUIPMENT.

Drawbar pull on dynamometer. Car standing on 12.44 per cent. grade. Weight of equipment, 12,685 lbs.

Group of Tests.	Average Amperes.	Average Drawbar Pull.	Ratio of Drawbar Pull to Weight.
1	200	3.125 lbs.	24 per cent.
2	240	3,750 "	30 "
3	230	4,075 "	32 "
4	220	4,500 "	35 "
5	200	4,375 "	34.4 "

The same operator applied current to the car in both tests, and every condition of electrical pressure, track and weight remained identical throughout.



The car was then run off the track and the rails blocked, as is shown in Fig. 10, one rail having 12⅝ inches rise in 10 feet, the other having 17.2 inches, making a mean of 14.92 inches rise in 10 feet, equalling a grade of 12.44 per cent., giving a warp of considerable magnitude to the roadbed. This warping, shown in Fig. 10, would at once reveal any rigidity introduced into the truck by the coupling, and would be apparent in the ratio of drawbar pull to the current absorbed if any part of the equipment was bound, unduly strained, or working under any but perfectly normal conditions. The following table shows the readings taken, and is conclusive as to the perfect freedom of the truck while working in this warped and highly distorted position.

COUPLED AXLES, SINGLE MOTOR EQUIPMENT.

Drawbar pull on dynamometer. Car standing upon warped track.

Right rail........................ 14.33 per cent. grade.
Left rail........................ 10.58 " "

Weight of equipment, 12,685 lbs.

Group of Tests.	Average Amperes.	Average Drawbar Pull.
1	230	4,425 lbs.
2	220	4,875 "
3	200	4,150 "
4	220	4,275 "

It will be readily understood that when an equipment is running on a grade the centre of gravity of the car lies nearest to the rear wheels, thus allowing the front pair to slip when independently driven. After slipping commences the tractive value of the front motor becomes almost *nil*, as shown by the traction curve in Fig. 1, the work being undertaken almost entirely by the rear motor, whereas with coupled drivers, and especially where a single large motor is used, the motor is compelled to deliver all its power to the rear wheels if the exigency so requires. At the same time the front wheels, instead of slipping, are compelled to revolve in step with the back wheels and bite the rails in unison therewith, and in fact all the wheels are held down to the business of effective non-slipping adhesion, this being true in whichever way the car approaches the hill, and whichever pair of wheels is respectively forward or rear. This great difference in favor of coupled drivers shows a percentage of 35 as compared with 12.5 of the total energy appearing as actual pull at the drawbar under the conditions named.

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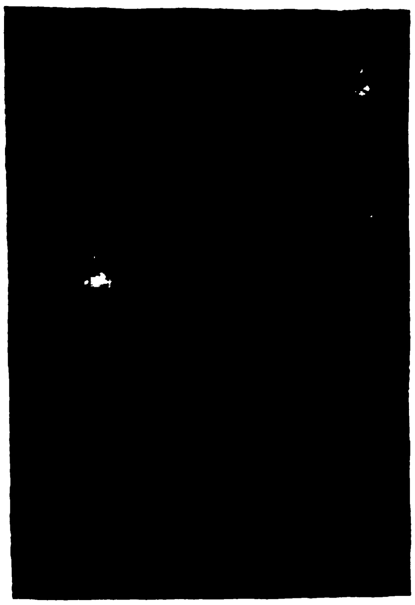
* Abstract of paper read at the American Street Railway Association Convention, Milwaukee.

In running on a level, and especially in damp weather with a slimy rail, almost the same increase in traction as shown here will be found to exist with coupled wheels, provided always the mechanism used in coupling does not interfere in the least with the flexibility of the truck.

(Concluded.)



A Curious Lightning Discharge.
From a photograph by G. J. Mack, M. D., Waterloo, Iowa.

Modern Uses of Electricity—I.

Professor Charles R. Cross, of the Massachusetts Institute of Technology, is engaged in giving a course of twelve lectures on "Modern Uses of Electricity," in Huntington Hall, in connection with the Lowell Institute. The course is to extend over six weeks, one lecture being given every Monday and one every Thursday evening.

The first of the course was given Monday evening, October 30, to a large and appreciative audience. In entering on his subject the lecturer remarked that some definitions of the nature of the agent employed and of certain terms usually employed were necessary to be explained, and in stating, in the first place, what electricity *is not*, he referred to the fact that the questions with which physical science is concerned are *matter* and *energy*. Matter is possessed of mass and inertia, and in virtue thereof refuses to enter into motion except as the result of the application of force.

Energy is the capacity of doing work by virtue of motion or position. An illustration of this is the weight in a clock, or a coiled spring, or a heated body, all of which represent the potentiality of work by reason of work already done to them; and in this connection the lecturer referred to the law of the conservation of energy and the indestructibility of matter. The capacity for doing work in any bodies cannot be affected from within; it must be affected by the application of some force.

Professor Cross then went on to say that electricity, whatever it is, is not energy; that while heat and motion are convertible into energy, electricity is not so convertible, and in this respect is analogous to water, the energy of a falling mass of which is utilized without the disappearance of the water, while in the case of energy derived from heat or motion, the heat or the motion as such ceases to exist.

It further appeared probable that electricity is not matter, although it must be admitted that the experiments on this point are not absolutely final. We do, however, know certain well-defined facts with regard to electricity—for example, if we connect by a wire the two poles or terminals of a voltaic cell, we find that some change takes place in the wire and the space surrounding it, and this change we call a current of electricity. We know that an alteration or change takes place in the condition of the circumambient luminiferous ether; also that an electric charge given to a body results in a condition of strain which is removed by discharge. Vibrating the rapidly successive charges and discharges produces rapid stresses and relaxations; and if these vibrations are carried on at a sufficient rate, they produce the phenomena called light.

The lecturer objected to the usual method of describing the laws of electricity as mysterious or occult. On the contrary, so far as these laws have been formulated, they are clearer and more exact than the explanation of the so-called and well-known law of gravitation, which may be said to be that all bodies attract one another directly in the ratio of their masses and inversely as the square of their distance, which leaves the whole matter about where it was. Other examples were the definitions of an atom or of matter itself.

The term electromotive force, as analogous to mass-moving force, means the force by virtue of which a current of electricity is forced or is tended to be forced through a conductor. Potential or difference of potential signifies difference of electrical level, the current flowing or tending to flow from a point of higher to a point of lower potential as matter does

The point of potential of the earth is taken as the *datum* or *zero*. If current flows from a glass ball or other positively charged body to the earth, it is said to be of a higher potential, and if the flow is from the earth to another body, as in the case of silk, then the body is of lower, and in this case negative, potential.

The term *pressure* is practically synomyous with potential. All generators of electricity, whether frictional machines, batteries or dynamos, operate by producing a difference of potential by setting up an electromotive force. The analogue of this, in hydro-dynamics, is the force pump which operates by producing differences of pressure. In both cases the current results. Generators of electric currents may be fairly called electricity pumps.

Again, it should be observed that electricity, by whatever name it is called, or however set in motion, is one and the same thing, although its manifestations vary infinitely.

The words "static" and "dynamic," often used in connection with electricity, if they mean anything, simply mean electricity at rest and electricity in motion.

The idea usually held, that current is forced through a wire or other conductor in somewhat the same manner as water is forced through a pipe, has now been displaced by the idea, suggested first by Clerk Maxwell, that the current is the result of ether stresses produced in the space surrounding the wire. As all practical commercial forms of electricity are now produced by the instrumentality of magnets, the consideration of magnetism and its phenomena becomes important.

All bodies possess this property, steel and iron most abundantly, nickel in a less degree, and all things to some extent, though in most cases feebly.

By means of diagrams, Professor Cross then illustrated some of the magnetic phenomena, such as the arranging of iron filings around the opposite poles of a bar magnet, etc.

In showing these he said it should be remembered that each line of force must begin at one pole and end at another. The lines are invariably closed curves, and cut, as Faraday said, like stretched filaments, tending to break and also tending to repel each other. These lines cannot end in space, but must return to the opposite pole of the system.

The revolution of loops of wire and of magnets was illustrated by experiments and diagrams; also Maxwell's rule that an electric circuit in a magnetic field tends to set itself so as to embrace the greatest possible number of lines of force, or at right angles to the field.

SOCIETY NEWS.

The New York Electrical Society's First Meeting of the Season.

The first meeting this season of the New York Electrical Society was held at Columbia College Tuesday evening, October 31st, at which a paper was read by Mr. D. McFarlan Moore on "Electricity in Advertising." At the close of the paper a number of lantern slides were shown illustrating various effects that may be produced with electric lights for display purposes. Mr. Moore spoke in part as follows:

Owing to the peculiar and almost inexplicable attraction that the word "electric" has upon the general public, it is used to advertise not only such electrical fakes as rings and hairbrushes, but even articles of some intrinsic value, such as glue and soap, the promoters knowing that the public can be deluded by a single word. Nevertheless, electrical manifestations that attracted public attention a comparatively short time ago are now considered unworthy of notice. We all remember when the "great electric arc light" was one of the leading attractions of the country circus, when crowds would gather to see an incandescent lamp nestling among silks and other inflammable materials in a show window, or when an aquarium with a lamp beneath the surface of the water, or a lamp in the centre of a block of ice, would cause much comment, and also the awe and respect which country folk displayed when the "matchless" lamp appeared, which they could not blow out.

Although an illuminated waterfall or a lamp in an aquarium burning under water ceases to cause wonder, the experiment, first shown by Trouvè, of illuminating the body of a live fish by a miniature incandescent lamp which it has been made to swallow, will always attract attention. Insects and bugs made of incandescent lamps are also attractive novelties, as well as photographic plates placed in a case with a lamp behind them.

Curiosity has always been the greatest factor in exciting the interest of Americans, and this is why the most successful advertisements are those by which this sentiment is prominently evoked. The first impulse upon viewing a revolving figure or showcase is to look for the motive power, and to-day this is generally an electric motor, a machine which has almost entirely superseded clockwork.

One of the earliest methods for attracting the public eye was to construct letters or words of small or freely suspended discs of bright metal, and causing the supporting frame to quiver by means of an electrical vibrator. In the street cars of some of our cities a moving panorama of advertisements operated by a motor beneath the seats attracts much attention.

The idea of illuminating signs, supported upon the posts along the line of an electric railway, only when the car is passing, has proved to be successful.

Although all great fairs and expositions represent the progress of the human race, the fundamental principle upon which rests the possibility of their existence is advertising. Therefore, everything connected with a fair which adds to its attractiveness is an advertisement.

The most impressive feature of the World's Fair was the electrical display—in one sense a huge advertisement, from the "writing hand" and Ferris wheel to the electric fountains, which latter are universally described as indescribable. The object of each exhibit was to produce an effect which would distinguish it from all others, and cause it to be remembered. The incandescent electric light was generally adopted to produce this result, and it offers great advantages, being specially adapted for this purpose by the infinite variety of forms in which lamps can be arranged. Although the arc lamp cannot as a rule compete with its miniature rival for decorative effects, nevertheless in a projector it produces results even more far-reaching. The troublesome and expensive calcium light in stereopticon work is to-day largely replaced by the arc lamp. The advertisements that shine forth at night on conspicuous walls in all our cities enable the operator in many instances to reap a rich reward. A little calculation will demonstrate this very clearly. Suppose the wall can be rented for ten dollars a week, and the operator obtain fifty subscribers at one dollar a week; it will be seen that handsome profits can be realized.

Since projectors are now constructed of 40,000,000 C. P., which throw a beam of light 65 miles, the inhabitants within that radius are forcibly reminded of the structure from which the light is; and when even the clouds are utilized as signboards, the question arises, has not advertising now reached its limit.

An ingenious system of composite letters, for spelling out words letter by letter and one letter only at a time, was devised by Kelway in England. It consisted of arranging a number of lamps on a space large enough for one letter, and so wiring these lamps that different combinations at different times would produce different letters. The immense electric sign, 60 x 68 feet, at the south of Madison Square, is the most gigantic in the world. It cost about $6,000 and consists of 107 letters, averaging 6 feet high, and comprises seven sentences. It is composed of lamps of different colors, which are controlled by switches so that they can be made to alternately appear and vanish. The deleterious effects of rain are prevented by placing a small tin shield over each circular hole through which the lamp is thrust into its socket. 1,457 lamps, representing 145 H. P., bestud the letters, which are made of painted tin, so that they are equally effective as an advertisement by daylight. The current for operating this sign is taken from the Edison Illuminating Company's mains, and costs 24 cents per minute when all of the sign is in use.

But the objection to be found with this, as with most other signs, electric or otherwise, is that it is of one fixed design which cannot be changed without great expense and inconvenience. I now have the pleasure, with your permission, of calling your attention to a new system of which I am joint inventor, and which is designed to overcome the last named difficulty, enabling the immediate production of successive widely varying designs consisting of lettering, sketches of almost any description and size, and adapted for use either indoors or in the open air, owing to its great flexibility. Its construction is as follows: Incandescent lamps are arranged in cross section over any given vertical surface to be used as the sign, covering it entirely, that is, they are placed at equal intervals in horizontal and vertical rows and as closely together as advisable. A cable consisting of as many separate wires as there are lamps connects them with a small table, which we will call the operating board. This operating board, placed at any suitable distance, is completely covered with push buttons or circuit closers, arranged close together, so that each little push-button on the small operating board will correspond to a lamp on the large surface used as a sign. It is now evident that by pressing on any single push button or circuit closer a lamp similarly situated on the sign will be lighted.

Simply by writing or drawing on the face of the operating board, pressing on certain buttons, will cause corresponding lamps to light, all others remaining dark, and practically any effect desired can be produced on the sign in a greatly enlarged scale.

With this system under consideration, absolute flexibility is secured. Comparatively small signs will be required for indoor use, and for them miniature incandescent lamps should be used, as it is evident that the smaller the lamps and the closer they are together the more perfect will be the designs. Of course the push buttons are so designed that when pressed down they will continue to keep the circuit closed and will not return to their normal position until the operator so desires. If the push buttons or circuit closers are made substantial and comparatively large, it is found that writing on the operating board in letters six inches high will produce letters six feet high on the sign. Of course the lamps are wired in multiple, and this will require one small wire of capacity for one lamp to connect each lamp with its corresponding circuit closer. These wires of course, being of one polarity, are in the form of a cable. One pole of the feeding circuit is attached to the sign and the other pole to the operating board. By the movement of a lever at the side of the operating board all the push-buttons are released, and an entirely new design can be produced.

It is not necessary that the operator see the sign as it is being produced, because with a bright light behind the operating board, and the push-buttons slightly conical in form, an exact fac-simile of the sign is produced on the face.

An Interesting Legal Case.

A lawsuit of interest to the electrical fraternity has just been decided at Hartford, Conn.

H. Ward Leonard & Company wired a theatre at Middletown for the Middlesex Mutual Insurance Company, who owned the building. The wiring was connected with the local central station. One Sunday evening after the work was completed, and before it had been fully paid for, a fire broke out in the building and did damage to the extent of some $40,000.

The property was insured, and in paying the loss the various insurance companies, six in number, took subrogation contracts enabling them to sue any party they might consider responsible for the fire.

H. Ward Leonard & Company, after repeated demands for the money due them, finally brought suit for the balance due, some $3,800. This was met by a cross bill from the insurance companies, suing H. Ward Leonard & Company for $40,000 damages, claiming that they caused the fire by negligence and improper construction.

H. Ward Leonard & Company pressed their suit and recovered the full amount of their claim with interest and costs.

A sentence of two months' imprisonment, with hard labor, has been imposed upon a London swindler for selling "electric" spectacles at £4 a pair.

Personal.

Mr. J. Holt Gates, Western representative of the Waddell-Entz Company, spent the greater part of last week in New York. He reports several good contracts for his company well under way.

Mr. George O. Fairbanks, who was for a long term of years the manager of the Westinghouse Electric and Manufacturing Company's business in Chicago, has connected himself with the Railway Equipment Company, particularly with a view of taking charge of the Western agency for the Holmes, Booth & Haydens wire, which has lately been given to that company.

HARD TIMES.

A Wail from the Mohawk Flats.

Some time ago I chanced to read
Of hard times down at Lynn,
And how the boys are all compelled
To bluff without the tin;
But if the version was correct,
This truth is plain to me:
The situation's not as bad
As at Schenectady.

My soul grows sad when I recall
The pleasant times gone by,
When every purse—and man—was full
And none was ever dry.
The clambakes at the Aqueduct,
Oh, they were jolly, fine!
And "hurrahs" out on Bellevue,
Or a dance at Brandywine.

To work then in the office
Was the softest kind of snap,
For every man had a roll-top desk
And an easy chair to tap.
Then envelopes were corpulent
On every Saturday,
But now they're very limp and flat—
They hold but three days' pay.

Then the draughting room was crowded
With fellows killing time,
Who wore "biled" shirts and diamond studs,
And made up quite sublime.
But the room is now a'most empty,
The merry crowd are gone
To put their diamond studs in hock,
Their overcoats in pawn.

The testing room was a jolly place,
None merrier in the town,
Its chiefest toil consisting in
Holding chairs and tables down.
The few now left bestir their bones,
With faces worn and meek,
Honyock with crowbars round the place
For three days in the week.

The students, too, once gay and free,
Roam idly through the streets—
The girls don't see the op'ra now,
Nor any other treats.
The boys are broke, and for a time
Are laid upon the shelf,
And so hard up was one galoot
He tried to pawn himself.

Come back, oh happy days, and let
Us blow ourselves once more
In the Edison at evening
As we used to do before.
Restore the games we used to play,
With wallets full and free,
And let us waken up the life
Of old Schenectady!

But what wild ramblings, vain, are these—
To the world we're good as dead,
For, treading light on our uppers now,
We can't produce a red.
A lucky few draw three days' pay,
And faintly can be heard,
But more are silent as the grave
And never say a word.

The "lion and the lamb" is good—
But, friend, just hear the rest,
Remember that who laughs the last
Laughs loudest and laughs best.
The game's not out, some cards are left,
Don't let your fingers burn,
It's ten to one, aye, bigger odds,
That we will call the turn.

Schenectady, Oct. 28. H. R. M.

Patent Department.

While we have been publishing a list of the electrical patents issued each week, to keep our readers informed of the developments in this direction, we have decided that this was not sufficient to meet the needs of inventor and others interested in patent matters. We have, therefore, established a Patent Department in connection with ELECTRICITY, and have made arrangements with Mr. T. F. Bourne, the well-known patent solicitor and expert, of New York City, to manage this department. The object is to afford to inventors and others a safe, reliable and efficient bureau through which they may procure United States and foreign patents at reasonable expense, and with most satisfactory attention to their wants, at the same time giving them such information as to the patentability of their inventions as they may ask for.

We are prepared to procure patents for inventions in all countries, on all classes of devices and improvements, and especially in the line of electricity. Mr. Bourne is well qualified for procuring patents for inventors, he having been practising before the Patent Office for many years with signal success, and inventors cannot do better than to procure their patents through this agency.

If you have invented an improvement in anything, and desire to protect your rights, communicate with us, and have your patent procured through this agency without delay. Write to us for any information you may desire regarding your invention and we will reply, free of charge.

Our charges for procuring patents are reasonable, and will be given upon application.

Address all communications regarding inventions and patents to

T. F. BOURNE,
Manager Patent Department ELECTRICITY,
6 Park Place, New York City.

Current Items.

An ingenious device for ballroom decoration which has recently appeared consists in the freezing of incandescent lamps into large and prettily shaped blocks of ice, which serve the double purpose of giving forth coolness and light.

Some of the London electrical-supply firms are taking very sensible and practical steps to enable the public to readily enjoy the advantages of electric heating. They are not only lending out electric cooking stoves to customers, but are prepared to supply a separate meter and charge half-rates for cooking, which they can afford to do, inasmuch as the consumption takes place during the day when the dynamos must gather electricity, and when there is little demand for it for lighting purposes. Besides these ovens there are breakfast cookers, in which eggs and bacon may be cooked on the breakfast table; electric plate warmers, which are being ordered for London clubs, for they can be kept in the dining-room without any offensive smell; electric foot warmers, hot plates, stewpans, kettles, flatirons, ornamental screens, which act as radiators of heat and warm a room; electric curling-iron heaters for ladies, and electric shaving-pots for gentlemen.

A correspondent of the Pittsburg *Dispatch* states that works for the manufacture of alkali and bleach powder by electricity are about to be established in Virginia, whose climate is supposed to be well adapted to the production of those commodities. In order to overcome the troubles caused by excessively varying temperature, a factory will be built in a huge excavation in the side of a mountain, and here the bleach chambers will be erected. The property is underlaid by a fine deposit of rock salt, and has a surface deposit of excellent limestone. There is plenty of good timber, and not distant coal fields will supply fuel at fairly cheap rates. The methods of alkali manufacture hitherto in vogue have been tedious, crude and expensive, and the introduction of electricity into the industry opens out new and remarkable possibilities. The electrolytic process, or the decomposition of common salt by electrolysis, is the only direct means of producing by one operation caustic soda and chlorine gas. The value of this process can be seen by comparing its results with those of the old methods. By one standard process 18 cwt. of salt will give one ton of salt cake, but it requires two tons of salt cake to yield one ton of caustic; and therefore 36 cwt. of salt is required to make one ton of caustic and 16 cwt. of bleaching powder. By electrolysis it is calculated that 36 cwt. of salt will yield one ton 16 cwt. of caustic soda and two tons 6 cwt. of bleach. In other words, at present prices the profits on bleaching powder will be nearly tripled, and on caustic nearly doubled.

Recently in Milwaukee four hundred telephones were rendered useless as a result of a trolley wire coming in contact with a telephone wire, the strong current of the former being conducted into the terminal room of the telephone exchange. A vertical strip of current arresters four feet high, on each side of which are trained the subscribers' wires, was speedily ignited and it burned to the top. Twenty-five cables containing subscribers' wires, which are carried from the arresters to the switchboard, were destroyed, rendering about 400 lines unserviceable. The failure of the arresters to act is a mystery.

Boston Notes.

The work of surveying the district for the new electric street railway that is to connect Boston with the popular seaside resort, Winthrop, is being pushed ahead, and the State Board of Railway Commissioners has given a hearing this week to an application for a charter. It is expected that as soon as authority is given work will begin on construction of the road.

A new device has been invented by Mr. George L. Hall, of Lynn, Mass., by means of which he can render dead when necessary any wire charged with electricity. It is called an electric cut-off, and works most satisfactorily. The inventor has already made and installed quite a number of these devices in various power stations around Boston.

The Northampton, Mass., Electric Light Company has just closed a contract for the erection of a new plant that is to cost $50,000 when completed.

The Wanoosnoc Power Company is the name of a new corporation organized in Portland, Me., with a capital of $20,000, to furnish electric power for mechanical and manufacturing purposes.

As yet there has been no final settlement of the dispute in the city of Cambridge about the laying of car tracks along the classic thoroughfare, Brattle street. Each party is equally persistent in urging their side of the case, and when the end will be deponent sayeth not. Meanwhile the people walk through Brattle street and appear as if satisfied to walk forever if only the modern vandals will hold off their ruthless hands from marring the street in dispute.

Accelerator cars is the name of a new type of car now being introduced by the West End Railroad Company of Boston, the distinctive feature of which is a pair of doors placed at the corners of the ends of the cars, and so unlike the single door at present occupying the centre of the ends of the cars. This construction has been adopted so as to facilitate the entering and leaving the car by passengers, which is now too often an unpleasant undertaking when the platform is crowded with passengers standing. Of course only one of the doors will be open at a time—the one on the side of the car furthest from the adjoining track.

General News.

What is Going on in the Electrical World.

Hartford, Conn.—Efforts are being made to organize a stock company at East Hartford to carry on an electric business.

Olathe, Kan.—The electric light plant here has been purchased by B. E. Morrison, of Newport, Ark., who will at once take charge of it.

Richmond, Va.—I. Bluford, of this city, has invented a device for shearing horses by electricity which does the work in one-third the time required by hand.

Fond du Lac, Wis.—The Fond du Lac Light, Power and Railway Company has fulfilled its promise to the public in equipping its electric road in first-class style.

Hamilton, Ohio.—There appears to be a strong desire among the citizens for a municipal electric light service, and meetings have been held to discuss the subject.

Madrid, Ia.—Mr. E. T. Pardee, of Clinton, representing the Fort Wayne Electric Company, has secured a franchise for a lighting plant here, and will begin work at once.

Leavenworth, Kan.—An ordinance has been passed by council giving Receiver Newman Erb the right to change the present street railway lines into an electric system.

Milwaukee, Wis.—There is a block in the transfer of the Milwaukee Electric Railway, the Hinsey line, to the Villard syndicate, which was to have taken place November 1.

Muncie, Ind.—The Citizens' Electric Street Railway Company has changed its old line into an electric system. A first-class 250 H. P. engine has been purchased for the power house.

Dundee, Ill.—The Dundee Rapid Transit Company has, it is said, completed arrangements to connect the river towns, Dundee, Elgin, St. Charles and Aurora by an electric railway.

Cleveland, O.—The electric light mast in the public square has been reduced from 250 feet in height to 135 feet, improving the light.—Electric light meters are to be placed in all the hotels.

Hoosick Falls, N. Y.—Ground was broken a few days ago for the new electric railway to connect North Hoosick and Waloomsac. It is likely that the road may be in time extended to Bennington, Vt.

Chicago.—The Electric Launch and Navigation Company reports having carried over 1,000,000 passengers in its electric launches with safety during its six months' operations at the World's Fair.

Fort Worth, Tex.—Stratton & White, electrical and general implement dealers, have filed a deed of trust for $400,000, with but $50,000 preferred. The failure of the company is a severe blow to Fort Worth business circles.

Scranton, Pa.—Arthur Lewis and William F. Hessel have opened an electrical supply house in this city, and will carry a complete line of electrical goods. Both of the men were lately in the employ of the Electric Light Company.

Port Huron Mich.—An electric railway from Port Huron to Maryville, St. Clair and Marine City will be built in the spring the St. Clair River Railroad Company having been organized for that purpose with a capital stock of $300,000.

Peoria, Ill.—The immense fly-wheel of the General Electric Company plant burst on the morning of the 30th ult., completely wrecking the front of the works and ruining valuable dynamos and machinery. The damage is between $15,000 and $20,000.

Brooklyn, N. Y. The New York and New Jersey Telephone Company propose to establish pay station telephones in bar-rooms and drug stores, many of these places charging the public for use of their telephones, which are rented for private use only.

Colorado Springs, Col.—The Lowe Gas and Electric Company has gone into the hands of a receiver, Irving Hawbert having been appointed to take charge. The company owns the only gas works here, and one of the two electric light plants. L. P. Lowe is manager.

New York.—The Commercial Cable Company has received a blue ribbon, preliminary to the delivery of a medal from the World's Columbian Exposition, for the best system of working ocean telegraph cables, and for the Cuttriss improved cable and telegraph apparatus.

Albany, N. Y.—It is believed here that no experiments will be made this year in the application of electricity to the propelling of canal boats.—The electric heating of trolley street cars has become an important branch of the business of the Consolidated Car Heating Company.

Newton, N. J.—The contract of the gas company for lighting the streets expires shortly and the residents generally have expressed themselves as favoring electric light; it remains therefore for either the gas company, a private corporation, a new company, or the town to furnish what the people demand.

Salt Lake City, Utah.—W. H. Rowe, R. M. Jones, J. W. Summerhays and George M. Cannon have petitioned city council for a franchise for an electric railway which they intend to extend to Big Cottonwood Cañon if they are given the right of way in the city.

Sharpsburg, Pa.—The Allegheny and Kiskiminetas Electric Street Railway Company is making a move to secure a right of way from Tarentum to Etna borough, through Sharpsburg, to connect with the Allegheny and Manchester electric line. The new company has secured a charter for operating the line between Tarentum and Sharpsburg.

Indianapolis.—Walker Brothers & Company, brokers, of New York City, have instituted suit in the Federal District Court at Indianapolis against the Muncie Street Railway Company and Citizens' Street Railway Company of Muncie to recover $5,500, claimed to be due as commissions earned in effecting the sale of the property and franchises of the Muncie Street Railway Company to Russell B. Harrison.

Rochester, N. Y.—The new train safety apparatus invented by Dr. J. H. McCartney, president of the Railway Electric and Automatic Signal Company, has been tested on the Delaware, Lackawanna and Western Railroad. The operation of the new device was witnessed by a number of railroad men and others, and was pronounced satisfactory. It resembles in some respects the block system. The system not only protects a line of straight tracks, but it renders collisions on sidings and switches well-nigh impossible.

Washington, D. C.—Col. Bullock and other representatives of the Universal Electric Company of New York, appeared before the District Commissioners a few days ago and presented the claims of the company of having "the best system of electric traction in existence." (The system is that which was tested on Coney Island a short time ago, and was explained at the time in ELECTRICITY.) The commissioners heard the details with apparent interest, but came to no determination as to its adoption in Washington.

Cincinnati.—The new Telephone Exchange, on Vine, near Fourth street, was opened for business on the 28th ult., at which time the telephone system of the city was changed from overhead wires to the subways.—A test of the Salamander fireproof and waterproof wire was made in the shops of the Card Motor Company last week, under the direction of a representative of the Washburn & Moen Manufacturing Company of Worcester, Mass., and proved a success. The electrician of the local board of fire underwriters witnessed the test and subsequently remarked that the wire filled every requirement for a fireproof electric wire.

Paterson, N. J.—The New Jersey Improvement Company proposes to build an electric railway line from Paterson to New Brunswick, passing through Montclair, Orange, Plainfield, Metuchen, etc., following the line of the Orange Mountains. The length of the proposed line is forty miles. The following are the officers of the company: President and general manager, Jacob L. Stapleman, of Bala, Pa.; secretary, John N. Bethel, of Philadelphia, Pa.; treasurer, Charles E. W. Smith, of Morristown; directors, Lewis E. Mans, of Philadelphia, Pa.; Roland F. Hill, New York; William N. Mills, Boston, Mass., and A. D. Thompson, Plainfield.

Vancouver, Br. Col.—The *Advertiser* says: "There has just been added to the Vancouver Electric Street Railway and Electric Light Works a fine piece of machinery in the shape of a Westinghouse 250 H. P. generator, capable of furnishing illumination required for 2,500 incandescent lights. So accurately is it constructed and placed in position that one can scarcely detect by sight that the parts are revolving with such high velocity. Connected with the generator is a small agitator. Both have the latest improvements in their construction. The machine has an automatic regulator so delicate that whether one light or 2,000 are burning the current remains steady."

The leading feature of the *Review of Reviews* for November is its presentation of the "Possibilities of the Great Northwest," in an article by Mr. S. A. Thompson, and in a supplementary article by Dr. Emory R. Johnson, upon "Inland Waterways for the Northwest." Mr. Thompson, as secretary of the Duluth Chamber of Commerce, has for several years been actively engaged in searching out and applying effective means for bringing the great States northwest of the Upper Mississippi, and the great Canadian Provinces belonging geographically to the same region, into closer communication with the rest of the North American continent. He is therefore able to write with an enthusiasm born of intimate knowledge of the subject and supported by very important and surprising statistics. Dr. Johnson is lecturer on Transportation in the Wharton School of Finance and Economics, University of Pennsylvania, and has recently published a monograph upon "Inland Waterways." Dr. Johnson particularly emphasizes the importance of canal and river transportation as a means of lowering railway rates, and he finds a very large social as well as economic influence resulting from this extension of facilities for shipping and for personal travel. These two articles suggest a future of almost unimaginable growth for the great Northwest. Each article is fittingly illustrated.

INCORPORATIONS.

The Michigan Electric Company, Detroit, Mich.—to manufacture and sell electrical appliances and do electrical engineering. Capital stock, $10,000. Promoters: Geo. A. Manfield, Joe E. Lockwood, Detroit; Francis B. Stockbridge, Kalamazoo, Mich.

The Victor Electric Light, Power and Water Company, Victor, Col.—to erect and operate electric plants, etc., to supply the towns of Victor, Fremont, Lawrence and Barry in El Paso County, Col., with light, etc. Promoters: Wilbur K. Honson, H. E. Woods, J. E. Rockwell, Victor, El Paso County, Col.

The Cripple Creek Electric Company, Cripple Creek, Col.—to operate an electric plant for furnishing light, etc., for Cripple Creek and vicinity. Capital stock, $100,000. Promoters: Robert P. Davie, Hiram Wilson, Willis S. Montgomery, Cripple Creek.

The American Novelty Company, Minneapolis, Minn.—to manufacture electrical machines and novelty devices, etc. Capital stock, $100,000. Promoters: Ed. H. Darrow, Albert E. Pray, Truman E. Penney, Minneapolis.

The Roslyn Light and Power Company, Roslyn, Wash.—to manufacture and sell light, heat and power and do general electric lighting. Capital stock, $17,000. Promoters: Chas. A. Sprandel, Mrs. Lena Sprandel, E. C. Sharpe Roslyn.

The Union Heater Supply Company, at Detroit, Mich.—to manufacture plumbers', trainmen's, electricians', dentists' and painters' specialties. Capital stock, $10,000. Incorporators: B. Rein, George C. Huebner and Catherine L. Huebner.

The People's Light, Heat and Power Company, Camden, N. J.—to manufacture and supply heat, light and power either by electricity, gas or other means. Capital stock, $100,000. Incorporators: Edward Dudley and Henry B. Wilson, of Camden; Selden Twitchell, of Philadelphia.

The Sidney Electric Company has filed notice at Columbus, Ohio, of an increase of capital stock from $15,000 to $25,000.

The San Francisco Bonet Electric Tower Company, Chicago. Capital stock, $150,000. Incorporators: Leo Bonet, Marie Dubois and W. H. Munich.

The Northfield Light, Heat and Power Company, Northfield, Minn.—to manufacture, supply and sell light, heat and power, and own real-estate and plants necessary for the manufacture and supply of such light, etc. Capital stock, $20,000. Promoters: J. W. Hilliard, J. C. Nutting, M. W. Skinner, A. W. Norton, D. J. Ferguson, C. A. Drew, B. Kelly, J. S. Tripp, H. O. Dilley, F. J. Wilcox, Northfield.

The LeRoy Electric Light, Power and Heating Company, LeRoy, Ill.—to supply electric light, heat and power in LeRoy and vicinity. Capital stock, $10,000. Promoters: L. A. Crumbaugh, A. J. Keenan, L. A. Reynolds, Amos Rutledge, S. D. VanDeventer.

The Electric Motor Company, Duluth, Minn.—to manufacture electric motors and electric and mechanical attachments and appliances relating thereto and used in connection therewith. Capital stock, $100,000. Promoters: D. H. Merritt, Geo. J. Northrop, Marquette, Mich.; Frank W. Merritt, Arthur R. Roe, Duluth, Minn.

The People's Power Company, Rock Island, Ill.—to furnish light, heat and power, and sell appliances for same. Capital stock, $300,000. Promoters: Theo. B. Davis, Samuel S. Davis and Chas. O. Nason.

The Atchison (Kan.) Electric Railway and Light Company has filed an increase of its capital stock from $250,000 to $300,000.

The Inter-State Telephone Company of Kansas City, Kan., has been chartered at Topeka. Its capital stock is fixed at $100 000.

The Buttermilk Falls Electric Company, Highlands, N. Y.—to manufacture and use electricity for light, heat and power. Capital stock, $15,000. Promoters: Chas. F. Roe, Geo. W. Flood, Highland Falls; Walter C. Anthony, Newburgh, N. Y.

The Philadelphia *Press* of the 3d inst. says: "The Pittsburg Electric Company yesterday took out a charter at Harrisburg. It is claimed, and apparently with good reason, that when the last Legislature re-enacted the corporation law of the State, and omitted electric light companies from its list, it necessarily repealed all legislation authorizing the incorporation of such companies. Until the Supreme Court settles this question no one can be certain that he can safely make contracts with an electric light company chartered since this repeal went into effect. The new Pittsburg company, therefore, will need to invest in a lawyer before it does in a dynamo."

The Deming Land and Water Company, Deming, N. Mex.—to construct street railways and electric light plants in Deming, etc. Capital stock, $700,000. Promoters: Paschal R. Smith, Samuel C. Hobart, Chas. F. Thayer, Jas. L. VanArsdale, Chas. E. Easby.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED OCTOBER 17, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

506,770. Elevated Railway. James F. Cranston, Springfield, Mass., assignor of one-half to Michael Craven, same place. Filed May 23, 1892.

506,993. Electric Railway Conduit. Henry H. Franklin, Brooklyn, N. Y. Filed July 13, 1893.

507,064. Trolley Wire Hanger. Benjamin B. Betts, St. Louis, Mo., assignor of one-third to Emil A. Kolbe, same place. Filed Dec. 28, 1892.

ELECTRIC LIGHTS AND APPLIANCES.

506,733. Manufacture of Electric Lamps. Hermann Schulze-Berge and Frank G. A. Schultze-Berge, Brooklyn, N. Y. Filed March 23, 1893.

506,890. Electric Arc Lamp. August Utzinger, Nuremburg, Germany, assignor to Schuckert & Company, same place. Filed Dec. 15, 1892.

DYNAMOS, MOTORS, ETC.

506,740. Dynamo-Electric Machine. Sidney H. Short, Cleveland, Ohio, assignor to the Short Electric Railway Company, same place. Filed April 13, 1891.

506,774. Dynamo-Electric Machine. Fritz A. Feldkamp, Newark, N. J. Filed Nov. 15, 1892.

506,775. Dynamo-Electric Machine. Fritz A. Feldkamp, Newark, N. J. Filed Nov. 19, 1892.

506,786. Electric Locomotive. Hosea W. Libbey, Boston, Mass. Filed April 21, 1892.

506,881. Regulator for Dynamo-Electric Machines. Jeremiah Keller, Canton, Ohio. Filed Oct. 10, 1891.

506,920. Electrical System of Distribution. Cyprien O. Mailloux, New York, and William S. Barstow, Brooklyn, N. Y. Filed April 27, 1893.

506,921. System of Electrical Distribution. Cyprien O. Mailloux, New York, and William S. Barstow, Brooklyn, N. Y. Filed June 23, 1893.

506,927. System and Apparatus for Raising Water. John H. McGowan, Cincinnati, Ohio. Filed Dec. 4, 1890.

TELEPHONE AND TELEGRAPH APPARATUS.

506,658. Multiple-Commutator Apparatus for Telephone Systems. Louis A. Berthon, Paris, France, assignor to the Societe Generale des Telephones. (Reseaux Telephoniques et Constructions Electriques). Filed June 15, 1892.

506,884. Apparatus for Suppressing Telephone Disturbing-Currents. Frank A. Pickernell, Newark, N. J., assignor to the American Telephone and Telegraph Company of New York. Filed June 6, 1893.

506,978. Printing Telegraph. Lewis P. Buck and Frank D. Sweeten, Wilmington, Del. Filed July 26, 1892.

MISCELLANEOUS.

506,683. Junction Box for Electric Cables. Samuel B. Fowler, Chicago, Ill., assignor to the Standard Underground Cable Company, Pittsburg, Pa. Filed April 12, 1893.

506,700. Automatic Sprinkler and Fire Indicator. Joseph S. Kiehl, Chicago, Ill. Filed Oct. 19, 1892.

506,729. Electric Push Button. Benjamin F. Rex, St. Louis, Mo. Filed Feb. 16, 1893.

506,830. Insulated Electric Conductor. Leonard F. Requa, New York, N. Y. Filed Dec. 24, 1892.

506,841. Electric Alarm System. George F. Bulen, Bayonne, N. J. Filed July 5, 1893.

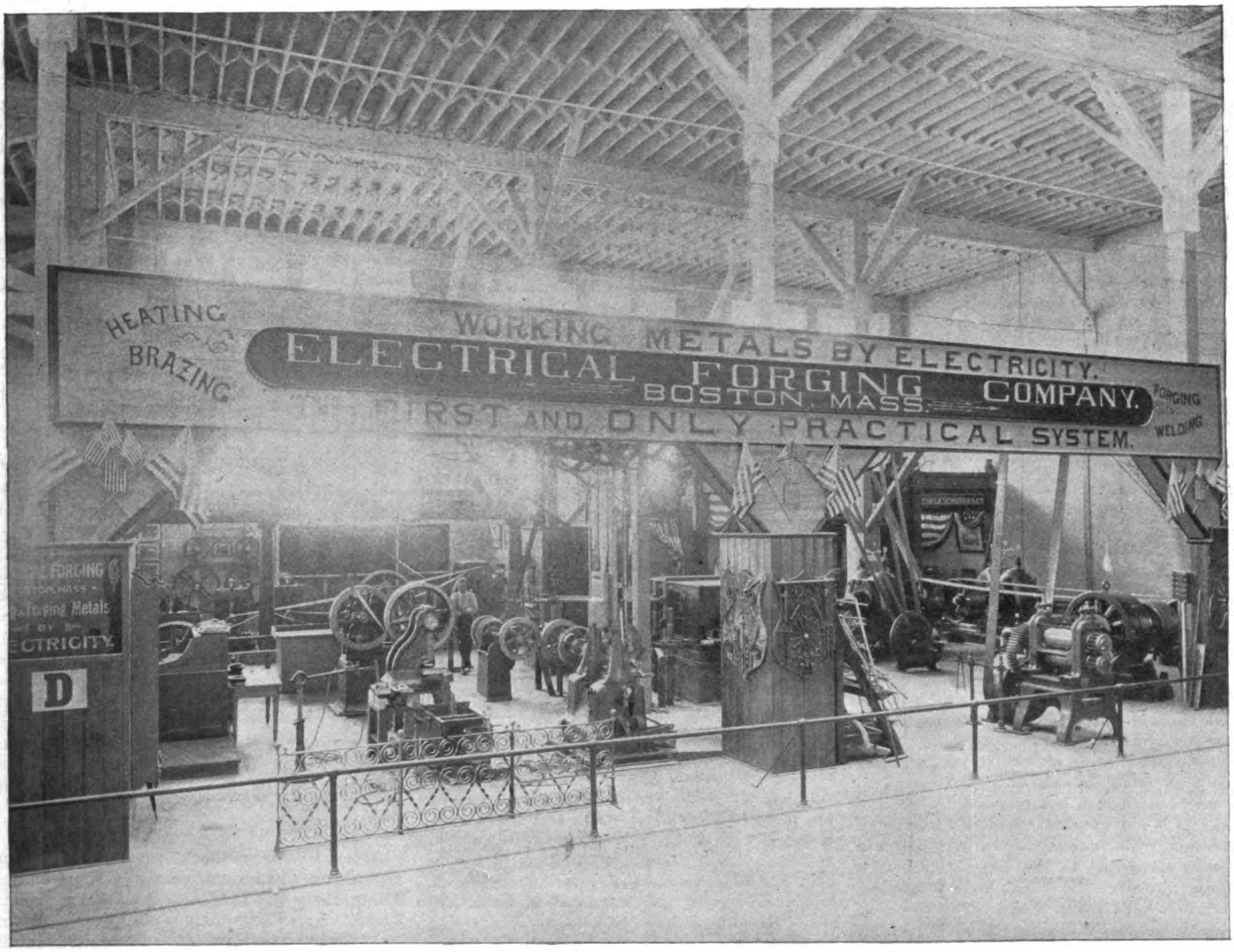
506,883. Visible Signal. Frederic S. Perrin, New York, N. Y., assignor to the American Telephone and Telegraph Company of New York. Filed May 15, 1893.

506,936. Electric Synchronizer for Clocks. Henry S. Prentiss, Elizabeth, N. J. Filed Nov. 3, 1892.

506,957. Method of Manufacturing Copper Wire. Emile Viarengo, Turin, Italy, assignor to the Val D'Aosta Syndicate, Limited, London, England. Filed April 5, 1892.

ELECTRICITY.

VOL. V. NEW YORK. NOVEMBER 15, 1893. CHICAGO. No. 18


HEATING
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ELECTRICAL FORGING COMPANY.
BOSTON, MASS.
FIRST AND ONLY PRACTICAL SYSTEM.
FORGING
WELDING
Forging Metals
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D

ELECTRICAL FORGING COMPANY'S WORLD'S FAIR EXHIBIT. (SEE PAGE 210.)

Electrical Forging.

The exhibit of the Electrical Forging Company of Boston at the World's Fair, which is illustrated in our Frontispiece, proved one of the attractive points in Electricity Building, and the applications of the process which were carried on in this booth attracted the attention of large crowds of visitors almost constantly.

The generator operating the machinery was of a special design, of 75 H. P. capacity, producing a current about 1,800 volts and 25 to 35 amperes. From the generator the current is conducted to the transformer carrying the massive copper conductors leading to the various styles of jaws or electrodes between which the different shapes of metal bars, etc., to be heated are placed. The transformer is four-sided and the electrodes are so arranged that a number of men may work simultaneously about the device. The power of the transformer is such that the current is changed from the high intensity of 1,600 to 1,800 volts down to 30 volts while the amperage is proportionally increased to 8,000 or 10,000.

One of the principal features of this system is the regulation, and this is accomplished by placing a rheostat in the exciter circuit instead of the dynamo circuit; the most sensitive regulation can thus be obtained.

As the details of this system have already been given in Electricity, the reader is referred to the previous description of this interesting and novel application of machinery.

A New Danger from Lightning.

Mr. A. A. Voysey gives an account in *Industries* of an apparently unusual cause of damage by lightning. In a room in a country house near Nottingham stood a table "ornamented by a fringe fastened securely to it by nails. This fringe had been almost entirely burnt on the side of the table facing the room, and the burning had partially extended to one other side. The wood was charred to a depth of $\frac{1}{8}$ to $\frac{1}{4}$ of an inch where the fringe was burnt. If the table had been struck by lightning there must have been some marks in the room showing where the discharge had entered and where it passed to the earth. But not a mark or sign of any kind could be found, and the damage to the table was completely isolated. A rigid inquiry proved that no one had entered the room with a candle. The only possible explanation of the occurrence was suggested by an examination of the fringe. It was found to consist of a fluffy material, probably a mixture of cotton and wool, and certainly of an inflammable nature. Interspersed among the fluffy material were fine metallic threads. Now it is in this combination of inflammable material with the metal threads that the explanation lies. The metal threads were acted on inductively by the lightning discharges taking place near the house. This inductive action was sufficient to cause small sparks to fly between various threads, and the sparks set the inflammable material on fire. If the fire caused in this peculiar manner had not quickly died out, the whole house might have been destroyed, and no sign would have been left to point to the true cause. It is not unusual for fires to occur in connection with thunderstorms, and they are generally attributed to the direct action of a lightning discharge. Possibly a large percentage of such fires have been caused by induction, and the simple incident which has come to my notice is sufficient to show how easily the inductive action may cause a fire."

Electric clocks that automatically ring bells at the end of each recitation hour or period, are being put into a number of New England schools.

The Artificial Lighting of Workshops.

BY BENJAMIN A. DOBSON.[*]

In manufacturing districts the use of artificial light is of considerably greater importance for work of all descriptions than it can be elsewhere. Whether the work be fine or coarse, delicate or bold, a better light is needed than for work which does not come under the head of manufacture. In Lancashire the staple industries of engineering, machine-making, spinning, weaving, bleaching and dyeing, are mainly established in certain centres; and with them is invariably associated in the surrounding district the great coal industry. Although Lancashire coal has a number of excellent qualities, yet it is one that makes the most smoke of any. A large portion of the manufacturing industries, great and small, date from a number of years back, when smoke-consuming and smoke-preventing apparatus had not yet been devised; and many of the factories are working at the present day under pretty much the same conditions as when they started. Hence the atmosphere in all manufacturing towns in Lancashire is heavily charged with unconsumed carbon, producing an excess of cloud and fog, which, while inducing an excess of rain, acts also as a screen against the rays of the sun, and thus does a double injury to the neighboring agriculturist, the producer of the country's native wealth. A circle of thirty miles radius around Manchester is said to include a larger population than an equal circle around any other place in the world; and within this circle, about twelve miles northwest of Manchester, lies Bolton, the town with which the author is best acquainted, where all winds, except the west and northwest, bring the surcharged atmosphere from other manufacturing districts, producing at any season of the year, if the wind happens to be slight, a sky ranging from dull lead to dark brown. For four years in succession it has occurred at the writer's works that on June 21, the longest day, the gas in every room, amounting to nearly 7,500 jets, has had to be lighted by 11 o'clock in the morning, and has remained lighted until work ceased; and this has occurred also in other towns and in weather that ought to have secured abundant sunshine. To such an extent does gloom prevail that in clear weather the effect of bright sunlight becomes even distressing to the eye-sight, simply from the rarity of the contrast.

REQUIREMENTS FOR A WELL LIGHTED WORKSHOP.

Firstly, the light, if artificial, should be sufficiently intense to give the power of clear and natural sight over any portion of the work. For enabling the work to be performed with ease the light should evidently be arranged to produce as nearly as can be the effect of natural sunlight. The light of the sun is diffused by the atmosphere; and unless its entrance is limited in extent, such shadows as it may produce are only natural shadows, so natural that the eye has no difficulty in following detail in any visible part. In this respect, therefore, artificial light should, as far as practicable, imitate the best natural conditions. Secondly, the light should be so diffused as to avoid casting shadows or placing any one portion of the work in too great relief as compared with the general tone of the whole. If the work were being done in front of a window which faced the sun, a certain portion of it would receive an undue amount of light, and give a false idea alike of size and distance, owing to the contrast of the overlighted and underlighted parts. This might be a natural light, but would nevertheless be improper. Thirdly, the light should be of such a character as to have no tendency to injure the sight by a blinding glare. This remark applies either to a good gas-flame or to the electric glow-lamp, from both of which the light is well diffused; the rays, being all comparatively weak, are easily diverted and thus distributed. But the effect of having either a bright gas-flame or the still brighter glowing wire before the eyes is exceedingly fatiguing and destructive to the sight, and in combination with the dust of workshops makes it a wonder that ocular diseases are not more common than they are. Fourthly, the light should be of such a character as to leave the atmosphere free from noxious emanations. Any kind of natural or electric light will fulfil this condition. The artificial light that most infringes it is gas, which varies much from town to town, and even in the same town from time to time; but it is generally so impure as to be deleterious to health and comfort in the products of its combustion, which is always more or less incomplete. Fifthly, the light should not unduly raise the temperature of the room in which it is employed. If, on a hot day, a gas burner has to be lit for every person in a crowded workshop, as has to be done in certain manufactories, the combustion of so much gas affects the temperature greatly, and thereby produces lassitude among the workpeople, together with various ailments which are almost in proportion to the amount of gas consumed. Sixthly, the light should be simple and capable of easy control. The whole arrangement should be so contrived that nothing but the simplest knowledge and experience are required for turning the light on and off. This implies, of course, both a central control and also various points of sub-central control. Seventhly, the cost should be kept within such limits as will render the light practicable at the present day for those who have to make their livelihood in their special trade in open competition with the rest of the world.

ELECTRIC LIGHTING BY INVERTED ARC-LAMPS.

Some years ago, while engaged in visiting and examining certain mills on the Continent, the writer was much struck with a mode of lighting which he then saw for the first time. This consisted in the use of electric arc-lamps of from 1,600 to 2,000 C. P., suspended in a white enamelled reflector at a certain distance below the whitewashed ceiling of the mill. The first he saw was of 2,000 C. P., and thoroughly lighted a large room of about 40 feet square with light sufficient to see to pick up a pin off the floor. The walls of the room, as well as the ceiling, were whitewashed. The light had a sort of bluish tinge, and looked like bright moonlight, but with much greater illumination and entirely without shadows. This appeared so striking that he made a few experiments at once, and found that it was possible to see into the interior of the machines, and even underneath them, in a way that up to then would have seemed incredible; and further, that it was not possible to make a shadow of any description, even when holding a hat only 2 inches above the floor; all that could be seen in the centre of the covered part was a comparatively slight deepening of the shade. In other departments of the factory he found the same plan equally effective, and the diffusion of light so complete as to be astonishing.

INCANDESCENT GLOW-LAMPS.

At that time the author's firm were engaged in replacing gas by incandescent glow-lamps on the Edison-Swan system in a large machining room at their own works, which is 345 feet long by 76 feet broad and only 12 feet high, containing 239 machines tended by 200 workpeople in the area of 26,220 square feet. The exigencies of trade had required that annexes should be constructed almost all round the building, thus further diminishing the amount of natural light that could gain admission. Along the whole of the centre of the shop, for a breadth of some 50 feet, gas was burning day and night; and in the close muggy weather of autumn and the fog-laden days of hot summer the atmosphere of the room became most oppressive, in spite of the best ventilation by Blackman propellers; even at six o'clock in the morning, on entering the room, the smell was most objectionable. It was noticeable, too, that an undue proportion of the men suffered from diarrhœa, which was in fact a standard complaint and furnished the constant explanation for absence from work. Although sometimes this was simply an excuse, there can be no doubt that the exhalations caused by the imperfect combustion of a gas not absolutely pure will suffice to explain the possibility of a large number of men being affected thereby. The incandescent glow-lamps, each with its own switch, and covered with a wire guard, were attached to the gas brackets, which for this purpose were left just as they had been. Within a week of the application of these lamps, the importance of the third requirement, with regard to glare, was amply proved; for nearly every work man had devised a shade of one kind or another, some of white or brown paper, some opaque, and some translucent. No better device than this has been found; it does not look neat, being simply a makeshift; but it answers the purpose, costs nothing, and is applied in a moment. The results of the alteration were curious; the atmosphere was improved, and heat considerably diminished, diarrhœa as a general complaint ceased, and was at first succeeded by bronchitis, which, however, was found to be of a temporary nature and disappeared as soon as the workpeople in that room had become acclimated.

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[*] Abstract of Paper read before the English Institution of Mechanical Engineers.

Nevertheless with the result of this lighting the author was not satisfied. The shop was as dark and gloomy as with the previous gaslights. The number of lamps broken by accident and by carelessness was so great as to become a serious consideration, their price being out of proportion to their actual cost, and no allowance being made in regard to royalty in replacing broken lamps which had already paid royalty. The writer then made two further journeys to the Continent, in order again to examine the plan of the inverted arc-lamp; and on the first occasion returned more favorably impressed than before. The second journey was therefore made with the view of going more thoroughly into the details, and of concluding arrangements for conducting a trial of the plan in his firm's establishment. On this occasion he had the opportunity of examining a large weaving shed at Ruysbroek, near Brussels, on a dark winter night. The dynamo was driven from the main engine of the mill, and was a fine piece of work. Corridors lighted by incandescent lamps led thence to the vast weaving shed, which had the usual roof containing glass panels almost upright, facing north, with a plastered ceiling sloping southwards from the top of each glazed panel, and lighted from an inverted arc lamp in each bay between the pillars. The impression upon entering the doorway was that the large room was brilliantly lighted by the mid-day sun; no glare, no flames to be seen, but a golden light pervading the whole of the vast enclosure; the color of the hair, complexion, and costumes of the workingwomen perfectly distinct; under the looms not the slightest trace of shadow. In fact the result attained was an absolutely perfect ideal light for textile work. The bluish tinge of the arc light itself, when lighting direct, is more apparent than real, because it does not prevent the most delicate shades of color from being appreciated. If, however, it is considered disagreeable or undesirable, it can be altered, as it was in this particular weaving factory, by mixing a trace of yellow with the ordinary whitewash; the ceiling is then still white, but the apparently bluish tinge is eliminated.

The result of this visit was the application of four inverted arc-lamps in the large low machining rooms at the writer's works. Over 50 tons of castings are daily taken in and out of this room; and there must be at least 300 tons of castings of various sizes and descriptions in progress of treatment stacked and piled in different places on the floor; there is therefore all the more necessity for good lighting in order to avoid accidents. The darkest portion of the shop was chosen, and the four arc-lamps were placed in approximately the best positions for lighting a certain area. The ceiling not being plastered, it was considered advisable to nail up to the joists light scantlings, which were afterwards whitewashed. These lights have now been running almost day and night for about two years, and with unqualified success. The four arc-lamps have replaced twenty-six glow-lamps; but whereas each glow-lamp lighted up its own work only and a few inches around, the whole of the area lighted by the four inverted arc-lamps is bathed in a gentle temperate light, absolutely equal in all parts. This was encouraging, as an arrangement of this description involves a heavy expenditure; and it was therefore considered advisable to have further experience before going largely into it. Moreover, this plan of lighting would not always be applicable. If the ceiling were very low it would scarcely be practicable, because the arc lamp must hang a certain distance below the ceiling and still leave head room. Also there are places where the amount of light required is so small that it would be injudicious to go to the expense of applying these lamps, which are capable of so much more duty. It was determined, however, to make an experiment on a practical scale at the author's works, and with this object to apply inverted arc lamps for the lighting of a three-story building with large attic floor above, the latter being used as an iron and wood pattern-room.

Current Items.

An attempt is being made in London to produce ozone on such a scale that it will be available for innumerable hygienic and commercial purposes. The apparatus used is electrical, the ozonizer consisting of a number of serrated strips formed up into grids and separated from each other by plates of glass. On connecting these grids with opposite terminals of a high potential alternating current, what is called a "brush discharge" takes place on to the glass from the points of the serrations, and the characteristic smell of ozone is quickly apparent. To make the ozone in still greater volume, a large number of these plates are so arranged in a suitable case that when the discharge is established a current of air is passed through the apparatus, whence it emerges heavily charged with ozone. Before the air is passed into the ozonizer it is filtered, cooled and dried, so that its purity is insured.

There is a certain Greek engineer, now resident in Europe, who ought to have been an American, for he is the author of just the kind of scheme that, in the matter of boldness and picturesqueness, the world at large looks to Yankeeland to originate. At various points on the Bosphorus the current from the Black Sea to the Mediterranean has prodigious force, and it is now proposed to harness some of this waste power for the lighting of the whole of the city of Constantinople and a considerable length of the adjacent coast by electricity. The way in which the inventor intends to turn the ocean currents to account is to erect three very powerful dynamo machines upon the three points of the Bosphorus where the current has the greatest force, and, so far as can at present be learned, the project appears to be practical and realizable. It is stated that the company of capitalists has been formed, the necessary funds subscribed and application for a concession addressed to the Turkish Government. It is understood that the Government has taken the project into consideration and has nominated a commission to report on it.

Transformer Diagrams Experimentally Determined.—II.*

BY DR. FREDERICK BEDELL,

Assisted by A. W. Berresford, W. M. Craft and B. Gherardi, Jr.

CONSTANT CURRENT EXPERIMENTS.

The transformer was supplied in these experiments with a constant primary current, the square root of mean square value of which was 9¼ amperes, and the maximum value about 13·2 amperes. The frequency was such that $\omega = 2\pi n = 566$. The transformer was used both as a "step-up" and as a "step-down" transformer. The step-up and step-down experiments were substantially the same, inasmuch as the ratio of primary and secondary turns was small; therefore, in this paper, the results of the constant current experiments will only be given for the step-down transformation. A run was first made with the movable tongue secured in the zero position, that is, in the position in which the reluctance of the magnetic circuit is the highest and the coefficients of induction the smallest. The secondary non-inductive load of incandescent lamps was then varied from short circuit to open circuit and the primary and secondary measurements taken as described for successive values of the secondary resistance. The tongue was then moved in and secured in the 70° position, and a complete set of readings again taken of primary and secondary for different loads. Runs were then made with the tongue secured at 90°, 120°, 150° and all in at 180°, and the same measurements taken.

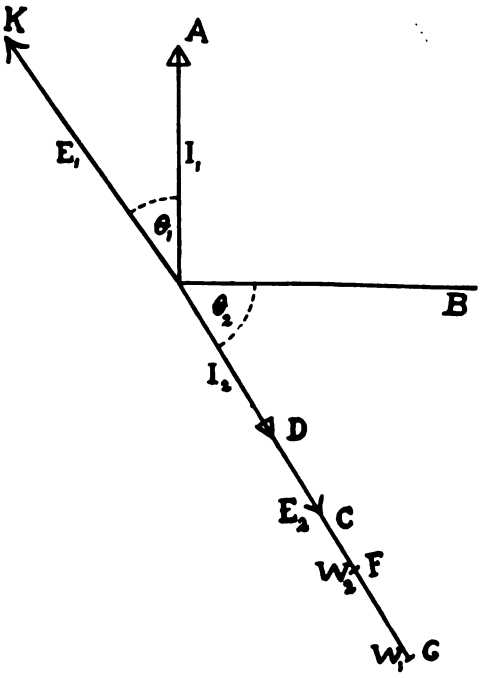

Fig. 4.

In this way data was obtained for all values of the coefficients of induction of the transformer, within the range of change produced by the moving in and out of the tongue, for all values of secondary resistance. For each observation, the primary and secondary currents and electromotive forces were known both in magnitude and direction—sufficient data for the construction of a polar transformer diagram. Such a diagram is represented in Fig. 4.

Polar Diagram.—The lines $\overline{OA}$, $\overline{OB}$, $\overline{OC}$, etc.. represent the maximum values of the harmonic electromotive forces and currents in their relative phase positions. Rotation is counter-clock-wise about o. The instantaneous values of the currents and electromotive forces are equal at any instant to the projection upon any fixed line of reference, of the lines representing the corresponding maximum values. Closed arrows indicate currents and open arrows electromotive forces. $\overline{OA}$ is drawn equal to the primary current, I_1. The primary impressed electromotive force is in advance of the primary current by an angle θ_1, and is represented by the line $\overline{OK}$ drawn to any convenient scale. The electromotive force induced in the secondary due to the primary current is 90° behind the primary current. $\overline{OB}$ represents this induced electromotive force, or the secondary impressed electromotive force. The secondary external resistance is non-inductive and the current is therefore in phase with the electromotive force measured at the terminals of the transformer secondary, but the current and measured secondary electromotive force lag behind the secondary impressed electromotive force $\overline{OB}$ by an angle θ_2 due to the self-induction in the secondary coil. The angle θ_2 is drawn so that $\tan \theta_2 = \frac{L_2\,\omega}{R_2}$. $\overline{OD}$ is drawn equal to the secondary current I_2, and $\overline{OC}$ equal to the electromotive force E_2 at the terminals of the secondary. As before explained, these lines represent maximum values.

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* Read before the International Electrical Congress, Chicago.

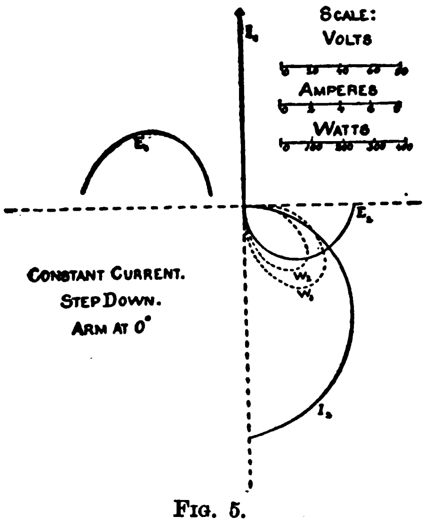

FIG. 5.

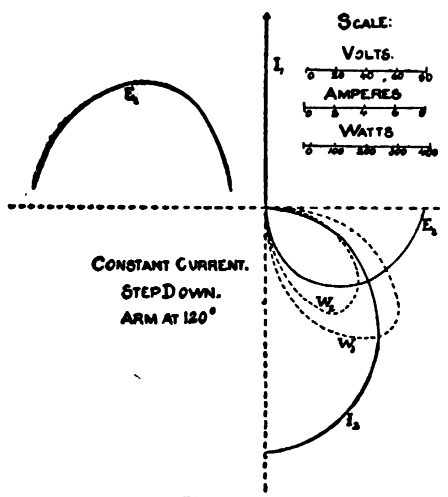

FIG. 8.

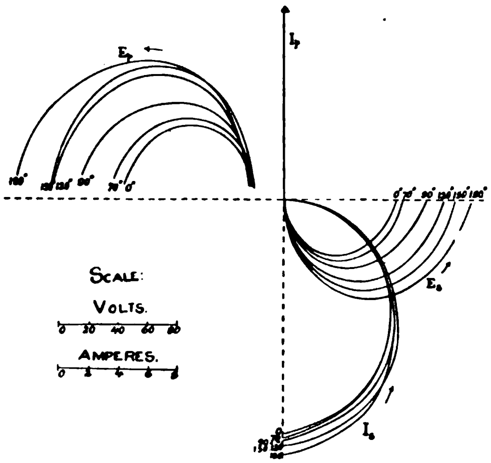

FIG. 11.

The primary and secondary power, W_1 and W_2, although not vector quantities, may for convenience be represented by the lines $\overline{OG}$ and $\overline{OF}$ drawn in the direction of the secondary current.

Diagrams similar to Fig. 4 may be drawn for each load of the transformer, the differences between them showing the effects of the variation of R_2. When these diagrams are superimposed, with the lines $\overline{OA}$ for primary current coinciding, the variations in the different quantities are more readily observed by a study of the locus formed for each of the several quantities, which changes as the secondary resistance is altered. It is in this way that the following diagrams are plotted. Fig. 5 shows the variation in the primary electromotive force, secondary current and electromotive force, and the variation in the primary and secondary power for all loads of the transformer, from $R_2 = 0$ to $R_2 = \infty$, for a constant primary current when the tongue is in the 0° position, that is, when it is all out. The arrows on E_1, E_2 and I_2 indicate the direction of the change as the secondary resistance increases. Figs. 6, 7, 8, 9 and 10 are drawn in the same manner for other positions of the tongue. In all cases the primary current is constant.

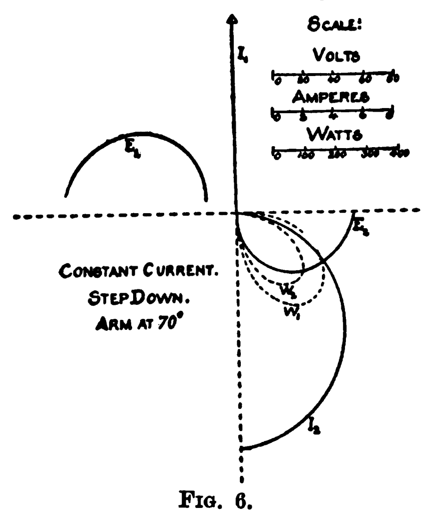

FIG. 6.

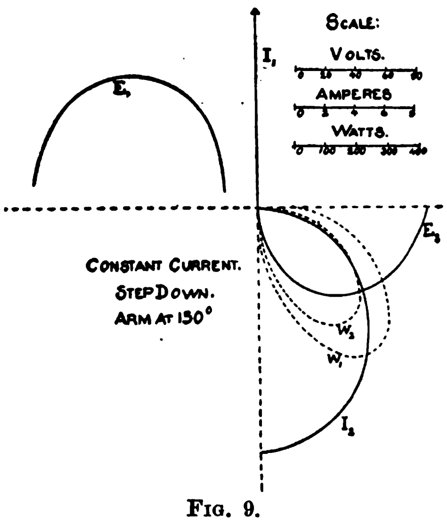

FIG. 9.

The agreement of these curves with the theoretical is noticeable. The primary electromotive force curve, the curves for the secondary electromotive force and current are approximately semicircles, as theory would indicate. The power curves, W_1 and W_2, are symmetrical lobes at about 45°. The shifting of the primary electromotive force curve to the left is caused by magnetic leakage and is also in perfect accordance with theory, as given in the series of articles on the Theory of the Transformer already referred to. The changes in the successive diagrams, from Fig. 5 with the tongue all out to Fig. 10 with the tongue all in, show the effects of diminished reluctance and increased coefficients of induction. The diameter of the semicircle for the secondary electromotive force increases in direct proportion to the increase in the coefficient of mutual induction. The primary electromotive circle increases in proportion to the coefficient of self-induction of the primary. The diameter of the secondary current circle is nearly constant.

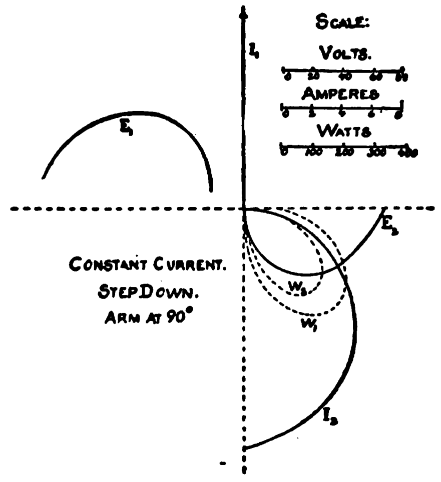

FIG. 7.

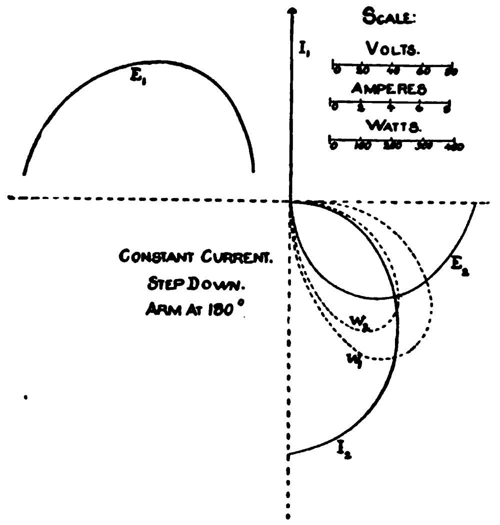

FIG. 10.

The comparison of these curves is better seen in Fig. 11, in which the preceding diagrams are combined so as to show the successive changes in the currents and electromotive forces for different tongue positions. A composite figure is shown in the same way for the power curves, W_1 and W_2, in Fig. 12.

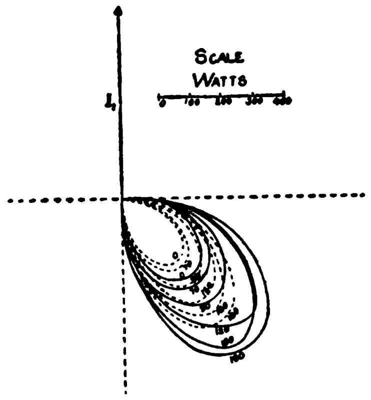

FIG. 12.

(To be continued.)

Niagara Falls, N. Y.—The Pittsburg Reduction Company is the first to enter into a contract for electric power with the Niagara Falls Power Company, engaging 6,500 H. P. The Reduction Company has leased eight acres of land here, and will put up extensive works. The Briggs Manufacturing Company will also put up works here for the manufacture of the Briggs patent press feeder, and will take power from the Niagara Falls Company.

General Electric Rumors.

BOSTON, Nov. 13.—A report reaches us from a source that is usually correct in its statements that the General Electric Company is at last to dissolve and the various companies now in the Trust are to revert to their former status as independent concerns, which is understood as meaning that there would at once be competition, free and open, even with the various concerns which constitute the Trust, most of which have been handicapped beyond endurance, and some of them actually closed up entirely. Another report, and this comes from Lynn, is that the Boston and Maine Railroad Company is trying to secure the Saugus River Works of the General Electric Company to use them as a machine shop, and along with this latter report comes a supplementary one that a rubber manufacturing company is being organized in Lynn, with Mr. C. A. Coffin as president.

Legal Notes.

In compliance with an order of Judge White, Attorney F. B. Skeels made a report in the Probate Court at Cleveland, O., on the 4th inst., concerning his trust as assignee of the W. D. Graves Electrical Manufacturing Company. The cause of the filing of the report was based upon an effort on the part of the Cleveland Electrical Manufacturing Company, one of the creditors, to have the business of the Graves Company discontinued. Attorney Skeels says that he has purchased material to the value of $7,201.75, and has sold manufactured goods to the value of $12,723.09. His expenses amounted to $7.056.82. He has received in cash $11,986.48, and has paid out $12,090.47. The amount of manufactured goods in excess of those included in the inventory of last January is estimated at $1,500.

Another suit affecting the City Electric Street Railway Company of Little Rock has been filed in the United States Circuit Court at Little Rock, Ark. The plaintiff is the Atlantic Trust Company of New York, holder of $300,000 first mortgage bonds of the City Electric Railway Company, and suit is brought to foreclose on these bonds on account of default in the payment of interest. The St. Louis Trust Company hold $300,000 bonds, executed subsequently, and they are made parties defendant, in order that priority of lien may be established; likewise, all judgment creditors are also made parties, including those obtaining damages against the road by reason of accident and resulting injury, over all of which the plaintiff asserts priority of lien.

A preliminary injunction has been granted in the United States Circuit Court restraining Edward N. Fraleigh, of No 26 Church street, New York, from making or using his magneto telephone, the receivers and transmitters of which are said to be an infringement of the American Bell Telephone Company's patent.

The Chester, Pa., Arnold Electric Manufacturing Company, which was closed by the sheriff on the 11th, has made an assignment, appointing Craig R. Arnold, late president of the company, as agent. The Delaware County Trust, Safe Deposit and Title Insurance Company was made assignee.

Status of the Mount Morris and United States Electric Lighting Companies.

An opinion was handed down Monday, the 13th, by Judge Shipman, in the United States Circuit Court of Appeals, in the case of the Edison Electric Light Company against the Mount Morris Electric Light Company and the United States Electric Light and Power Company. Judge Lacombe handed down a decision six weeks ago restraining the Mount Morris and United States companies from using in this city lamps infringing the Edison patents. Judge Shipman reverses this as far as it affects the customers of the other companies taken on prior to the first decision of the courts in favor of the patents. In substance, his decision is that the Edison Company is bound to furnish the defendants with Edison lamps for their business upon reasonable terms.

Mr. Wallace's Resignation.

Mr. John B. Wallace has resigned his position as receiver for the Ansonia Electric Company in Connecticut. The motion for his removal, which was made by creditors of the company, has therefore been dropped. Mr. Wallace's counsel stated to the court that his client did not desire to remain as receiver against the wish of the creditors. Mr. S. S. Mersick, of New Haven, has been appointed to succeed Mr. Wallace.

It is stated that the Ansonia National Bank is the largest creditor objecting to the proposed basis of settlement, and that it refuses to sign.

Buffalo Electrical Society.

The annual meeting of the Buffalo Electrical Society was held a few evenings ago at its rooms in Buffalo. The treasurer's report was read, and showed a balance on hand of $152.88; the librarian's statement showed the library to contain 75 copies of standard electrical works, 66 bound volumes of electrical periodicals and a large quantity of experimental apparatus. President Kitton congratulated the society on having completed its eleventh year of existence and on its success as an organization.

These officers were elected for the ensuing year: President, Philip K. Stern; vice-president, Frank C. Perkins; secretary, Astley C. Terry; treasurer, Samuel Stewart, and librarian, John G. McNerney; executive committee — Frank Kitton, George A. Burnett and C. V. Boughton.

At the next meeting, on November 16, President Stern will read a paper on "Electricity at the World's Fair."

American Institute of Electrical Engineers.

The eighty-first meeting of the Institute will be held at headquarters, 12 West 31st street, New York City, on Wednesday, November 15, at 8 o'clock P. M.

The business of the evening will be the discussion of the report of the Special Committee of the Council appointed at the last meeting on Local Meetings of the Institute.

The committee is composed of the following members of the Council: Herbert Laws Webb, chairman; Geo. M. Phelps, Wm. J. Hammer, A. E. Kennelly and M. I. Pupin.

The Complete Electric Construction Co.

At a recent meeting of the directors of the above company the following officers were elected:

Mr. John A. Seely, president and general manager.

Mr. W. H. Baker, of the Postal Telegraph Company, vice-president.

Mr. C. O. Baker, Jr., of Baker & Company, platinum refiners, secretary and treasurer.

Mr. George G. Ward, of the Commercial Cable Company, and Mr. George F. Porter, secretary of the National Electric Light Association, directors.

Mr. Baker retains his interest with Baker & Company, and his position there will be unaffected by his connection with this company.

A Safe Statement.

The News as It is Given Out in Connecticut.

(From the Boston Advertiser.)

President Dustin, of the Schuyler Electric Company, Middletown, is authority for the statement that the works will be started in full as soon as there are sufficient orders ahead to warrant it.

Trade Note.

Messrs. Taylor, Goodne & Ames, Chicago, have discontinued their agency for Wagner motors, and are now handling a full line of Diamond motors, dynamos, transformers, etc.

General Electric.

Its Stagnation Explained to an Arkansaw Constituent.

To the Editor of ELECTRICITY.

DEAR SIR: Down this way we are all dependent upon your valued and courageous journal for our news in regard to the General Electric Company, and for several weeks you seem to have neglected us in this respect. What is the reason? Have you also, like your contemporaries, been subsidized, or is your fighting editor dead? CONSTANT READER.

Gravelly Hill, Yell Co., Arkansas, Nov. 10.

We will answer the last of our correspondent's inquiries first. ELECTRICITY'S fighting editor is not dead. He has not been knocked out. He has had something over fifty rounds with the General Electric Company, and has not received even a scratch in the scrimmage. But our fighting editor is a true sport. If he were to visit Yell County he would by unanimous consent be called "dead game." He does not believe in fighting after the battle is over, or in the wanton enthusiasm of success waving his fists over the prostrate form of his beaten antagonist, and shouting "Come on, get another!"

ELECTRICITY has not been subsidized. And if devotion to principle were not sufficient to render this impossible, the general condemnation which has been expressed of the course of our milk-and-water contemporaries is the strongest kind of a *business* argument against accepting anything in the nature of a subsidy. ELECTRICITY is *right*, and also *successful*.

The reason we have published little General Electric news of late is that there is little news to publish.

The affairs of the company as it stands to-day are of slight interest to any one except to the careful historians and philosophers who will write long treatises on the "Peculiar Contortions of a Corpse."

The business of the company has sunk to almost nothing, its factories are almost as silent as a graveyard at midnight, and its employees have few duties except attendance upon committee meetings.

There is no head to its affairs, no policy, and consequently no energy. It is like a ship at sea with a discredited captain and broken-down engines.

To go beyond our correspondent's inquiries, and state how the company was wrecked, would be merely to reiterate the facts published in these columns during the past year.

The present condition of affairs, however, cannot continue long, and ELECTRICITY may be relied on to give the news when there is any.

Already Drexel, Morgan & Company are reported to have offered the entire concern to a syndicate for a sum only 25 per cent. above the capitalization of the Edison General Company, but the offer was not acccepted.

The company will be reorganized, and will be conducted upon fair or dishonorable methods exactly in proportion to the thoroughness with which the T.-H. element is weeded out. When occasion demands, our yell will be loud enough to reach even our Constant Reader in Gravelly Hill.—ED.

Bulk Does not Signify Greatness.

(For the instruction of the E—l W—d.)

It is not growing like a tree
In bulk, doth make man better be;
Nor standing long an oak, three hundred year,
To fall at last, dry, brown and sear.
A lily of a day, is fairer far in May;
And though it fade and die that night,
It was the child and flower of light.

BEN JONSON.

ELECTRICITY.

The Popular Electrical Journal.

GEORGE R. METCALFE, - - - EDITOR.
R. H. WILLOUGHBY, - - ASSOCIATE EDITOR.

B. E. GREENE, Publisher.

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NOTICE.—Hereafter cuts will be admitted to the first page of "Electricity," not to exceed one square inch in size.

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Ring Rule at the Institute.

The action of a few of those in power in the American Institute of Electrical Engineers in regard to the disposition of papers presented before other societies, which culminated at the last meeting in the order to print a paper which had never come properly before the Institute, is exciting quite as unfavorable comment among members outside of New York as among those who reside here and are conversant with the facts. We have heard directly and indirectly from a number of members whose membership is valued by the Institute as highly as they themselves have valued it, and their characterization of the proceedings has been that it was high-handed in the extreme. More than one prominent member has stated that if such mistakes are repeated as have in several recent instances occurred in the selection of papers for the Institute and for admission to the Transactions, they will make manifest their disgust by resigning their membership. When men of this calibre speak in such a manner there is certainly something radically wrong, and it behooves us to look about us both for the evil and its remedy. Fortunately for the good of the society the nature of the evil was made perfectly manifest in the proceedings of the last meeting, and its remedy is suggested at once.

There are one or two or three members whose activity in the affairs of the Institute from the beginning has given them a prominence to which their qualifications as engineers have not entitled them so much as have their abilities as organizers, wirepullers and politicians. To them the Institute has been indebted for much of wise counsel, and their preferment has been natural and deserved in a large measure. They have looked upon themselves, however, as leaders, and have been leaders for so long a time that they have become accustomed to dictate the policy of the Institute as did Croker the policy of the Democratic party in New York and McLaughlin in Brooklyn. In fact the position of politics in New York previous to the last election and of politics within the Institute are strikingly similar. Tammany shoved Maynard down the throats of the people in the one case, and another Tammany, smaller in its ramifications, but no less autocratic, by the most unusual proceedings forced a paper belonging to another society into the archives of the Institute. The Institute Tammany will reply that the proceedings referred to were not unusual or contrary to the customs of the Institute. Let us grant for a moment that they were not. If it is possible in accordance with the rules and customs of the Institute that a paper read before another society can be incorporated in its transactions without having been either submitted to or discussed by that Institute, without revision of any kind and without its being known in any way that the copy submitted even in any particular resembled the address delivered before that other society, or that such a measure can be forced through the society on the dictum of one man, supported only by the plea that to reject the paper would embarrass that man—we say if such is possible under the rules as they exist, it is its own best argument that they should be at once changed. But we maintain that the proceeding *was* unusual, and that no change in the rules is required; it is only their interpretation by an unprejudiced and fair-minded presiding officer that is needed, backed up by a healthy sentiment among the members against boss or ring rule. If this were not apparent before, it will become so by reference to the following which transpired at the last meeting. A motion was made to refer the paper in question to the Editing Committee, and the question arose as to the functions of that committee. The presiding officer interpreted them as supererogatory. He stated that they were solely to edit the discussions; that they had nothing to do with the paper itself, as no one would present papers before the Institute if they were to be edited by anybody in the Institute, and ridiculed the idea that any such duties were intended for the committee, or that it was usual for any society to assume for itself such privileges or rights with contributed manuscripts. He also stated in substance that in assuming such prerogative the Editing Committee would be clearly trenching on the vested functions of the Committee on Papers and Meetings.

Did not he *know* that his interpretation of the functions of the Editing Committee was directly contrary to those with which they were originally vested *as shown by the records?* The records state expressly that it shall be the duty of the Editing Committee to *revise* and *edit* papers which come before the Institute.

Did he not *know* that it is universally customary in societies publishing their own proceedings to have an editing committee, either under that name or some other, whose duty it is to scrutinize and revise, and edit when necessary, all papers previous to publication? If he does not, we will call to notice a dozen societies that have such a committee to every one that he can mention that has not.

Did he not know that the Committee on Papers and Meetings did not come into existence until six months after the creation of the Editing Committee, and that the functions of the latter are entirely distinct from those of the former, and that the "trenching," if any, is on the other side? If he does not, would it not be well for him, as the presiding officer, to inform himself by looking up the records? But this is of consequence only in so far as continued ignorance on the part of the presiding officer may result in continued activity of the ring, which knowledge would enable him to squelch at once. According to his interpretation of the functions of the Editing Committee, the motion to refer was absurd, and it received no second. A precedent was established which will be dangerous in the extreme, and all the more so because, by a measure engineered by this same ring and thoughtlessly supported by many others who did not understand its full import at the time, all record of protest against this high-handed proceeding has been expunged from the minutes. As an immediate result, it may be in order for the Committee on Papers to deny space in the Transactions to all written discussions of the paper, and for the New York Electrical Society to demand for its own members copies of the papers in question, printed at the expense of the Institute. Thus far we have discussed this matter without reference to the intrinsic merit of the paper. We are willing to assume that that was all the most critical could wish, but the Institute does not know this yet, and will not until it is printed in the Transactions. But there have been numerous instances before of the acceptance of papers totally unfit for, or inappropriate to, a publication such as that of which we speak. That such has been and is possible lies not so much in the *personnel* of either the Committee on Papers or Editing Committee, for both of them contain men who have the confidence of the Institute, but rather in the fact that power has been usurped by men who have neither the qualifications nor the abilities which entitle them to sit as censors in such important matters. In fact, a single individual has so far assumed these duties as to make it appear almost presumptuous for those to whom they were originally delegated to raise their voices in opposition, and they have lapsed into a state of innocuous desuetude. When heretofore papers of an improper character have been read before the Institute, we have purposely withheld criticism in these columns, feeling that their discussion by the members of the Institute would be the proper remedy. This has not, however, proved to be the case, for every paper that has been read has been published simply on the dictum of the Institute Tammany. But now when this ring removes even this last safeguard, viz., the free discussion of all papers offered for the Institute's consideration—when it arrogates to itself the right to over-ride all sense of propriety, and to muzzle those who have an unselfish interest in the welfare of the Institute—it is high time for the members to assert themselves, for by so doing alone can the dignity of the organization be maintained. No one can contribute to this desirable consummation more ably than can its honored president by breaking away from the influences of which we speak and observing a strict neutrality even though it do violence to personal obligations. But the members themselves have a duty to perform in upholding his hands in such endeavors, and insisting in no uncertain terms upon a strict scrutiny of everything that is destined for the pages of the Transactions. We believe the duties of the committees are properly distributed, and sufficiently explicit and defined, but have been usurped. It only needed an incident such as the Maynard incident in New York politics to arouse the people to action. We hope that the incidents of the last meeting of the Institute will have been sufficient to in like manner arouse its members from their lethargy. If so, they will have proved a blessing in disguise.

Those members residing in New York or in its vicinity who fail to attend the monthly meetings of the Institute are to a considerable extent responsible for the present turn of affairs, for the reason that their personal influence, if present, as well as their votes, would lend its proportional weight in the decision of questions which come up at these meetings. In order to maintain the standard of the society at the highest rank, it is essential that every member should, as far as possible, fulfil the duties which his membership involves, and the failure on the part of representative members to take an actual interest in the affairs of the Institute must inevitably result in its deterioration.

The most emphatic condemnation of a poor paper would be its exposure in the discussions, and impartial criticism is the most effective method of discouraging the presentation of trivial or inferior papers, but if these are allowed to pass unchallenged, their acceptability is thereby tacitly acknowledged.

The American Institute of Electrical Engineers has attained the position of the representative electrical society of this country solely on the merits of its previous career, and any tendency toward its deterioration cannot but be deplored; but this result can only be averted by the participation of its worthiest members in its affairs, and by selecting from among them officers whose ability will be a guarantee of their efficient management.

……o……

Steam vs. Water Power. The question of the utilization of water power, which has been brought prominently to public notice by the great Niagara project, is the subject of a communication from the United States Consul at Switzerland, where water power abounds and has been extensively used as a source of power. The figures given in this report are far from being unfavorable to water power under some conditions, and in the absence of any details they are difficult to criticise, but the fact that power procured from this source and transmitted three miles is said to cost nearly three times as much per horse power per annum as that generated by steam in England is sufficient to make the statement of interest. The most disadvantageous conditions can hardly account for such an excessive difference in the cost of power generated by these two methods.

The report contains a table recently published in Chemnitz—by whom is not mentioned—giving the relative cost per horse power of producing 50, 300 and 500 horse power in England, Germany, Bohemia and Switzerland as follows:

	50 H. P.	300 H. P.	500 H. P.
England……….	$24.24	$12.58	$9.88
Germany……….	29.21	15.52	13.51
Bohemia……….	27.50	14.74	12.97
Switzerland…….	46.82	29.61	25.54

The relative cost of producing the same from a waterfall is given at the source of supply as $30.88, $16.98 and $12.54 respectively, for 50, 300 and 500 horse power plants, but by adding to these the cost of an electric transmission of about three miles, the totals reach $57.68, $31.27 and $25.48.

It is stated also that the necessity often exists of holding a steam plant in reserve on account of the failures of the hydraulic and electric plants due to freshets, icy winters, mountain storms, etc., but where the power has been used for twenty-four hours a day, and supplies lighting at night, water power shows an advantage over steam.

From an American standpoint these figures for the cost of water power and electric transmission are about what might be expected, and agree very closely with the conclusions of Dr. Emery, published in ELECTRICITY, Vol. IV, No. 2, but some of the figures given as the cost per horse power with steam plants are so incredibly low as to leave much doubt as to their accuracy.

On the basis of ten hours a day in this country the operating expenses and interest charges per horse power alone on a 500 horse power plant, without making any charge for coal whatever, are nearly double the total cost per horse power named for the same size plant in England, which makes it more than probable that the figures for the different countries given in the table include certain factors only and are not true totals.

The report in general is intended to convey a warning against the inconsiderate adoption of water power for every class of work, and to refute the idea that a waterfall is necessarily the cheapest source of power obtainable. It points out, on the other hand, the fact that under certain conditions this motive power may prove a great saving over a steam plant, and in this way suggests the importance of carefully weighing the conditions of every case before deciding between the two methods.

Where a waterfall is available as a motive power, a careful comparison of its annual cost of operation and interest charges with those of coal or other fuel is necessary to determine their relative values in any locality. The first point of importance is the certainty and adequacy of the water supply. There are probably but very few places where it is necessary to keep a steam plant in reserve to supplement or replace the water power that the use of the latter will prove of any advantage; certainly not where coal is moderately cheap. Where the water supply is ample the interest on the first cost of both the hydraulic plant and the transmission plant, besides their operating expenses per year, remains to be compared with the corresponding expenses of a steam plant located at the point of consumption of the power. This should include, of course, the efficiencies of both systems.

In some parts of the West, where coal is very scarce and commands an exorbitant price, there would be no question between it and a water power. In such cases the decision rests entirely between the cost of the power delivered and its value at the point of consumption.

The use to which the power is to be applied cuts a very large figure in the decision between water and steam power, which depends upon the electrical transmission plant. The transmission of *current* even over great distances for lighting is one thing, and the transmission of *power* is distinctly another. The former is an accomplished fact, and plants of this character have reached a high efficiency. Considerably over 90 per cent. of the current transmitted can be utilized, and for this service water power has proved its special adaptability and will usually far outrival steam in economy.

The subject of general transmissions for both lighting and power distribution is far more complex than the former one and still remains to be satisfactorily solved.

Considerable of the current electrical literature might be construed as a contradiction of this statement, but in spite of the progress in this direction, on paper, we are still without a comprehensive long-distance transmission plant for general light and power distribution in this country.

The Niagara project, which is confidently expected to throw much light on this subject, will furnish our first experience in this line; and in this respect about the same conditions obtain abroad. Without disparaging the systems which have been proposed for distant power transmission, it is only fair to state that none of them which contemplate furnishing power applicable to every ordinary demand as well as light has been tested under actual commercial conditions, so that their commercial efficiency could be determined.

The work which has been done heretofore in the line of long distance power transmission has been designed to meet the requirements of special cases only, and where water power is utilized for these plants the economy of the system depends almost entirely upon the way in which the power is employed and the number of hours per day it is in use. As almost all such plants have been equipped with simple alternating current machines up to the present time, their success or failure is determined by the adaptability of synchronous motors to the work required.

Where the power is delivered at the transforming station to a main shaft carrying a moderately uniform load throughout the day, this system attains a fair efficiency and will often surpass a steam plant in economy. On the other hand, a widely fluctuating load, or intermissions in the work requiring frequent stopping and starting of the machinery, would almost unquestionably condemn the plant as a failure. In either case, if the current can be utilized for lighting after shutting down the power plant it will add to the profits of the system, but the fact that a special starting device must be used with synchronous motors, which in order to develop torque must be brought into unison with the generators, effectually precludes their use for general power distribution.

The adoption of water power is therefore neither to be advocated nor rejected without the most careful consideration of the special conditions surrounding it, and especially with respect to its annual cost in comparison with that of any other motive power with which it may come into competition.

The efficiency of the hydraulic station and the current transmission are readily determined, so that for lighting purposes the problem is simple, but the efficiency of a further transformation of the electrical energy into mechanical energy will vary between wide limits in different cases.

The development of multiphase currents it is expected will establish light and power transmissions on equally certain grounds, but until this is accomplished the use of waterfalls for distant power will be attended with many contingencies.

The Practical Measurement of Alternating Currents.

Dr. Fleming, in his course of Cantor lectures, gave a valuable discussion on alternating current "energy," and alternating current "quantity." The lecturer first approached the problem of the energy supplied to non-inductive circuits, and then examined the more complex case of inductive systems, such as the primary circuits connected with alternating current stations.

Instruments for the measurement of alternating current energy, or quantity, he classified into "ampere hour meters," and "watt hour meters." In their simplest form they could be called "graphic ammeters" and "wattmeters." The Holden ammeter and the Mengarini wattmeter were examples. In these instruments an arm, carrying a pen, is placed over a paper-covered drum, which is revolved uniformly in twenty-four hours by a clock. The motion by which the pen is displaced is regulated by a part of the instrument which is simply an ammeter or a wattmeter; the extent of movement of the pen is, at any instant, proportional to the current or the power passing through the measuring part at that time. When, therefore, the diagram is cut off and unrolled, there is found on the paper a curve, which represents by its ordinates the power at any instant; and if the whole area of the curve is integrated, then such area represents the total energy or "quantity" which has passed through the meter in twenty-four hours. These instruments have, therefore, the practical advantage of recording two functions at once; they serve the double purpose of indicating the instantaneous current or power, and the total current, quantity or energy. They have, however, the disadvantage that they are not self-integrating.

Next in order of simplicity are the self-integrating ammeters and self-integrating wattmeters. Of the ammeters of this class, one of the simplest is the well-known Shallenberger instrument. This is, however, available only for the measurement of alternating current quantity. The Shallenberger meter consists of a small transformer, one coil of which may be called the primary; this is in series with the circuit in which the current to be measured is flowing. The core of the transformer consists of a little soft iron disc, which is capable of revolving on an axis. This axis is geared at the top with a counting mechanism which records the number of revolutions of the disc; at the bottom there is a vane or fan of aluminium, which serves to retard the rotation of the disc. The secondary circuit of this transformer consists of a small coil of copper which is closed upon itself, and which is placed with its axis inclined at 45° to the axis of the primary coil. When the primary current flows through the primary coil it does two things: it magnetizes the core, and it induces a secondary current in the closed secondary circuit. It is not difficult to show that the phase of this secondary current must be about 90° behind the phase of the primary current, also that the magnetism of the iron core, which is in a direction at right angles to the plane of the primary coils, also lags in phase behind the primary current by about 90°. The magnetism of the core and the induced secondary are therefore in step, and are in such directions that the axis of the disc is always being pulled round by the induced field of the secondary coil. If, then, there were no friction of any kind, the iron disc would be continually accelerated in speed; but, since the air friction varies approximately as the square of the velocity, and since the mean driving force is proportional to the mean square of the current strength, it follows that the total number of revolutions which the disc makes in any time is proportional to the total mean quantity or ampere hours which have passed the primary circuit. The meters can, therefore, be calibrated for a constant in such a way that they read directly ampere hours, and if the pressure between the mains is invariable, they may be graduated to read in Board of Trade units. These meters are very simple to construct and very fairly accurate in performance; they have, therefore, come into extensive use. The velocity of the disc being, at any time, proportional to the mean current passing through the meter, it is possible, if the current is kept tolerably constant, to employ the instrument as an ammeter. By moving the position of the secondary coil, a little adjustment can be made in the meter for change of frequency; so that the instrument can be calibrated for the particular frequency for which it is intended to be used. The 10 ampere meter starts with less than half an ampere and reads up to 10 amperes. The greatest variation in accuracy, within the limit of reading, is about 3 per cent. The meter has therefore a range of about 1 to 25, and, with care in adjustment, can be made to read more accurately than the above mentioned figure.

The next in order of simplicity, and very similar in principle to the Shallenberger instrument, is the Wright-Ferranti meter. This is also a self-integrating ammeter; it measures, at any instant, the mean square current, and gives the mean quantity which is passed through the meter. The indicating part consists of a wheel with a light iron rim, which is nearly embraced by two curved horns of laminated iron. These horns spring from the corners of a rectangle of laminated iron, which is wound over, on all four sides, with two coils of wire. Through one of these coils the current to be measured passes; the other coil is a shunt coil, the function of which will be described below. The arrangements of the coil are such that at any moment the ends of the curved horns are oppositely magnetic poles. Copper rings are placed upon these curved horns. When the alternating current passes through the series coil it creates alternating magnetism in the curved horns, but owing to the eddy currents set up in the embracing rings, the magnetic lines of force are thrust outwards, making a lateral leakage field, which travels up the horn. This leakage field induces eddy currents in the iron disc which is thereby repelled in virtue of the electro magnetic repulsion between the horn and the wheel. To illustrate this repulsion, Dr. Fleming exhibited a large alternating current magnet, across the top of which he placed a laminated iron bar, embraced at intervals with copper rings. Near to the iron bar he held a soft iron disc, mounted on a pivot, which began to revolve rapidly as soon as the alternating current was set in action. This could be explained by saying that there were a series of alternating magnetic poles running up the iron bar, and that these alternating poles induced other poles in the iron of the disc, which was thus pulled round.

In the Wright-Ferranti meter, the axis which carries the wheel has upon it four aluminium or mica vanes, and was also in connection at the top with a counting mechanism. When an alternating current is passed through the meter, it tends to drive the wheel round with a speed which is proportional to the mean square strength of the current; and, therefore, it follows that the number of revolutions made by the wheel in a given time is proportional to the mean quantity in ampere hours which has passed through the meter at that time. A 20-ampere meter starts with a current of about half an ampere, and reads up to 20 amperes. Within these limits, the greatest deviation in accuracy is only about 1·8 per cent. Both the Shallenberger and Wright-Ferranti meters require to be calibrated for the particular frequency for which they are to be used, and they only give Board of Trade units provided that the pressure between the supply mains is kept constant. The meter reads quantity directly, but power only on the assumption of constant pressure.

Reference was made above to the fact that there were upon the electro-magnet two coils, and that one of these constituted a shunt circuit. The function of this shunt is to supply the driving force which overcomes the friction of the counting train. If this circuit were not present there would be a frictional resistance to be overcome before the meter would start at all.

Another meter, of a simple character, also intended for measuring ampere hours, is the windmill meter, invented some years ago by Prof. Forbes. In this instrument there is a coil of wire which is heated as the current passes through it, thus generating an upward current of air, which is made to rotate a very delicately constructed windmill with mica vanes. The counting train attached to the mill records the number of turns made in a given time. Although this might have seemed a somewhat unpromising principle to apply, the meter itself gave good results.

The second class of meters are the watt hour meters, which are self-integrating. These again may be sub-divided into "continuously" and "intermittently" integrating instruments. Taking the last class first in order, it is well represented by the Frager meter, in which there is a *wattmeter part*, which measures at any instant the power and the *integrating* part, which integrates at intervals the power and the time. The wattmeter part has two coils, a thick one, which is a series coil and a shunt coil, which is movable, being suspended by a steel wire. Attached to the movable shunt coil is a long arm, the displacement of which varies with the power passing through the instrument. Adjacent to the wattmeter, and fixed on the same base, is an electrical clock which drives a curved plate of metal, technically termed the "snail." On the end of the long projecting arm is a small steel point; as the snail is turned round, it passes underneath the arm, and, if this arm is displaced, the length of the path of the pointer when traveling over the snail is proportional to the power passing through the wattmeter. The snail plate is pressed down as the pointer passes over it, making an engagement between the snail and the counting mechanism. At each revolution of the snail the counting mechanism moves through a number of revolutions proportional to the mean power or watts passing; hence, the total number of revolutions in any given time is proportional to the watt hours recorded by the meter. The period of the snail is about three minutes, and hence the record is, as it were, the summation of the power and time increments passing through the wattmeter made at intervals of three minutes. If the current which is to be measured does not vary very rapidly, such an intermittent recording meter may be made to give very accurate results, but there are many cases, as in theatres, where the amount of current is very irregularly and rapidly varied. Under these conditions the wattmeter needle is thrown about in such a manner that the actual power recorded on the dials at every revolution is not always the true mean power passing in the interval between two revolutions, and the readings of the meter may, therefore, become very erroneous. Practice has confirmed these interferences, and although the Frager meter is under some conditions of use a very accurate instrument, there are other conditions under which its readings cannot be depended upon.

(To be continued.)

Dr. W. E. Sumpner has been appointed head of the electrical department of the Battersea (England) Polytechnic Institute.

Fire Losses.

The power house of the Mansfield, O., Electric Railroad Company was partially destroyed by fire on the night of November 8. Two new boilers had been placed in the engine room, and they were ruined by having water thrown on them while red hot. Loss, $7,000; partially covered by insurance.

The porcelain buildings of the Peru Electrical Manufacturing Company have been totally destroyed by fire. Loss $10,000. A large quantity of valuable dies, which were in daily use, all machinery and manufactured and raw material were ruined.

Russell Harrison to be a Street Railway Magnate.

Mr. Russell Harrison's New York syndicate, which has held an option on the Terre Haute, Ind., Electric Street Railway for six months, has secured the property, and Mr. Harrison, as president, has taken charge of the railway. The price is about $750,000, which includes a bonded debt of $600,000. It has about twelve miles of track. The capital stock is $200,000, of which $67,000 is paid up. The road was owned by three Terre Haute men, who, it is said, clear $225,000 on their four years' investment.

General News.

What is Going on in the Electrical World.

St. Paul, Minn.—The St. Paul Electric Manufacturing and Construction Company has made an assignment to E. Yanish, secretary of the St. Paul Barrel Company.

Mascoutah, Ill.—The stockholders of the Mascoutah Electric Light Company have decided to issue $5,000 in bonds for the purpose of raising money to build a new power house.

Spring City, Pa.—The council has given a franchise for an electric street railway to the Schuylkill Valley Illuminating Company. The road will run from Valley Forge through Phœnixville to Spring City.

Hillsdale, Mich.—The electric light war in this city has been settled by the city buying the plant, etc., of F. W. Stock, paying him $10,000 in the bonds of the city therefor. The city is to take possession of the plant November 15.

Los Angeles, Cal.—The Board of Public Works has recommended the granting of a franchise for a street railway on Boyle Heights to W. H. Workman and T. D. Hoskins. The franchise is for fifty years. It is proposed to use the Hoskins electro-vapor motor on the road.

Albany, N. Y.—The Consolidated Car Heating Company has transferred to an English syndicate the English steam and hot water heating patents of the Consolidated Company. The English electric heating patents have not yet been taken by the English syndicate, although it has an option thereon until January 1, 1894.

Janesville, Wis.—Arrangements have been made for lighting Janesville by an electrical current brought from Fulton, fourteen miles away. If the experiment proves a success, it is stated that enough electricity will be generated at the Fulton water power to light all the towns in Southern Wisconsin.

Eau Claire, Wis.—The National Electric Manufacturing Company's plant was sold on November 1 by Ralph E. Rust, receiver, to Peter Truax, of Eau Claire, for $7,500. He was the only bidder. The plant was valued last May at $81,000, but recently appraised at $32,000. Mr. Truax intends to operate it.

Bloomfield, N. J.—The Citizens' Light and Water Committee have made a report recommending the erection and maintenance of an electric light plant by the township. The cost of erecting and equipping a plant that would supply 140 800-candle power arc lights was given at $27,968, and the annual cost of maintenance $6,368.

Indianapolis, Ind.—By the end of the season the only mules left on the Citizens' Street Railroad's system will be the Haughville, Blake Street and Brightwood. The Citizens' Company during the past year has reconstructed and equipped with electricity their roads on as many as fifteen streets and avenues in the city and suburbs.

Columbus, O.—The Columbus Street Railway Company has complied with the law requiring cars to have a vestibuled compartment for the motorman to protect him from the blasts of winter and enable him to attend to his duties in comfort. In other cities of Ohio the street car companies are disposed to test the constitutionality of the law in the courts.

St. Louis.—The Municipal Electric Lighting and Power Company has been formally absorbed by the Edison Illuminating Company, the deeds completing the transfer having been placed on file in the Recorder's office last week. Shortly afterward the new corporation filed for record a deed of trust to the Knickerbocker Trust Company of New York for all its property to secure $4,000,000 worth of bonds. The latter document discloses the fact that the Edison Company owns 5,930 of the 20,000 shares of the Missouri Electric Light Company.

Greenfield, Mass.—A number of local and Boston capitalists and manufacturers are looking up a valuable water power privilege in the town of Conway which is capable of supplying power to a number of large manufacturing plants at a small cost. The scheme is greatly helped by an almost natural dam across the valley through which the South River flows into the Deerfield River. Four hundred and fifty feet below the dam it is proposed to put a power house for the generation of electricity. In the short distance the fall from the top of the dam to the water wheels would be 198 feet, and at the head of the new pond is another natural fall of thirty feet, an additional gain of height and power. It is believed that the storage capacity and watershed would, even in the dryest season, supply 2,000 H. P.

New York.—The Second Avenue line is being equipped with storage batteries, the company, after prolonged tests of the Waddell-Entz system, feeling satisfied of its practicability. Several storage battery cars are now running on the line from Astor Place to 129th street. The company has been operating storage battery cars between 129th and Ninety-second streets since May 1. At 127th street there is a plant with a capacity for serving eighteen cars. With the plant working at full capacity the cost of operating each car per mile is only 5.29 cents. The batteries, consisting of 144 cells for each car, are stored in heavy boxes under the seats of the cars. Each battery has a capacity for forty miles and is of fifty horse power, but each car is supplied with a fresh battery every round trip, the change requiring only four minutes.

Rochester, N. Y.—The statement that electricity as a motive power on the Erie Canal would not be tried this year appears to be unfounded in fact, as it is announced from the office of the Superintendent of Public Works that the Westinghouse Company will at once begin a trial on the Pittsford level, near Rochester. The Rochester *Herald* of the 6th inst. has the following: "On the Erie Canal at Pittsford Saturday will probably be launched the first electric canal boat ever used. In the early forenoon State officials, officers of the Niagara Power Company, and of the Westinghouse General Electric Company will arrive by way of the West Shore to witness the experiments. George Forbes, the noted English electrician, and Nicola Tesla, the great Hungarian electrician, will also be present. The paraphernalia for equipping the plant has already been shipped from the manufacturer at Pittsburg, and together with the boat to be used will be shipped from Buffalo by canal to-day."

Utica, N. Y.—The City Council has passed a resolution directing the clerk to "advertise for proposals to light the city by electric arc lights of 2,000 candle power for 365 nights per year on an average of ten hours per night, at a stated price per light per night, for a term of one year, two years and three years each from January 1, 1894, towers 125 feet high, mast arms and pole lights to be used at or near points where towers, mast arms and poles carrying lights are now located, and for such lights as the mayor and aldermen may deem necessary at the proposed price per light per night, such lights not to exceed 450 during the continuance of this contract. Proposals shall be accompanied by plans showing towers and mast arms proposed to be used; also accompanied by a certified check in the sum of $5,000 that the contractor will perform his contract, said check to be retained by the city clerk until January 20, 1894, and in case of the failure of the contractor to enter upon the full performance of this contract, said sum to be forfeited to the city; sealed proposals to be received by the Common Council and left with the city clerk or mayor of the city on or before November 17 next, at 7:30 P. M., the Common Council reserving the right to reject any and all proposals. The contractor shall give bonds in the sum of $40,000 for the faithful performance of the contract."

Boston Notes.

A report has been in circulation for the last few days that a $2,000,000 contract for apparatus had been secured by the General Electric Company, the filling of which would start up the Lynn factories throughout at full blast. Of course such a report promptly raised high the hopes of everybody hereabouts and in Lynn. But the report was lacking confirmation, so some one took the trouble to ask Prof. Thomson himself, and received the reply that he for one had not heard of any such contract falling into the lap of the company, so for the present the roseate report has to be regarded *cum grano salis*, like most other reports anent the affairs of the General Electric Company which have been published for some months past.

Work on the Interstate Railway, an electric system forty miles long, to extend from Attleboro, Mass., through Pawtucket and Providence to Bullock's Point, R. I., has been suspended for some time past, but is likely to be resumed, and within a few days the entire project may probably be absorbed by the United Traction Company, which owns the Providence and Pawtucket railway systems. Negotiations are in progress, and everything points to a speedy consummation of the undertaking. It has been thought for some time past that it was only a matter of a few months when every street railway in Southern New England would be absorbed by the United Traction Company, and so placed under one general management. The Interstate Company has about twenty-four miles of track in operation already, and the work of extension will be rapidly pushed if the deal goes through.

The City Council of Lynn has under consideration a petition from the Woodward Underground and Electric Company of that city for authority to put underground in its own special type of conduit to the extent of from one to three miles, whereby it shall demonstrate that the Woodward is the best underground conduit on the market for electric wires. Great interest is being taken in the movement in Lynn by the authorities and citizens generally.

Next Thursday evening Professor Elihu Thomson gives a lecture in Odd Fellows' Hall, Lynn, on "The Phenomena of High Potential Currents," which will be illustrated by means of the apparatus that was shown at the World's Fair as Professor Thomson's personal exhibit.

The Edison Electric Illuminating Company is busy laying underground cables from its new central station on Atlantic Avenue out to South Boston by way of Congress Street Bridge, a brisk demand for light and power service having sprung up in that part of the city.

The improvement in the electrical business which we have noted in our columns the last few weeks steadily continues, and as orders come in more freely so the spirits of those receiving them rise proportionally. There is a feeling of greater confidence all round, and while the season has considerably advanced, there are hopeful signs that the worst is past, and that a fair trade will be done through the winter.

Interest in the course of lectures now being given at the Massachusetts Institute of Technology by Prof. Charles R. Cross continues to grow. A large audience of cultivated men and women assembles in Huntington Hall every Monday and Thursday evening to enjoy Prof. Cross's lucid exposition on the subject of "Modern Uses of Electricity," a condensed report of the first two of which we published in our last issue, continuing our reports in the current issue of ELECTRICITY.

The movement in favor of the city of Newton possessing and operating its own electric light station is growing rapidly, and indications warrant the belief that such an undertaking may ere long become *un fait accompli*.

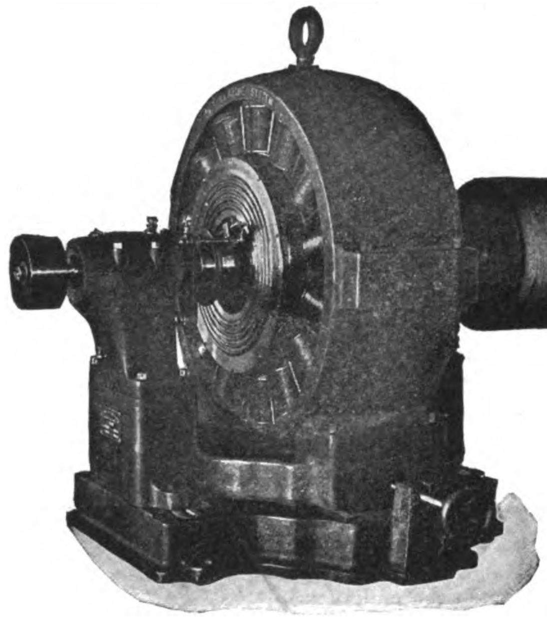
A rich Philadelphia syndicate has purchased the Dixwell Avenue Street Railway, New Haven, Conn., and will entirely remodel it and extend it to Hamden, three miles beyond its present limits. The purchase money is said to have been $200,000, and the entire system will be at once equipped with electricity.

It is reported that the General Electric Company is about to adopt the three-phase electric current system at Tariffville, Conn., for long distance power transmission This is about the largest power transmission plant in New England, and the General Electric and Thomson-Houston Electric Companies have been at work on it for over two years.

With the arrival of the season of the year when electric railway building practically ceases throughout the country, the manufacture of railway apparatus at the General Electric Company's factories at Lynn has slowed down considerably, and only those men absolutely required for filling pressing orders, which are few, will continue at work.

The LaRoche Electrical Works.

The constantly growing demand for larger units in electrical work, and the success which the LaRoche Company has met in the installation of its alternating and direct current apparatus during the past year, has necessitated a very great enlargement and extension of its factory and office facilities in order to handle comfortably the increasing business.



2,000 LIGHT LA ROCHE ALTERNATOR.

The president and general manager of the company, Mr. F. A. LaRoche, so well known to the electrical fraternity, is kept very busy watching its numerous interests, for even through the extremely dull summer season the factory has been running continuously, some large orders have been taken and much prospective work has been estimated upon. Additions to the engineering force of Geo. W. Bacon, of the Wightman Electric Railway Company, and Frank R. Ford, formerly Chicago agent of the Short Electric Railway Company, have recently been made, while Geo. S. Loutey, general construction superintendent for the company, still oversees the installation and operation of the apparatus. The company is also represented by selling agencies at St. Louis, Boston, Pittsburg, Cincinnati, Mobile, Knoxville and San Francisco, and is establishing district agencies in New York and Chicago.

The new works, consisting of a spacious six story brick building, located on the Philadelphia and Reading Railroad at American and Diamond streets, Philadelphia, are well calculated to meet every requirement for the prompt handling of the large alternators and generators which are now being built, for while having the advantage of the best and most convenient shipping facilities, there has been no expense spared in equipping the factory with the most complete and modern machinery, all of which is driven directly, without the intervention of intermediate shafting, from the slow speed automatic LaRoche motors distributed through the factory.

Many special machines have also been added to the factory equipment, by means of which the entire machine work, assembling and final testing can be completed with practically no handling or moving of the heavy castings.

The accompanying illustration shows the 2,000 light pattern of the LaRoche alternator embodying all the most recent improvements. The electrical design of these alternators, both of the single and two phase types, is such that while maintaining a practically constant potential from no load to full load, the iron losses have been reduced to a minimum, and by means of the greatly diminished air gap and close proximity of the armature coils to the magnetic circuit the electrical efficiency has been increased. The copper on the armature is said to be probably less than that of any other alternator on the market of equal output, for by an improved method of winding and placing the armature coils, it has been found possible to entirely do away with the so-called "dead" wire on the armature.

Another novel and vital feature of the LaRoche alternator, which cannot but interest every central station engineer, is the method of connecting the armatures, by which the potential between the different coils is greatly reduced below the total E. M. F. developed by the dynamo.

Mechanically, the design of the alternator is so proportioned as to render it remarkably stable and firm upon the foundation, but capable of perfect adjustment by means of heavy cast-iron sub-bases provided with a belt-tightener. The machines are provided with large self-oiling and self-aligning bearings of the ball and socket type, well rabbeted, and provided with an automatic overflow, with brass rings for securing a continuous lubrication. Another feature, the construction of the brush-holders, will prove highly advantageous where it is required to suddenly lift the brush from the collector. Other details of construction have been perfected to meet the practical requirements of alternating current distribution, so that after a trial of six years, during which time they have undergone modifications and readjustments, the LaRoche alternators embody what practical experience has undoubtedly dictated to be the best for this field of work.

The Non-Infringing Buckeye Lamp.

The Buckeye Electric Company are feeling the effects of a well-established reputation in the rush of orders they are receiving for their non-infringing "Buckeye" lamp. They expect to increase the present output up to 3,000 lamps per day by the first of December; their business winning combination, viz., the coiled filament, perfect vacuum, pure white light, low cost of operation, fair prices and fair dealing, will be perpetuated. The sale of one million "Buckeye" lamps is purposed during the coming year.

A Commutator Preserver.

The commutator preserver illustrated below is a very excellent article and will pay for itself many times over if attached to commutators using either copper or carbon brushes. It does away entirely with the use of oil or other greases and enables the dynamo tender to keep his machine always in a cleanly condition, and it will add at least 50 per cent. to the life of the brushes and commutator.

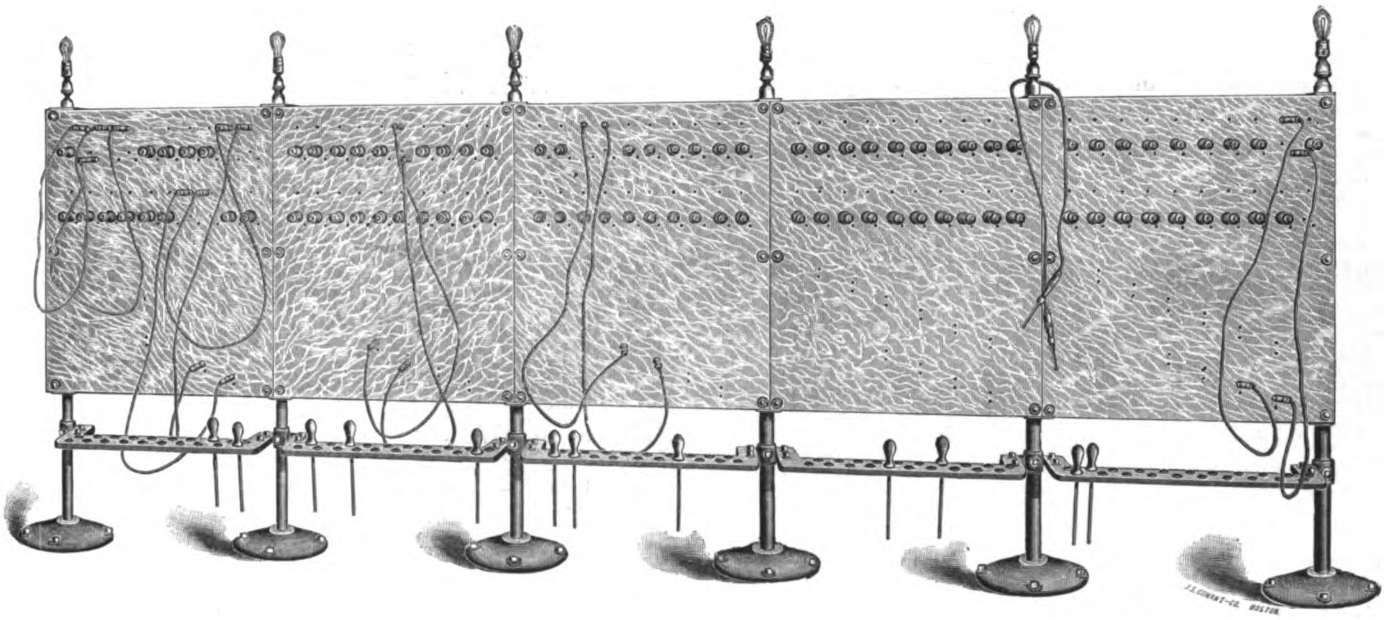
Any user of carbon brushes knows the extreme difficulty he has in getting a perfect bearing through the entire surface of the brush that is supposed to rest upon the commutator. It is almost impossible to get a brush to bear all over until it has worn itself into position by time. This preparation, if used in a proper manner when a new set of brushes is put on a machine, will at once build up the brush so that it will bear its entire surface on the commutator, as there is a preparation in this compound that assimilates readily with the carbon brush and becomes a part of it.

The E. G. Bernard Company, of Troy, N. Y., the manufacturers, state that they have used this preserver for some years on their own plants. and in putting it on the market and recommending it to owners of dynamos they guarantee an article of rare merit and very cheap in price

A Unique Switchboard.

Notwithstanding the stagnation and depression that have prevailed for so long a time throughout the electrical field, it is a fact and a pleasure to know that at least some firms have experienced little, if anything, of the pinching bad times, having been quite busy without intermission right along, and this because of the excellency of their work and the high reputation of their goods having brought them into increasing demand. This statement applies fully and unreservedly to the W. S. Hill Electric Company of Boston, Mass., which are rapidly coming to the front as manufacturers of high-grade switchboards and switches. During the general depression of the last few months the company have been pushed to their utmost capacity to fill orders, running nights a portion of the time, which speaks volumes for their reputation.

The accompanying cut shows a 50 Circuit Arc Switchboard that has been recently constructed for the Narragansett Electric Lighting Company of Providence, R. I., besides which they have completed several others, among them one, similar to the one illustrated, for the Lynn Gas and Electric Company of Lynn, Mass., for 24 circuits, and we understand they are now at work on an 8 panel alternating switchboard to take care of six 7,000 light machines and have several more under consideration.



Switchboard, Narragansett Lighting Station, Built by the W. S. Hill Electric Company.

One of the prominent features of the arc switchboard is that all working and contact parts are blind-fastened to the back side of the boards in the most rigid manner, avoiding the necessity of having belts go through the board, so that there is absolutely no metal on the face of it to appear unsightly or be dangerous to the operator.

This company's very large and complete line of switches is unexcelled, and their business in this direction has assumed rapidly-increasing proportions. They recently shipped on one order switches aggregating over three and one-half tons in weight, and comprising some of 1,000 and others of 4,000 amperes capacity, the latter being one of the largest, if not the largest, ever made in this country.

A large number of finished parts for switchboards and switches are kept constantly on hand, ready to assemble at a moment's notice, thus insuring prompt delivery.

The company is represented in New York by The Elson & Brewster Engineering Company, No. 122 Liberty street, who are selling quantities of high-grade goods, for which this firm is now quite famous.

Diamond Apparatus in Chicago.

Taylor, Goodhue & Ames have resigned the agency of the Wagner motors and transformers and are placing on the market a full line of motors, dynamos and transformers, manufactured by the Diamond Electric Manufacturing Company, and for which the firm of Taylor, Goodhue & Ames is sole selling agent.

The Diamond transformer has always been a favorite with central station men and the improvements made during the past twelve months place it well in the front rank and merit the consideration of all buyers of electrical apparatus.

The diamond motors and dynamos are of the latest type, combining slow speed with handsome appearance, high efficiency and good wearing qualities. They have long passed the experimental stage and are in successful operation to-day in various parts of the country.

Diamond machines of fifteen horse power and larger are of the four pole type, smaller sizes are two pole.

A Speed Indicator.

We illustrate herewith a novel and valuable instrument which shows at sight, continuously, the speed and variations of speed of any machine to which it may be connected. It may be placed at the machine in the office, in the cabin of the steam yacht, or wherever motion can be conveyed to it by a small cord or by friction. Connected to an engine, it plainly shows irregularities in the stroke due to a light balance wheel, improper setting of the valve, or other cause. Connected to a dynamo or other driven machine, it will show errors in belting or operating, and leads to the discovery and correction of irregularities and defects, thus avoiding loss in product, damaged products, damage to machinery or other loss in results, saving even in an hour, or a moment, many times the cost of the gauge.

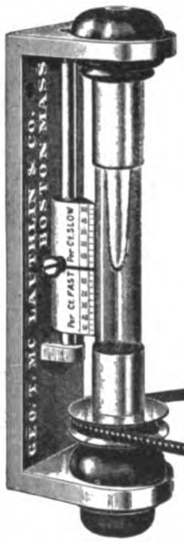
Mr. J. H. Henderson, engineer-in-chief General Electric Company, New York, says:

"I consider this gauge a most accurate and useful little instrument. It is based upon the well-known law that the surface of a liquid in rotation assumes the form of a parabola, being acted upon horizontally by centrifugal force and vertically by gravity.

"One of the instruments, suitably connected to an engine (or other machine), will show whether the speed is up to the mark at a glance, the index being set to correspond to the normal number of revolutions per minute.

"The gauge gives the best results when driven at a high speed, when a small variation will make quite a difference in the indication.

"Most tachometers have springs, levers and other mechanism—all of which are liable to get out of order, but this one has only the very simple parts necessary to bring it into action, and is based on two fundamental physical laws which cannot possibly change."



The McLauthlin Speed Indicator.

It is especially adapted for connection to engines, dynamos, looms, and all other machines wherever it is desirable to know at a glance whether normal speed is being maintained.

This gauge is patented and sold by Geo. T. McLauthlin & Company, 120 Fulton street, Boston, Mass.

Commercial Electric Engineering Company.

As noted in another column, articles of association of the Commercial Electric Engineering Company of Detroit have been filed, the authorized capital being $50,000, $16,250 of which has been paid in. The business of the company will be that of electrical engineering and construction and general electric supplies. The company has opened temporary offices at 47 and 51 Hodges Block, Detroit, and have already secured several contracts for central station lighting plants. The company will represent the Standard Electric Company's system of arc lighting in Michigan, Ohio and Indiana, and is under the management of G. E. Fisher, formerly with the Commercial Electric Company of Detroit.

COMMERCIAL PARAGRAPHS.

The F. E. Belden Mica Company, of Boston, which owns and operates some of the best mica mines in this country and does one of the largest businesses in that specialty, continues in the enjoyment of its wonted prosperity. It has just declared its regular monthly dividend, which is payable on November 2.

The Hawks Electric Company, of Boston, one of the most prosperous construction firms in New England, has something like a dozen large contracts in hand for lighting and power work. It has just closed a contract for the entire installation of 550 incandescent lamps in the streets of Attleboro, Mass.

The Campbell Electrical Supply Company, Boston, New England representative of the LaRoche Electric Company, Philadelphia, has secured a contract for an experimental plant to be installed in the laboratory of the Sheffield Scientific School, Yale College, New Haven, Conn. The LaRoche electric light system is becoming quite popular, contracts for several 1,000 light dynamos being in hand at the present time.

Mr. J. Bradford Sargent, Eastern representative of the Stirling Boiler Company, is receiving profuse congratulations from friends and customers on the honor won by the specialty he handles, the now well-known Stirling Safety Water Tube Boiler, at the World's Fair. The Blue Ribbon, Bronze Medal, together with a special Gold Medal—such were the honors—are distinctions and awards that any firm might be proud of, and as these were given in consideration of the superior excellence of the Stirling Boiler the manufacturers are entitled to congratulations.

"Anti-Thunderbolt" is the name given to a new insulating material for use on the armatures of dynamos, preventing burn-outs and short circuit, that is being used by several firms in and around Boston. It is really an insulating paper and comes highly recommended from the West, where it is being used with much satisfaction by electrical manufacturers, station superintendents and others. It is being placed on the market and pushed in a very successful manner by Mr. George Thomas, 205 and 207 South Canal Street, Chicago.

Some interesting tests have been made the last few days by the Massachusetts Electrical Engineering Company with a new brand of Paranite Fire-proof Wire. The tests were made to compare it with other brands of fire-proof wire, and the "Paranite" more than stood the tests applied, settling beyond all question that "Paranite" is a first-class fire-proof wire.

Throughout the protracted period of depression that has so long prevailed the wire manufacturers of New England have kept quite busy filling orders, and now the times are improving business is beginning to rush. Availing themselves of the promising outlook the Boston Electric Wire Company, whose factory is at Allston, Mass., has entered the field with very high grade magnet and annunciator wires and has already some good orders on hand. Their wires are manufactured on machines of an original and unique design, which, it is claimed, turn out their product much faster than any other machine, and with a finish of the very highest type, special attention being given to uniformity of covering. All wires from No. 40 to No. 16, single or double covered, are manufactured on these machines. Mr. C. A. Clark, one of the best known and most successful wire men in the country, has been appointed traveling sales agent.

The Metropolitan Electric Company of Chicago reports the receipt of a very important order for N. I. R. Wire. This wire is coming into favor very rapidly, contractors and builders finding that it meets every requirement. The Metropolitan carries a large stock of all sizes, and is enabled to fill orders promptly.

INCORPORATIONS.

The Hulings Electric Company, East Liverpool, Ohio—to manufacture electrical supplies, wire buildings, and engage in electric lighting, etc. Capital stock, $25,000. Promoters: Marcus H. Hulings, Alfred R. Walton, Sanford W. Durkee, T. W. Stevenson, W. P. Gardner.

Wanoosnoc Power Company, Fitchburg, Mass.—to furnish electric power for mechanical and manufacturing purposes. Capital stock, $20,000. Promoters: Daniel Simonds, Geo. M. Holman, A. T. Gifford.

The Pittsburg Electric Company, Pittsburg, Pa.—to supply light, heat and power by means of electricity. Capital stock, $5,000. Promoters: Jas. A. Curry, Wilkensburg, Pa.; Wm. H. Warwick, Bellevue, Pa.; Wm. M. Gillespie, Pittsburg, Pa.

The Manitou Electric Railway and Casino Company, Manitou, Col.—to construct, operate and maintain a system of electric street railways, etc. Capital stock, $125,000. Promoters: M. A. Leddy, Jno. Hurlbert, S. King, H. L. Cable, Manitou, Col.

The Canisteo Electric and Fuel Gas Company, Canisteo, N. Y.—to manufacture gas and electricity for use for public and private purposes in the village of Canisteo and town of Hornellsville. Capital stock, $50,000. Directors: William G. Porter, Levi S. Davis and William T. Bailey, of Canisteo; William H. Harris, of Washington, D. C.; John W. Trim, of Brooklyn, and John W. Farquhar, of Buffalo.

The Interstate Telephone Company of Kansas City, Kan. Capital stock, $100,000. Directors: Lyman Utter, Charles B. Riley, J. A. Trickett and M. G. McLean, of Kansas City, Kan., and L. C. Ferree, of Kansas City, Mo.

The Old Dominion Electrical Construction Company, Richmond, Va.—to manufacture all kinds of electrical machines, to furnish light and power, to equip and operate electric railways, and conduct any style of business requiring electrical devices. Capital stock, $25,000. The officers are: President, Maurice W. Thomas, Richmond; vice-president, J. Powell Eastwood, Portsmouth; secretary and treasurer, Maurice Hunter; directors, the above and W. B. Saunders and A. B. Guigon.

The Riverhead Electric Light Company—to furnish electricity for public and private purposes in the village of Riverhead, Suffolk County, N. Y. Capital stock, $7,500. Directors: John R. Perkins, J. Henry Perkins, T. M. Griffing, John H. Perkins, William H. Sweezey, George H. Skidmore and William M. Litchard, of Riverhead.

Simpson Electrical Supply Company, Chicage, Ill.—to manufacture and deal in electrical and other supplies. Capital stock, $12,000. Promoters: Geo. D. Coleman, Henry R. Pebbles, Thomas Fahey.

The Fullner-Danhoff Electric Company, Chicago, Ill.—to manufacture and deal in electric light batteries, appliances, etc. Capital stock, $5,000,000. Promoters: Franz Fullner, A. B. Coon, Henry A. Gates, Wm. B. Keep.

ELECTRICAL PATENT RECORD.

Letters Patent Issued October 17-25, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

507,247. Trolley-Wire Cleaner. Charles H. Thompson, Detroit, Mich., assignor of one-half to George A. Sheley, same place. Filed Dec. 19, 1892.

507,299. Trolley-Wire Insulator. Mowry S. Williams, Syracuse, N. Y., assignor of one-half to Stewart Worden, same place. Filed July 5, 1892.

507,339. Closed-Conduit Electric Railway. Robert Weir, Montclair, N. J. Filed May 10, 1893.

507,396. Electric Locomotive. James T. Wilson, Tyrone, Pa. Filed April 7, 1893.

507,498. Conduit for Electric Railways. George F. Green, Kalamazoo, Mich., assignor of one-half to Oliver S. Kelly; Martha L. Green, Springfield, Ohio, executrix of said George F. Green, deceased. Filed April 28, 1892.

507,539. Ice Scraper for Trolley Wires. William Heston, Alliance, Ohio. Filed Nov. 26, 1892.

507,606. Electric Railway Supply System. Granville T. Woods, New York, N. Y. Filed March 2, 1893.

507,641. Trolley Wheel Guard. John N. Akarman and Frederick Le Nois, Worcester, Mass. Filed April 10, 1893.

507,732. Switch for Trolley Wires. Gustavus A. Huben, Springfield, Ohio. Filed July 29, 1893.

507,733. Trolley for Electric Railways. Gustavus A. Huben, Springfield, Ohio. Filed July 29, 1893.

507,806. Conduit Railway Conductor. John W. Grantland, Philadelphia, Pa., assignor to Gilbert L. Parker, same place. Filed May 17, 1892.

ELECTRIC LIGHTS AND APPLIANCES.

507,916. Electric Arc Lamp. William B. Luce, Brookline, Mass., assignor of one-third to E. S. Ritchie & Sons, same place. Filed Nov. 26, 1892.

507,313. Hanger Board for Electric Arc Lamps. James J. Wood, Fort Wayne, Ind. Filed June 7, 1893.

507,364. Hanger for Electric Lamps. Giles P. Hiler, Grand Haven, Mich. Filed Dec. 3, 1892.

507,554. Incandescent Electric Lamp. William E. Nickerson, Cambridge, Mass. Filed July 31, 1893.

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507,558. Incandescent Electric Lamp. William E. Nickerson, Cambridge, Mass. Filed August 5, 1893.

507,600. Luminous Fountain. Paris E. Singer, London, England. Filed Dec. 28, 1892.

507,714. Electric Lamp Shade and Holder. Albert S. Marten, East Orange, N. J. Filed March 8, 1893.

507,867. Electric Arc Lamp. Henri Wilbrant, Brussels, Belgium, assignor to Henry Chapman and Louis Sterne, London, England. Filed July 6, 1893.

ELECTRIC BATTERIES.

507,139. Storage Battery. Charles W. Kennedy, Philadelphia, Pa. Filed Oct. 19, 1892.

507,463. Secondary Battery. Charles A. Smyth, Momence, Ill. Filed March 3, 1893.

507,708. Galvanic Battery. James A. S. Gregg, New Rochelle, N. Y. Filed April 3, 1890. Renewed Dec. 14, 1892.

DYNAMOS, MOTORS, ETC.

507,194. Armature for Dynamos. James J. Wood, Fort Wayne, Ind. Filed June 8, 1893.

507,297. Armature Coil for Dynamos. Gilbert Wilkes, Detroit, Mich., assignor to Hugh McMillan, same place. Filed June 20, 1893.

507,344. Commutator Brush Holder. James J. Wood, Fort Wayne, Ind. Filed June 27, 1893.

507,449. Reciprocating Electric Motor. Henri Pieper, Fils, Liege, Belgium. Filed Sept. 23, 1891.

507,547. Series Multiple Electric Controller. Arthur P. Knight, Boston, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Jan. 26, 1892.

507,629. System for Operating Electric Motors. Edmund C. Morgan, Chicago, Ill. Filed June 9, 1892.

507,658. Electric Motor. John F. Kelly and Cummings C. Chesney, Pittsfield, Mass., assignors to the Stanley Laboratory Company, same place. Filed Dec. 7, 1892.

507,690. Laminated Field Magnet Frame for Dynamo-Electric Machines. Andrew L. Riker, New York, N. Y. Filed July 27, 1893.

507,769. Motor. William J. Walker and Alexander L. Bedford, St. Louis, Mo. Filed March 15, 1893.

TELEPHONE AND TELEGRAPH APPARATUS.

507,424. Distributing Frame for Electric Wires. William S. Ford, Chelsea, and Bertram A. Lenfest, Wakefield, assignors to the American Bell Telephone Company, Boston, Mass. Filed March 31, 1892.

507,[illegible]65. Test and Signal Circuit and Appliance. Theodore Spencer, Cambridge, assignor to the American Bell Telephone Company, Boston, Mass. Filed Nov. 19, 1892.

507,568. Telephone Circuit. John S. Stone, Boston, Mass., assignor to the American Bell Telephone Company, same place. Filed Jan. 31, 1893.

507,694. Telephone Transmitter Circuit and Apparatus. John S. Stone, Boston, Mass., assignor to the American Bell Telephone Company, same place. Filed May 22, 1893.

507,715. Telephone Transmitter. James H. Mason, Brooklyn, N. Y., assignor of nine-tenths to Alfred Van Derwerken, same place. Filed June 6, 1893.

507,728. Telephone. Stephen D. Field, Stockbridge, Mass. Filed June 30, 1893.

507,791. Machine Telegraphy. Patrick B. Delany, South Orange, N. J. Filed May 4, 1893.

ALARM AND SIGNALING APPARATUS.

507,125. Electric Signal for Railways. Albert B. Herrick, Bayonne, N. J., assignor to Arthur C. Fraser, trustee, Brooklyn, N. Y. Filed Feb 11, 1891.

507,170. Electric Alarm-Signal for Railway-Trains. James M. Rupel, Kansas City, Kans., assignor of two-thirds to Edward J. Haynes, same place, and Robert G. Rhodes, Kanses City, Mo. Filed April 26, 1892.

507,322. Electric Fire and Stable Alarm and Horse Releaser. Alexander R. Holmes, New York, N. Y. Filed Feb. 4, 1893.

507,510. Railway Time and Block Signal. Adelbert H. Thorp, Toledo, Ohio. Filed Feb. 7, 1893.

507,518. Electric Apparatus for Controlling Signals. Michael B. Leonard, Richmond, Va., assignor by mesne assignments, to the Electric Selector and Signal Company, of West Virginia. Filed March 14, 1892. Renewed March 25, 1893.

507,569. Electric-Protective System. Frederic G. Storey, Cambridge, Edward R. Andrews and John P. Cushing, Boston, and Howard F. Eaton, Quincy, Mass.; said Eaton and Cushing assignors to said Storey and Andrews. Filed June 24, 1893.

507,590. Automatic Bathometer and Shoal-Water Indicator. Nicolaus Potschinsky, Odessa, Russia. Filed Dec. 27, 1892.

507,869. Electric Signal Apparatus. John C. A. Xiezopolski and Charles Bode, Milwaukee, Wis. Filed June 29, 1893.

507,918 Electric Train and Switch Signal Device. George E. Miller, Saugus, Mass., assignor to the American Electric Train and Switch Signal Company, Portland, Me. Filed May 24, 1890.

507,925. Electric Burglar-Alarm. Thomas S. Patty, Cooper, Iowa. Filed Jan. 26, 1893.

507,959. Electric Alarm-Clock. Charles F. Wyman, Minneapolis, assignor to Lawrence E. Gerety and Henry W. Knapp, St. Paul, Minn. Filed Nov. 29, 1892.

ELECTRIC HEATERS.

507,217. Electric Heater. Charles L. Coombs, Washington, D. C., assignor of two-thirds to Edward Renaud and Allen B. Hayward, same place. Filed Feb. 11, 1893.

507,941. Electric Heater. William Snee, Pittsburg, Pa., assignor of thirteen-sixteenths to Abner Owens and John A. Snee, same place. Filed Dec. 27, 1892.

MISCELLANEOUS.

507,130. Electrolytic Production of Metals. Carl Hoepfner, Berlin, Germany. Filed July 16, 1888.

507,144. Apparatus for Controlling the Application of Electrical Currents. Robert Lundell, Brooklyn, assignor of two-thirds to Edward H. Johnson, New York, N. Y. Filed April 4, 1893.

507,150. Cut-Out. Louis W. Miller, Rochester, N. Y. Filed July 29, 1893.

507 205. Electric Selecting Device. Samuel S. Bogart, New York, N. Y., assignor by mesne assignments, to the Electric Selector and Signal Company of West Virginia. Filed Nov. 24, 1891.

507,206. Electric Selecting Device. Samuel S. Bogart, New York, N. Y., assignor, by mesne assignments to the Electric Selector and Signal Company, of West Virginia. Filed Dec. 9, 1891.

507,257. Insulated Wire. Herman H. Brown, Montreal, Canada. Filed Oct. 12, 1892.

507,269. Electric Door-Operating Apparatus. Oliver H. Hicks and Robertus F. Troy, Chicago, Ill.; said Troy assignor to said Hicks. Filed May 15, 1893.

507,298. Application of Electricity to Pianos or other keyed Instruments for Hygienic Purposes. William Willeringhaus, London, England. Filed May 29, 1893.

507,345. Resistance-Coil. James J. Wood, Fort Wayne, Ind. Filed June 30, 1893.

507,367. Electro-Thermal Bathing Apparatus. William F. Howe, Evanston, Wyo. Filed April 29, 1893.

507,374. Electrode. Farnham M. Lyte, London, England. Filed July 1, 1893.

507,391. System of Electrical Distribution. William Stanley, Jr., and John F. Kelly, Pittsfield, Mass. Filed March 8, 1892.

507,403. Connector. Charles Bell, Stroudsburg, Pa. Filed Jan. 28, 1893.

507,419. Electric Heating and Welding Apparatus. Chas. L. Coffin, Detroit, Mich. Filed Jan. 26, 1893.

507,458. Adjustable Induction-Coil. Edgar M. Senseney, St. Louis, Mo. Filed Dec. 5, 1892.

507,515. Electrical Ignitor for Gas or Hydrocarbon Engines. Paul A. N. Winand, Philadelphia, Pa. Filed March 10, 1892.

507,516. Electrical Ignitor for Gas or Hydrocarbon Engines. Paul A. N. Winand, Philadelphia, Pa. Filed March 14, 1892.

507,522. Electrical Steering-Gear. Charles W. Ayton, New York, N. Y. Filed July 13, 1892.

507,526. Electrical Transformer. William P. Carstarphen, Jr., Denver, Colo., assigner of two-thirds to James E. Gregg, same place, and Richard W. Webb, Santa Fe, N. Mex. Filed Nov. 7, 1892.

507,585. Automatic Time-Recorder. Isaac N. Lewis, Fort Wadsworth, N. Y. Filed Oct. 10, 1892.

507,589. Electric Car-Brake. Joseph H. McEvoy, Waterbury, Conn. Filed Dec. 30, 1892.

507,671. Electrically-Operated Machine for Molding Clay or Cement Pipes. Reinhold Boeklen, Omaha, Nebr., assignor to Jeff W. Bedford, same place. Filed July 30, 1891.

507,678. Insulating Compound. John J. Farnham, Chicago, Ill., assignor of one-half to John Bairstow, same place. Filed May 27, 1893.

507,689. Magnetic Frame for Field-Magnets. Andrew L. Riker, New York, N. Y. Filed July 27, 1893.

507,691. Electric-Circuit Testing and Switching Device. Miner Robinson, Newton, Mass. Filed March 6, 1893.

507,703. Electrically-Operated Piano. Lawrence J. Zimmerman, Linden, N. J., assignor to himself, and Geo. V. Hann, New York, N. Y. Filed Sept. 16, 1892.

507,768. Electric Coin-Controlled Fortune-Telling Machine. Adolph Waldman, St. Louis, Mo. Filed April 24, 1893.

507,785. Apparatus for Automatically Displaying Pictures. George Cook, London, England, and Charles K. Marr, Glasgow, Scotland. Filed March 20, 1893.

507,803. Combined Switch and Cut-Out for Electroliers. Iczak Goldkind, Max Stirn and Louis Stirn, New York, N. Y., assignors, by direct and mesne assignments, to Louis Stirn and Helen Somborm, same place. Filed April 25, 1893.

507,886. Electrolytic Apparatus. Thomas Craney, Bay City, Mich. Filed March 16, 1893.

507,912. Device for Demagnetizing Watches. Frank M. La Bolteaux, Cincinnati, Ohio, assignor of one-half to Henry Varwig, same place. Filed Jan. 21, 1893.

507,944. Apparatus for Lessening the Rolling of Vessels. John I. Thornycroft, London, England. Filed Nov. 26, 1889.

507,945. System of Electrical Transmission of Power. Charles J. Van Depoele, Lynn, Mass.; C. A. Coffin and Albert Wahl, administrators of said Van Depoele, deceased, assignors to the Thomson-Houston Electric Company, Boston, Mass. Filed Oct. 23, 1890.

507,946. Portable Electric Pump. Charles J. Van Depoele, Lynn, Mass.; C. A. Coffin and Albert Wahl, administrators of said Van Depoele, deceased, assignors to the Thomson-Houston Electric Company, Boston, Mass. Filed Feb. 26, 1891.

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ELECTRICITY.

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THE S. S. WHITE DENTAL MANUFACTURING COMPANY'S WORLD'S FAIR EXHIBIT. (SEE PAGE 222.)

Electric Dental Appliances.

The S. S. White Dental Mfg. Co., who manufacture a large line of electrical goods for dental purposes, had an attractive exhibit in the gallery of Electricity Building, World's Fair, which is reproduced in our Frontispiece. The exhibit included a large line of Partz gravity batteries and all kinds of dental apparatus for use in connection with electricity. The dental motors and appliances were leading features of this exhibit. These motors, which are belted to dental engines, are regulated by rheostats and controlled by means of a treadle. Carpenter enamel rheostats are now being introduced for this purpose.

The motors are supplied with a magnetic clutch which is attached to the driving wheel, and is arranged to stop the machine instantly in case of accident. Some of these outfits are completely self-contained, and are ready for use by simply making connection with the current. These are usually wound for 100 volt circuits, but may be specially wound to run at any voltage or with batteries. This exhibit at first contained an outfit wound for a 500 volt street railway circuit, but as this voltage was not obtainable it was removed to the Liberal Arts Building for this general dental exhibit.

Among the smaller articles were cautery snares, electric mallets, miniature lamps, etc., the whole constituting a very complete display, which was awarded a medal and diploma.

The Practical Measurement of Alternating Currents.—II.

Coming next to the continuously recording watt hour meters, we reach that class which may be said to be the best adapted for general wants. One of the most efficient of these continuously recording watt hour meters is that invented by Prof. Elihu Thomson. This is a wattmeter in which the series coil carries the current, forming really the field magnet of a very small electromotor. The armature of this motor has a small commutator and brushes of the usual kind; and the armature, together with the added external resistances, constitutes the shunt circuit of the wattmeter. The shaft which carries the armature carries also a copper disc which is embraced by three horseshoe magnets. When the disc revolves eddy currents are set up in it which retard the motion. The number of revolutions of the disc in a given time is recorded by the counting mechanism attached to the shaft. Then since the force driving the armature round is at any instant proportional to the power passing through the instrument, and since the retarding force is proportional to the velocity, it follows that the number of revolutions in a given time represents the watt hours that have passed through the meter. In order to overcome the constant friction of the train of mechanism, there is a compound winding on the field magnet, consisting of a few turns of the shunt coil, which is arranged in such a direction that the driving force due to the fixed and movable shunt windings tends to overcome the permanent friction of the armature shaft. By properly treating the permanent magnets, it is found that they retain a constant field for long periods of time. The meter is so arranged that when working on a 100 volt circuit the shunt coil has a resistance of 1,000 ohms altogether, and takes therefore ·1 of an ampere. The loss in the meter, therefore, is only 10 watts, which is the power taken up in driving the motor. By properly arranging the shunt coil it is possible to make the same constant serve for a very long range of action, and one great advantage which this meter has is that it can be employed with both alternating and continuous currents. When properly adjusted this wattmeter is capable of very great accuracy in the measurement of alternating current energy.

The lecturer spoke of the Brillié meter as one of the same type as the Frager meter, that is to say, it is an intermittent recording wattmeter. The Mengarini recording meter, which has been extensively used in Rome, was also exhibited.

Reviewing the whole of these meters as used for alternating current measurement, the following rough classification was given :—

1. Graphic recording ammeters.
2. Graphic recording wattmeters.
3. Continuously recording ampere-hour meters.
4. Intermittent recording wattmeters.
5. Continuously recording wattmeters.

It might be asked at this stage what ought to be the characteristics and requirements in a good commercial meter for the measurement of electric energy supply to houses for lighting and other purposes. Most persons, without experience, would probably say that the first requirement in a meter is accuracy; but, as a practical matter, accuracy is not of so much importance as that the meter should never go far wrong. A type of meter which is capable of measuring, under some conditions, to ·1 of accuracy, and at other times is liable to make errors of 150 per cent. in actual practice, is not nearly so useful as a meter which will not read closer than 1 per cent., and yet which, in actual practice, proves never to go more than 3 per cent. wrong. The next condition with which a meter must comply is that it shall consume little power. Since a meter is connected to a circuit continually, if it absorbs power, the sum total of all these consumptions may amount to a serious item. It has been pointed out that in the case of voltmeters a continuous power absorption of 20 watts, during the whole year, amounts to an annual consumption of 160 units of electric energy, showing that small power consumption is certainly important in appraising a meter.

The third great requisite is, that the meter ought not to require elaborate care and delicacy in fixing; it should be hardy enough to be easy of carriage. House meters have to be fixed in places which are sometimes subject to vibration, dampness, etc., and a meter for such purposes ought, therefore, to be hardy enough to stand these conditions. The fourth condition is, that the meter must be so constructed in principle as not to be capable of being easily tampered with, or its indications made to vary even when enclosed in a lock-up case. To the above requirements ought, of course, to be added the broad and general conditions of structure and cheapness in price, as far as consistent with good workmanship.

In the distribution of alternating currents for commercial purposes, not only is it necessary to be able to measure the power or energy supplied to the consumer on the lamp circuits, but it is also required to be able to measure the power and energy sent out from the alternating current station which is supplying, generally, transformer circuits. Hence we have to consider the special difficulties of making such measurements on circuits which have a considerable self-induction, or in which the power factor of the circuits is below unity. During the past two years, Dr. Fleming had paid particular attention to this subject, in a long series of researches on the efficiency of transformers; and had thereby been led to study most of the various methods which, from time to time, have been proposed for measuring alternating current energy. Passing over impracticable suggestions, he proceeded to describe the methods which had proved, in his experience, satisfactory and workable. There are two instruments for this purpose which are capable of giving such results for the measurement of alternating current energy on inductive circuits—the Thomson recording wattmeter and the Mengarini wattmeter. Generally speaking, these measurements have to be taken on high-tension circuits; for instance, the very common case of an alternating current station, supplying alternating current at a pressure of 2,000 volts on transformer circuits. One method of employing either of the above wattmeters for the measurement of energy would be to place a non-inductive resistance of sufficient magnitude in series with a shunt coil, and to put the series coil in circuit with one of the primary mains. In such an arrangement there would be certain disadvantages. In the first place the Thomson recording wattmeter takes a current of about one-tenth of an ampere through the shunt, and hence we should have to add to the shunt coil, the resistance of which is about 1,000 ohms, another 19,000 ohms of non-inductive resistance, and then, when this was done, the power wasted in the whole of these shunt circuits would be 200 watts. If they were connected to the mains throughout the whole year, the waste of energy in these shunt circuits would be something like 1,600 Board of Trade units, and if we reckon the manufacturing cost of these at only 2d. a unit, the expense would be something like £12 per annum, merely to supply the shunt circuit with current. But this difficulty can be got over, and also the difficulty of constructing a large, non-inductive resistance of 20,000 ohms—sufficiently well divided up not to be in any danger of breaking with 2,000 volts pressure—by the adoption of a transformer to excite the shunt circuits in the way described in the last lecture. A small transformer is employed transforming down from 2,000 to 100 volts, and, as this transformer is only to supply one-tenth of an ampere on its secondary circuit, it can be made very small, not more than, say, a tenth of a horsepower in capacity. It can, therefore, be made to waste not more than about 10 to 20 watts in itself. This transformer has its primary circuits connected across the primary mains, and its secondary circuit is connected across the terminals of the shunt circuit of the Thomson wattmeter and so joined up that the current in the shunt circuit of the wattmeter is in the same direction and has the same magnitude as if the wattmeter were joined up simply on a 100-volt circuit in the ordinary way.

The wattmeter in itself only wastes about 10 watts in its shunt circuit, and therefore the whole arrangement of the transformer and wattmeter can be made to waste not more than, say, 25 to 30 watts instead of 200; the reduction in the cost of up-keep is reduced to something like 200 units a year instead of 1,600. The primary current going out of the station is then taken through the series coil of the Thomson wattmeter, and in order to keep all parts of the wattmeter at the same potential, one terminal of the secondary circuit of the little transformer is also joined up to the primary main on the side nearest to it. It is usual to mount the transformer and wattmeter on one board and then to insulate well the whole of this board. The first step is, now, to calibrate the wattmeter. This can be done most easily on a 100-volt circuit by passing through the meter known powers and observing the readings on the dial. In order to obtain what may be called "the high tension constant" of the wattmeter, the constant of the meter has then to be multiplied by the transformation ratio of the small transformer. When this is done the meter can be set up in the station in such a way that the whole current going out of the station passes through the meter, and the engineer can, by taking observations from day to day, record the whole number of units which have been taken out from the generating station on the primary circuits in any interval of time. In exactly the same way, Dr. Fleming has found that it is possible to employ a Mengarini wattmeter coupled with a transformer and placed on the primary circuit. This has the advantage that it not only enables us to record the whole of the energy going out of the station in a given time, but it tells us, at any instant, the primary watts.

Before placing confidence in either of these two methods, Dr. Fleming made a very careful series of experiments and observations on an inductive alternating primary circuit, in which was employed the Thomson self-integrating wattmeter, as above described, to measure the whole number of units sent out along that primary circuit in four hours, and at the same time observations were made on the same circuit by means of a wattmeter to obtain the power sent out at intervals of minutes. When these observations were reduced and compared it was found that the power sent out in four hours, as determined by the observations, was 66·924 units in the wattmeter, and the energy given by the self-integrating Thomson wattmeter in the same time was 66·946. It thus became evident that the Thomson recording wattmeter was capable of giving very accurate results as a primary wattmeter, and that there is no reason whatever why the record of the primary energy sent out should not be made in alternating current stations with the same accuracy as in the case of continuous current stations.

To complete arrangements it would be desirable in the case of an alternating current station, in order to enable the engineer to know exactly what the result of his working is, to act as follows: On the primary should be put, in the first instance, an ammeter capable of measuring alternating currents and giving the mean square value. In the second place, an electrostatic high tension voltmeter should be connected across the mains in order to give the high tension volts. In front of this instrument should be a Mengarini wattmeter and a Thomson self-recording wattmeter, the whole primary current from the station going through the series coils of these instruments. The shunt circuits of these instruments should be excited by a small transformer, transforming down from a working pressure to 100 or 50 volts. These instruments would then enable the engineer, by daily readings, to record, first, the energy sent out of the primary circuits in Board of Trade units in any time; secondly, the power being sent out at any instant, measured in watts; thirdly, the primary current being sent out at any instant, and the primary pressure; and from the product of these two, the apparent power being sent out at any instant; and, fourthly, from the readings of the real and apparent power, the power factor of the station could be ascertained at any instant.

By comparing these readings with the sum total of the house meters, taken at any intervals, the engineer would be enabled to know the efficiency of distribution of his alternating current station, and to reckon out not only the cost of the unit sold, but the cost of the unit generated, and to watch and know the effect of any alterations that are made in the transformer system. It is only by adopting such methods of measurement that engineers in charge of alternating current stations will be able to remove the reproach which is sometimes hurled at them, that they have no means of measuring the energy or power they are supplying, or of knowing how much of what they make is sold.

In concluding, Dr. Fleming thanked those who had lent him instruments to enable him to show the experiments. His endeavor had been to put the subject in as practical a manner as possible; the cream of practical experience rather than the milk of mere theory. The practical measurement of alternating currents might be more difficult in many respects than the measurements of continuous currents; but, at any rate, there was the satisfaction of knowing that it is now placed on a basis equally certain.

Recollections of Werner Von Siemens.[*]

I—Early Vicissitudes and Their Lessons.

In the autumn of 1840 I was transferred to Wittenberg, where I had to enjoy for a year the dubious pleasures of life in a small garrison town. All the more eagerly did I continue my scientific studies. In that year Jacobi's discovery was made known in Germany of precipitating copper in a metallic form by means of the galvanic current from a solution of the sulphate. This process interested me in a high degree, as it evidently was the key to a whole class of hitherto unknown phenomena. As I succeeded well with the copper precipitates I tried also to precipitate other metals in the same way, but only with moderate success owing to my limited means and apparatus.

My studies were interrupted by an event which in its consequences had an important influence on my future career. I was condemned (for acting as second in a duel) to confinement in the citadel of Magdeburg and had to report myself there on the confirmation of the sentence. The prospect of being shut up for at least half a year without occupation was not pleasant, but I consoled myself with the thought that I should have a good deal of leisure time for my studies. In order to make good use of this time I searched out a chemist's shop on my way to the citadel, and provided myself with the necessary means for pursuing my experiments in electrolysis. A friendly young fellow in the business promised not only to smuggle these articles into the citadel, but also to execute promptly future orders, and conscientiously kept his promise.

Accordingly I set up a small laboratory in my barred but roomy cell and was quite contented with my situation. Fortune favored me in my work. I remembered that some time ago I had tried experiments with my brother-in-law Himly in Göttingen for the production of pictures according to the process made known a little while before by Daguerre, and that hyposulphite of soda employed in these experiments had dissolved otherwise insoluble salts of gold and silver. I determined therefore to proceed on these lines, and to test the applicability of such solutions for electrolysis. To my unspeakable joy the experiment succeeded in a surprising manner. I believe it was one of the happiest moments of my life when a German silver teaspoon, which I had dipped into a beaker filled with a solution of hyposulphite of gold and connected with the zinc pole of a Daniell battery, whilst the copper pole was connected with a louis d'or as anode, changed in a few minutes into a golden spoon of the finest and purest lustre.

Galvanic gilding and plating was then, at least in Germany, still quite new and naturally caused a sensation in the circle of my comrades and acquaintances. I almost concluded a bargain with a Magdeburg jeweller, who had heard of the marvel and visited me in the citadel, whereby I sold him the right of making use of my process for forty louis d'or, which supplied me with the required means for making further experiments.

In the meantime a month of my confinement had elapsed, and I imagined I should have at least a few more months quietly to continue my work. I improved my apparatus and lodged a petition for a patent, whereupon with surprising rapidity a Prussian patent for five years was granted me. But the officer of the guard unexpectedly appeared and to my great terror, I must confess, handed me a royal order-in-council announcing my pardon.

Luckily I was not again sent to Wittenberg, but received an order to go to the pyrotechnic factory at Spandau. My discovery had in the eyes of my superiors doubtless made me appear less qualified for actual service! The firework factory was a relic of the old times when "gunnery" (Constablerthum) was still an art, of which the manufacture of fireworks was held to be the crown. My interest in the activity assigned to me was great; in good spirits I repaired to Spandau and took possession of the rooms in the citadel allotted to the pyrotechnic manufacture.

My new occupation was in fact very interesting, and I devoted myself to it with the greater eagerness as a large order had arrived at the pyrotechnic department for a quantity of fireworks, which it was intended to let off on the birthday of the Russian Empress in the Park of Prince Charles at Glienicke, near Potsdam. Owing to the progress of chemistry means were afforded at that time for the production of very beautiful colored flames unknown to the old gunners. My fireworks on the Havel Lake at Glienicke brought me therefore much honor and recognition, especially by the splendor of their colors. I was asked to the prince's table, and received an invitation to engage the young Prince Frederick Charles in a sailing match, as the sailing boat in which I had come from Spandau to Glienicke had distinguished itself by its excellent speed. I had the honor of conquering the future victor of famous battles, who even then impressed me in a high degree by his resolute, energetic character, or his "smartness," as one now expresses it.

With the letting off of these fireworks my command at the pyrotechnic factory came to an end, and to my delight I was ordered to Berlin for service in the ordnance department. Through this transference my greatest wish was fulfilled, to obtain time and opportunity for further scientific studies and for increasing my technical knowledge.

But there were also other reasons which made this change welcome to me. After my parents' death the duty devolved upon me of providing for my younger brothers and sisters, of whom my youngest brother Otto was at our mother's death only in his third year. The farming of the domains still remained, it is true, for a term of years in the hands of the family, but the times continued to be extremely bad for agriculture, so that the slight profits which were made by my brothers Hans and Ferdinand by farming did not suffice for the education of the children. I was therefore obliged to look out for some way of earning money in order to fulfil my obligations as senior of the family, and that appeared to me to be easier in Berlin than elsewhere.

My brother William had meanwhile completed his course at the Magdeburg School, and at my suggestion had gone for a year to Göttingen, in order to prosecute his scientific studies. After that he entered as pupil the Count Stolberg Engineering Works in Magdeburg. He there devoted himself with great energy to practical engineering, which just then was undergoing rapid development in Germany in consequence of the introduction of railways.

I kept up a frequent correspondence with William, and got him to communicate to me the problems which exercised the constructive faculty. One such problem was the precise regulation of steam engines which were assisted by wind or water mills. William's plan did not satisfy me, and I proposed to employ as regulative principle a heavy freely swinging circular pendulum, which, connected with the engine to be regulated by a differential mechanism, might effect an absolutely uniform rotation, instead of diminishing the irregularities by the only means then known, the very imperfect regulator of Watt. To this suggestion was due the construction of the differential governor, to which I shall return in the sequel.

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[*] Selected from "Personal Recollections of Werner Von Siemens," recently published in America by D. Appleton & Company, New York, 416 pp., 12mo, uncut edges, wide margin, photogravure portrait.

In Berlin my efforts to earn money by my inventions were soon attended with success, although I was very much hampered by being as a military officer considerably restricted in the choice of devices for initiating business undertakings. I succeeded in concluding an agreement with the German silver manufacturer, J. Henniger, by which I agreed to set up an establishment for him for gilding and plating in accordance with my patent in return for a share in the profits. Thus arose the first establishment of the kind in Germany. In England, a Mr. Elkington had already started a similar establishment, employing another process, now in general use—viz., depositing from gold and silver cyanides—which soon obtained great success.

In the negotiations with regard to the Berlin plan and the fitting up of the establishment, I I was materially assisted by my brother William, who had paid me a holiday visit, and who succeeded at the same time in inducing a Berlin engineering firm to adopt the differential governor. As he clearly showed talent for such negotiations and himself wanted to get to know England, we agreed that he should try to utilize my inventions in that country, and for this purpose obtain a longer leave of absence from his factory. Considerable means I could certainly not afford him for his journey, and I have often wondered how in spite of this he attained his end. With excellent judgment he went straight to our competitor Elkington, who at first cut him short with the remark that we had no right to use our process in England, as his patent gave him the exclusive right to employ electric currents, produced by electric batteries or by induction, for depositing gold and silver. William had sufficient presence of mind to reply that he employed thermo-electric currents, therefore did not infringe his patent. I did in fact once succeed in making a thermo-electric battery, consisting of pairs of bars of iron and German silver, with which we could very well precipitate gold and silver from hyposulphite solutions. As a consequence William succeeded in selling our English patent to Elkington for £1,500. This in our then circumstances was a colossal sum.

I had meanwhile made two more discoveries which William was likewise to try to turn to account there. The prosecution of my experiments in electrolysis had led me to attempt to get also good deposits of nickel from a solution of the double salt of sulphate of nickel and sulphate of ammonia. This nickelizing appeared of especial importance for engraved copper plate, which, provided with a coating of nickel, allowed of a far larger number of impressions, without the fineness of the engraving being blunted by the nickelizing. To derive benefits from this process I had made a compact with a Berlin house, from which I expected considerable profits. Unluckily, however, soon afterwards the galvanic depositing of iron from the corresponding iron solution was discovered, which had the great advantage over the nickel coating that it could be easily renewed when worn out, in that the iron could be again liberated by dilute of sulphuric acid and the plate then coated afresh with iron. This made my nickelizing worthless for this purpose. A few years later it was again discovered and made known by Professor Böttger, but has only in recent times been much employed in industrial operations.

The second discovery consisted in the application of the zinc printing to a rotating fly-press, which process had just then come to be known. With the help of a skilful mechanician, the watchmaker Leonhardt, I had prepared a model of such a press, which very satisfactorily executed the necessary operations for producing lithographic impressions from a cylindrical zinc plate. But it subsequently turned out on its employment on the large scale by William in England that zinc printing allowed of no rapid repetition of impressions. After from 150 to 200 impressions the work had to be interrupted for a pretty long time, or else an obliteration of the reprint on the cylinder took place.

Returned to Berlin I very seriously reflected on the aims I had lately been pursuing, and saw clearly that the chase of discoveries, by which I had allowed myself to be carried away through the facility of a first success, would if continued probably be my own and my brother's ruin. I accordingly got rid of all my inventions, sold even my share in the manufactory set up in Berlin, and devoted myself again with heart and soul to serious scientific study. I attended courses at the Berlin University, soon, however, perceived to my dismay from the lectures of the celebrated mathematician Jacobi that my previous training was insufficient to enable me to follow him to the end. This imperfect schooling in scientific study has always to my great regret kept me back and crippled my efforts. All the more grateful am I to some of my earlier teachers, among whom I must specially mention the physicists Magnus, Dove and Riess, for friendly reception into their highly interesting circles. I also owe many thanks to the younger Berlin physicists, who allowed me to take part in founding the Physical Society. That was a wonderfully stimulating association of talented young scientists, who subsequently almost without exception became celebrated by their achievements. I need mention only the names of Du Bois-Reymond, Brücke, Helmholtz, Clausius, Wiedemann, Ludwig, Beetz and Knoblauch. Intercourse and co-operation with these young men, distinguished by talent and earnest endeavor, strengthened my preference for scientific study and labors, and kindled in me the determination to be in future the votary of strict science alone.

But circumstances were stronger than my will, and the native impulse never to let acquired knowledge lie idle, but as far as possible to make some use of it, led me ever and again back to technology. And so it has been my life long. My affection has always been given to pure science as such, but my labors and achievements have been for the most part in the domain of applied science.

This technical turn was especially favored and supported by the Polytechnic Society, to which as a young officer I zealously devoted myself. I took an active part in the proceedings, and in the answering of the questions which were deposited in the query box. The answering and discussing of these soon formed a part of my regular activity and proved a good school for me. My scientific study stood me in good stead, and it became clear to me that technical progress is only to be attained by the diffusion of scientific knowledge among technologists.

At that time there still existed an unbridged gulf between pure and applied science. The meritorious Beuth, who is unquestionably to be regarded as the founder of the technical science of North Germany, had indeed in the Berlin Industrial Institute erected an institution which was especially designed for the diffusion of scientific knowledge among young technologists. The existence of this institute, out of which arose the Industrial Academy and finally the Technical College in Charlottenburg, was however too short for raising the level of education of the craftsmen of the period.

Through my activity in the Polytechnic Society I arrived at the conviction that scientific knowledge and scientific methods of investigation are capable of developing technology to a degree far beyond anything that can be foreseen. It further had the advantage of making me personally acquainted with Berlin manufacturers, and of affording me personally an insight into the achievements and defects of the industry of the time. My advice was often sought by manufacturers, and I thereby became acquainted with the contrivances employed and the modes of working. It became clear to me that the industrial arts cannot advance by sudden leaps, as has often been possible to science through the fruitful ideas of a few remarkable men. A technical invention only obtains value and importance if technology itself has so far progressed that the invention is a practical one and supplies a need. Hence one so often sees the most considerable inventions unutilized for decennia, until all at once their great importance is recognized, their hour having arrived.

Of the scientific technical questions which at that time especially occupied me, and at the same time gave occasion to my first literary labors, the first owed its origin to a communication in a letter of my brother William with respect to an interesting engine which he had seen at work in Dundee. From a rather brief account it appeared that this engine was not driven by steam but by heated air. This idea interested me exceedingly, since it appeared to afford a foundation for an advantageous transformation of the whole engine construction art. In a paper entitled "On the Use of Heated Air as Mechanical Power," contributed in 1845 to *Dingler's Polytechnic Journal*, I described the theory of such air engines, and gave also a sketch of the construction of such a one as I conceived to be practicable.

My theory was based entirely on the principle of the conservation of energy, which had been advanced by Mayer and mathematically worked out by Helmholtz in his celebrated memoir "On the Conservation of Energy," originally read before the Physical Society. Later on my brothers William and Frederick occupied themselves a good deal with these engines, and constructed them in various forms. They too, however, unfortunately had to undergo the common experience of finding that engineering had by no means advanced far enough to allow of the discovery being utilized with advantage. Only small engines could be constructed on the basis of the above principle so as to work well for a length of time; for large ones the right material for the heating apparatus was and is still wanting.

In the same year I printed in *Dingler's Journal* a description of the already mentioned differential governor, to which in collaboration with my brother William I had tried to give the most varied forms.

Another question, which had already occupied me for a long time, was that of an exact measurement of the velocity of projectiles. The watchmaker Leonhardt, known as a skilled mechanician, and in the employ of the Artillery Commission, had constructed a clock which turned an indicator with great velocity when the latter was electro-magnetically connected with the clockwork.

The coupling and uncoupling of the indicator by the flying shot was attended however with great difficulties, which in spite of our efforts could not be quite overcome.

This led me to the idea of the employment of the electric spark for the measurement of velocity. In a paper, published in *Poggendorff's Annalen*, "On the Application of the Electric

Spark to the Measurement of Velocity," I demonstrated the possibility of accurately measuring the velocity of projectiles at every stage of their progress by means of a rapidly rotating polished steel cylinder, on which incident electric sparks could leave a distinct mark. This paper also contained the plan, only many years subsequently executed by me, of ascertaining by the same method the velocity of electricity itself in its conductors.

My interest in electrical experiments was most vividly stimulated by participating in the labors of Leonhardt, who was at the same time occupied with experiments, which the military staff had caused to be instituted, with regard to the substitution of electric for optic telegraphy. In the house of Hofrath Soltmann, father of an intimate comrade of mine, I had the opportunity of seeing the model of a Wheatstone indicator telegraph, and had taken part in the attempts to bring it into operation between the dwelling house and the establishment for artificial mineral waters at the end of a large garden. This, however, never succeeded, and I soon perceived the cause of these failures. It was traceable to the principle on which the apparatus was constructed, which required the turning of a handle with such regularity that the impulses of current produced had always sufficient strength to keep the clockwork of the receiving apparatus in motion. This was not attainable with certainty even if the apparatus worked in the room, and was altogether impossible where an important part of the current was lost through the imperfect insulation of the conductors.

Leonhardt, trying at the instance of the commission to remedy this defect, caused the impulses to be produced by clockwork, i. e., in quite regular intervals, which was certainly an improvement, but still did not suffice with the varying loss of current. This made it apparent to me that the problem was most completely to be solved by converting the indicator telegraphs into self-acting machines, each of which would automatically break and make the circuit. If two or more of such electrical machines were connected to *a single* electrical circuit a fresh impulse could only be given when *all* the inserted apparatus had completed their stroke, and this had again closed the circuit. This proved in the sequel a very fruitful principle for innumerable electro-technical applications. All the self-acting alarms or bells employed at the present time are based on the automatic interruption after a completed stroke first introduced as above stated.

The construction of these self-interrupting dial telegraphs I entrusted to a young mechanician, named Halske, with whom I had become acquainted through the Physical Society, and who at that time managed a small mechanical workshop, the business firm being known as Böttcher & Halske. As Halske at first entertained doubts whether my apparatus would act, I myself set up a couple of automatic telegraphs, composed of cigar boxes, tin plate, a few pieces of iron, and some insulated copper wires, which worked with perfect certainty. This unexpected result filled Halske with so much enthusiasm for a design capable of execution notwithstanding such defective materials that he gave himself up with the greatest eagerness to the construction of the first apparatus, and even declared himself ready to withdraw from his firm and in conjunction with me to devote himself entirely to telegraphy.

(*To be continued.*)

Milwaukee, Wis.—The Electric Light Company of South Milwaukee intends to enlarge its plant to accommodate a number of new factories that wish to put in electric lights.

SOCIETY NEWS.

American Institute of Electrical Engineers.

REPORT OF COMMITTEE ON LOCAL MEETINGS.

At the regular monthly meeting of Council, Wednesday evening, November 15, the committee appointed at the meeting on October 18 to consider the subject of Local Meetings reported as follows:

It is the opinion of the committee, first, that provision should be made for local meetings of the members at points inconveniently distant from New York for the reading and discussion of papers accepted by the Institute. Second, that the provision in Section VI of the Rules of the Institute, authorizing the secretary to "call a special meeting on a requisition signed by fifteen or more members," was not intended to and does not cover local meetings of the character contemplated in this report.

The following plan for the holding of local meetings of members was presented by the committee:

When not less than twenty members in any stated locality shall in writing notify the secretary of the Institute of their desire to hold local meetings, such request shall be presented to the council at its first meeting thereafter. The council shall then, upon the recommendation and nomination of the signers of the request for local meetings, appoint a local honorary secretary, who shall be a member or associate member of the Institute residing in the specified locality.

The duties of a local honorary secretary shall be in general to serve as a channel of communication between local members and the general body of members through the secretary and council. But no member in any locality shall be debarred from direct communication with the Institute.

In any locality where a local honorary secretary shall have been appointed, local meetings may be held, the local members to elect their own chairman, such meetings to be known as Meeting of the Members of the American Institute of Electrical Engineers, and such meetings shall be for the purpose of reading, by the authors or by proxy, and of discussing, papers accepted by the Institute and such papers only. Such local meetings shall be held simultaneously with the Institute meetings or subsequently; that is to say, no paper before the Institute shall be read or discussed at a local meeting in advance of its reading at the Institute meeting.

Wherever local meetings shall have been provided for, as in the foregoing section, the local honorary secretary shall be supplied by the secretary of the Institute with a suitable number of advance copies of papers to be read before the Institute, which copies he may distribute to the local members at their local meetings. The local honorary secretary shall transmit to the secretary of the Institute a report of the discussions at each local meeting, together with any written discussions or comments on papers that he may receive from members in his locality. Any member or associate may introduce a stranger to any meeting, but the latter shall not take part in the proceedings without the consent of the meeting.

The local honorary secretary shall transmit to the secretary of the Institute all papers offered by local members, but any member may send papers directly to the secretary of the Institute.

The publication of the discussions at local meetings in the Transactions of the Institute shall be subject to the same regulations and restrictions as govern the publication of discussions at the regular meetings of the Institute. No publication of papers or discussions at local meetings in local or other journals or newspapers is to be permitted without the sanction of the council or the secretary of the Institute.

The expense of local meetings shall be borne by the local members, and not become a charge upon the funds of the Institute.

The title, name and address of each local honorary secretary shall be printed in the publications of the Institute.

In dealing with the subject before it, and in preparing its report, your committee has carefully considered the documents and correspondence placed in its hands, particularly the paper of the secretary on "Monthly Meetings" and the plan for the establishment of chapters of the Institute drawn up by Dr. Emery, both of which were read at the October meeting.

The scheme for local meetings suggested in this report has been designed with the purpose of affording to members distant from the headquarters of the Institute opportunity to participate in its work on substantially the same footing as members whose location permits them to attend meetings held in New York. The Institute is a national body, having members in every section of the country, but with a large preponderance of membership relatively near headquarters. Its work and its publications have a national significance. Its subdivision into sections or chapters would detract from the unity and strength of its effort to serve the best interests of electrical science and industry.

The committee is of opinion that it would not be for the welfare of the Institute to create any separate local organizations or any class or classes of members not now provided for in its rules.

It is believed that the plan for local honorary secretaryships and for local meetings herewith submitted would meet fully the desire of members in diverse parts of the country to participate in the work of the Institute, and that it would avoid the disadvantage and disintegrating tendency that might arise from the formal establishment of a number of separate and distinct sub-societies.

Herbert Laws Webb, Chairman; A. E. Kennelly, M. I. Pupin, Wm. J. Hammer, Geo. M. Phelps, *Committee.*

The report was adopted by the Institute with some slight amendments.

The following associate members were transferred to full membership: Bion J. Arnold, Chicago, Ill.; Chas. D. Parkhurst, U. S. A., Fort McHenry, Md.; Alfred A. Dion, Ottawa, Ont.; Chas. F. Uebelacker, Cleveland, O.; Robert McA. Lloyd, New York.

The Ferris Wheel an Infringement.

Strange Interpretation of Patent Law.

William Somers, of Atlantic City, patentee of the roundabout wheels which are so common at Eastern resorts, has secured a verdict against the Ferris Wheel Company of Chicago for an infringement of his patent.

The case was tried in the Circuit Court at Chicago and afterward carried to the United States Court in Philadelphia, where evidence was taken two week ago.

Mr. Ferris on the witness stand testified that in 1892 he was in Atlantic City and rode on the Somers wheel. He considered it a popular amusement, and afterwards built from this suggestion the big Ferris wheel. The Court has not yet fixed the amount of damages on royalty.

Schuyler Electric Company's Affairs.

President C. E. Dustin of the Schuyler Electric Company is quoted in a recent interview as follows:

"The Schuyler Electric Company is an entirely separate corporation from the General Electric Company, that company simply being one of the stockholders. We are running few men at present, owing to the dull times, but expect to start up as soon as there is sufficient work to warrant it. We are making no shipments of machinery, nor of any materials, excepting such as has been made up and now being shipped on order. In closing down our factory we had orders which would keep us going probably for three or four months, but the payments on these would be long deferred, and I considered it the best of judgment to sail close to the wind and not be burdened with additional stock of goods with no prospective customer, or with no assurance of early payments. The result of this policy has been proved to be the very best, as the Schuyler Company was never in such good condition financially or in better shape for holding up until times improve."

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The Lamp Situation.

The expiration of the Edison lamp patent in Great Britain has created renewed interest in the lamp situation on this side the water, and desultory discussion of the status of the Edison patent here has resulted. No new facts have been brought out, however; there has been at least no public announcement that the matter is to be brought before the courts for settlement.

There can be no question as to the expiration of the American patent next year; there is an open question as to whether or not it has actually expired now, but in matters of this nature editorial opinions count for little. A judicial opinion is what is needed, and inasmuch as the case could be brought to issue and decided at a trifling expense, there seems no good reason why outside lamp makers should not combine for this object.

We understand that at least one of the companies has in view the securing of a decision on its own account, and results may be looked for early next year.

The recent suit brought by the General Electric Company against the Davis Company at Springfield, who were engaged in refilling lamps only, shows that the owners of the patent are still prepared to fight.

We note in the English papers that nearly a dozen companies are already in the field there, and that the price of lamps has been reduced.

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The Ansonia Company's Affairs.

The proposition for settlement offered by the Ansonia Electric Company, of Chicago and Ansonia, some weeks ago has created considerable comment. Although it was not printed in full in these columns, we assume that to those interested the terms are thoroughly known

We are informed that some of the largest creditors have refused to sign, and on the other hand, Mr. John B. Wallace, the president of the company, states positively his belief that all will sign and that the proposed arrangement will be a success.

We are convinced that the proposition as made was a serious mistake, and that the best interests of the trade would not be conserved by the continuance of the company on that basis.

We regret exceedingly that we feel called upon to make this statement, but the questions involved are serious ones and far-reaching in their possible consequences.

It is a disagreeable fact, but it is a fact, that electrical enterprises, from the point of view of credits in the financial world, are looked upon with suspicion, suspicion which is not wholly groundless, but which can easily be removed provided the leading houses in the trade conduct their affairs according to old-fashioned standards of honesty and business morality. The proposition of the Ansonia Company is not calculated to work an improvement in this direction. Its acceptance is putting a premium upon the disregard of honest obligations, and the continuance of the company on this basis must have a pernicious influence on smaller concerns when they find themselves losing money.

The greatest injustice, perhaps, would be done to the competitors of the company, some of whom, notwithstanding the falling off in business and other unfavorable features of the past three or four months, are courageously and honorably endeavoring to pay dollar for dollar.

The company might better make an entire surrender and begin anew. Their own chances of future success would be immeasurably brighter; and the creditors, at least those with whom we have talked, would prefer to realize 35 to 40 cents cash at once than take the chances of getting the full 60 cents on the dollar by the proposed plan.

We suspect that the high personal regard in which Mr. F. S. Terry is universally held has been a potent factor in moving many of the creditors to sign. We do not believe that personal considerations should influence men in a matter of such importance. And moreover, we believe that true friendship for Mr. Terry does not dictate any such policy on the part of the creditors.

He could put a new company on its feet in short order, but not even his prestige could make a success of the Ansonia Company after its flagrant violations of business obligations.

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The General Electric Wreck.

The temporary activity of General Electric stock for one day last week aroused some interest in the present condition of the company. The speculators had many theories, but, as usual, their views were superficial, and they failed to reasonably explain a slump of 4 points in one day. As a matter of fact no explanation was necessary. The stock has no support, and can be moved downward at any time by a little pool such as caused the flutter referred to.

The interest of the trade is not so much in the stock market as in the actual business of the company, and the speculators and stockholders who are waiting for a rise to unload might with profit investigate the matter from the standpoint of the trade.

A director of the company who is known to Electricity said last week:

"General Electric affairs have been put in such shape that the company is no longer losing any money. It may not be making much, but it is not losing anything. It has no floating debt. The company has closed all of its works which are not absolutely necessary to the profitable operation of the plant. The company has never had as excellent management as it is having to-day."

This is a noteworthy statement. It is a frank admission that the company was at one time losing money. We all knew this much. But what becomes of Mr. Coffin's daily assertions for a year and a half that large profits were being earned? Moreover, the company has a debt and a big one. It may not be a "floating debt" Indeed many merchandise creditors whose bills are several months behind begin to believe it is a stationary debt. And as for management, there is no such thing.

In order to inform our readers as to the correct situation, a representative of this paper last week made a tour of the company's plants in the East. To know the condition of the company this was the place to begin.

What are the factories doing in comparison with other years?

At the Harrison lamp works a fair business is being done, though the factory is by no means working up to its full capacity. The shrinkage here is only noteworthy as emphasizing the fact that the lamp monopoly is thoroughly broken.

Our poetical contributors had already given us an inkling of the dry rot which has attacked the splendid plants at Lynn and Schenectady, but we were not prepared for the report made by our representative.

At Schenectady about 600 men are at work on half time. Many departments are closed, and the draughting room is deserted. Further discharges of men are looked for. The Schenectady works at one time gave employment to 4,000 people.

At Lynn the actual situation is worse than at Schenectady, though more men are employed. The factories are in a state of disorder, machinery is uncared for, dust is thick on everything, and there is no evidence of care or thought for the future. Here 1,500 men are at work on half time, as against 3,500 on full time a year and a half ago. In the draughting room there are about a dozen, as against 175.

All work at the Schuyler and Brush factories is practically suspended, not over a score of men being employed at last accounts in both places.

The results of the investigation at Lynn and Schenectady are worth further consideration. They have 2,100 men at work on half time, equivalent to 1,050 *men working at full time*, as against a high water mark of 7,500 *men at full time.*

We have already given the total business of the company last year as about $14,000,000. Using the number of men at work as a basis of estimate, the General Electric Company is now doing at the rate of $2,000,000 business for the year. This is not an encouraging showing. Little wonder that the directors have decided that it will be the part of wisdom to pass the dividend on the preferred stock which is due in January next.

Refuge cannot be taken in the generally depressed condition of business. There is not an electrical manufacturing concern in the country, if ever prosperous, that shows one-half the falling off.

The facts cannot be dodged. The asinine policy of the company has resulted in wreck and ruin to a once magnificent business.

There is moreover no possibility of an improvement in present conditions without a thorough and radical reorganization—a new and liberal policy, carried out by honest and capable men.

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AN impressive lesson has been taught by the developments of the past summer, and this is that concerns should use more caution in their credits. Many good houses have been seriously crippled as a result of unwise conduct of this department of their business.

THERE is nothing encouraging in the latest reports from Eau Claire in regard to the affairs of the National Electric Company. The sale of the plant for $7,500 has not been confirmed, owing to the very natural objections filed by the Standard Electric Company and other Chicago creditors.

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NOTHING would go further to place the electrical manufacturing and supply business upon a solid footing than the adoption by American companies of the plan of making full reports at least once a year, which might be published in the trade papers. This has been done with profit in England from the very inception of the business. Thus it might readily be known who are and who are not worthy of long and large credits.

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WHILE contemplating with infinite satisfaction the merits of the American patent system, as described by a valued contributor to ELECTRICITY, we learned that the Ferris wheel had been declared an infringement in a suit brought by the man who first patented the nasty little wheels which are so common at Coney Island and elsewhere. Our own confidence in the American patent system is abiding, but thus it receives an occasional shock. How the idea of a wheel of this nature could be patented is a mystery, and how the Ferris wheel could be considered an infringement is a greater mystery. Its only point of similarity to the Atlantic City and Coney Island wheels is that it goes round. But all wheels go round, and we suspect that sometimes the head of a United States Circuit Judge goes round.

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OUR office cat has given birth to four healthy kittens; they are now in training. We shall soon, therefore, be able to offer three to some of our contemporaries besides adding one to our own staff. We thought once of offering them to the *Electrical World*, as we know our neighbor needs them badly, but have decided not to do so; we think too much of our cats. It is supposed that the *World's* office cat committed suicide when confronted with the report of that lawsuit.

Business is Booming.

At Least That is What Mr. McDonald Told a Detroit Reporter.

Mr. R. T. McDonald, general manager and treasurer of the Fort Wayne Electric Light Company, and president of the Peninsular Company, was at the Cadillac yesterday. To a *Free Press* representative he said that the electric light business throughout the country was on the boom.

The innocent freshness of this recalls an incident connected with a campaign in Canada a few years ago when the Liberals were causing plenty of trouble for Sir John McDonald, and making capital of the alleged decadence morally and intellectually of the British nobility. Lord Dufferin had made an address before the Greek class of McGill University, and the reporter had given it out that "his lordship spoke to the class in the purest ancient Greek, without mispronouncing a word or making the slightest grammatical solecism." A friend of Sir John's came in smiling with this statement and asked, "How do you suppose the reporter knew that his lordship's Greek was correct?" "I told him," answered Sir John. "You told him? What do you know about Greek?" "Nothing, nothing at all; but I know a little about politics."

General Electric Rumors.

The Mysterious Company Excites Comment.

On Wednesday of last week there was a sharp downward movement in General Electric shares, the price going in an hour from 41½ to 38. The trading reached over 30,000 shares, being one-sixth of the total business on the Exchange for the day.

This started a fresh flood of gossip, and there was a rumor to suit every man's theory. The following are given as examples, taken from the various financial articles in the daily press:

"No payments of dividends on the stock are expected for a long time, but the company's officers assert that they hold the funds required for the December interest, amounting to about $250,000. One explanation of the weakness of the stock was that it was due to a recent adverse legal decision. It was also suspected that progress might have been made in the organization of the opposition company which has been threatened for some time."

"The sellers explained the selling as due to a scurry to get away from a bad investment. A receivership was hinted at, and it was explained that the company for want of ready capital had been compelled recently to forego bidding for very profitable contracts. Then it was said that there was to be a consolidation with the Westinghouse Company; but the Electric's officials denied this, and George Westinghouse declared that he would not accept General Electric as a gift."

"It was announced in the Board of Directors that C. H. Coster, of Drexel, Morgan & Company, and H. McK. Twombly would resign from the directory of the company, and that the syndicate that had undertaken to right the indebtedness of General Electric, receiving in return an option upon the treasury assets, would fail to qualify."

"The demonstration was made on the inside information that the Fort Wayne Company, which is one of the subsidiary companies of the General Electric, was on the point of going into the hands of a receiver, and the preliminary papers had already been drawn."

(*From the Boston News Bureau.*)

"The rumor having the most influence was that there had recently been an expert examination of the books of the company in the interest of certain holders of the securities and some unfavorable facts are alleged to have been developed.

"We are told that a foreign interest lately made an inquiry into the affairs of the company, and decided that it was best to close out its holdings of the stock.

"There is also a rumor of a consolidation with the Westinghouse on unfavorable terms.

"There is some talk of moving the accounting offices to New York.

"General Electric officers say that they are satisfied that the General Electric Company could liquidate and aside from franchises and good will return stockholders above $50 per share.

"A bid of $1,000 was made in Stock Exchange this morning for the right to exchange any time within a year 1,000 shares General Electric for 1,000 shares Westinghouse common."

A Common Sense View.

(*From the Daily America.*)

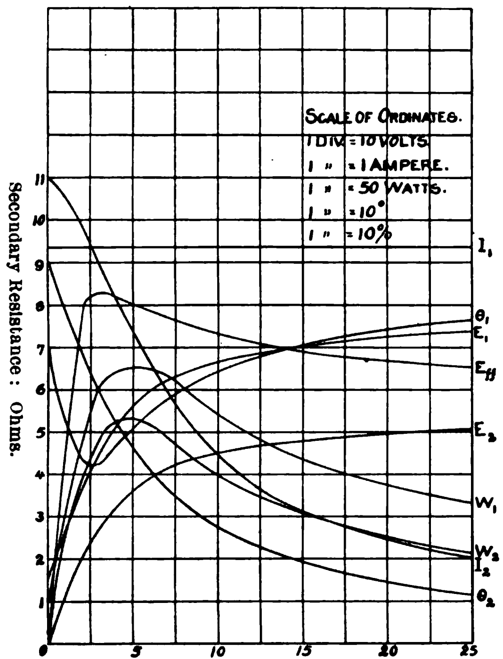
It has been repeatedly stated in this column that the assets of the General Electric Company and the restricted business it is now doing do not justify the price at which the stock has been selling ever since the panic. Now that it has gone down the toboggan slide 10 or 12 points to 39, the statement is still true. The fact of the matter is that the profits of the company at present are not sufficient to pay any dividends on the common stock, and there is no prospect in the near future that any such dividends can be paid. Without going too elaborately into calculations, it may be stated confidently that the stock is worth about 25 on the basis of its present revenues, and that is where it will land just as soon as the necessity for reorganization is announced, and I do not see how that can be very much longer delayed.

Transformer Diagrams Experimentally Determined.—III.*

BY DR. FREDERICK BEDELL,

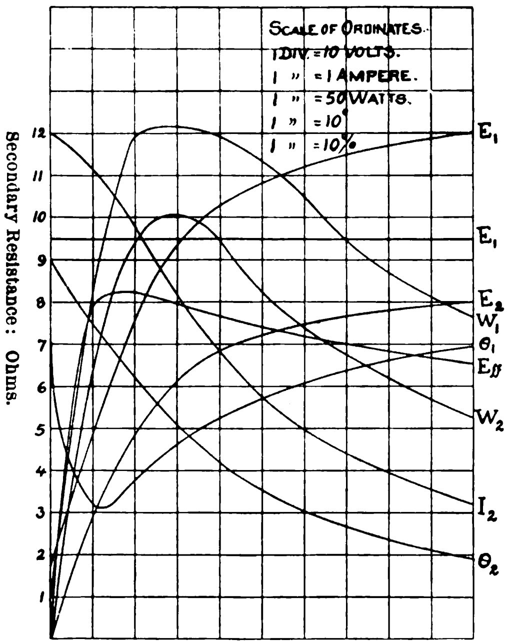
Assisted by A. W. Berresford, W. M. Craft and B. Gherardi, Jr.†

Rectangular Diagrams.—Rectangular diagrams do not indicate the direction of the quantities represented, but they show quantities in such a way that they are often superior to polar diagrams for indicating relative magnitude. For this purpose rectangular diagrams were drawn from the polar diagram Figs. 5-10, and two of these are shown in Figs. 13 and 14, for the tongue all out and all in respectively. These figures give the currents, electromotive forces, angles of lag, the power for the primary and for the secondary, and the efficiency of the transformer for different values of the secondary resistance. The curves explain themselves. It is interesting to note that the primary angle of lag on short circuit has about the same value, 70°, for all positions of the tongue. As the secondary resistance is increased, the angle decreases at first and then increases again. A study of Fig. 11 will show that this is explained by the shifting of the primary electromotive force semi-circle in Fig. 11, to the left, due to magnetic leakage. If the leakage were diminished, the primary semi circle would be moved toward the primary current $\overline{OA}$. In the rectangular diagrams, a diminishing of the magnetic leakage would cause the minimum point in the curve for θ_1 to shrink and disappear in the case of no leakage.



CONSTANT CURRENT. STEP DOWN. ARM AT 0°

FIG. 13.



CONSTANT CURRENT. STEP DOWN. ARM AT 180°

FIG. 14.

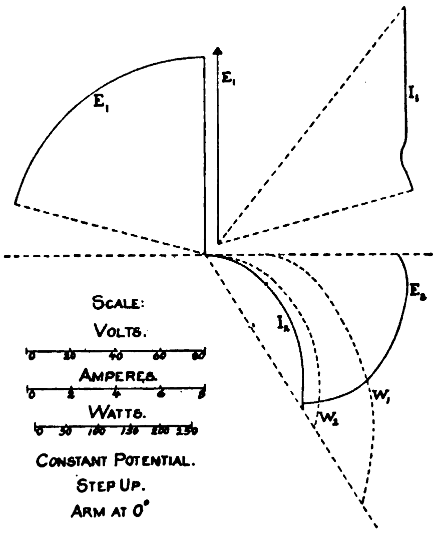


FIG. 15.

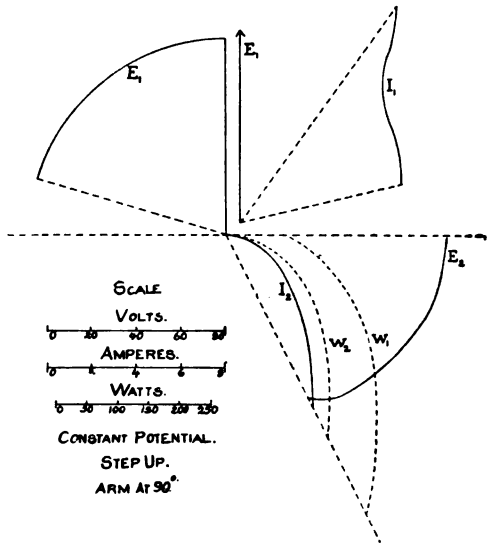


FIG. 17.

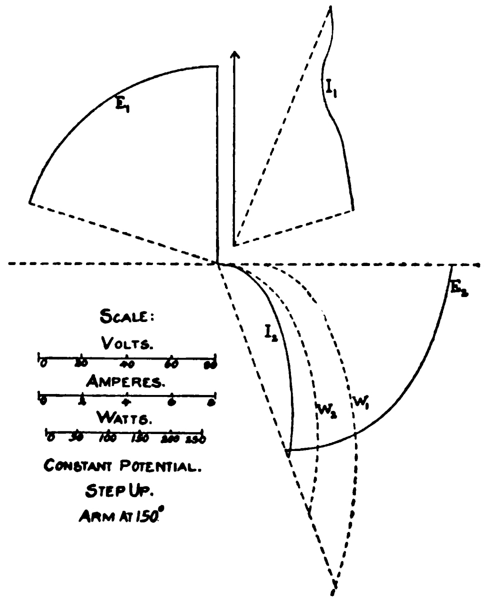


FIG. 19.

CONSTANT POTENTIAL EXPERIMENTS.

Runs were made with the transformer supplied with a constant potential of about 62 volts (square root of mean square value), with the movable tongue secured in the different positions 0°, 70°, 90°, 120°, 150° and 180° as before. The electromotive force of the generator was about 110 volts, but varied a little, so that it was necessary to maintain the electromotive force supplied to the transformer constant by adjusting the non-inductive resistances. Measurements were made as in the constant current experiments, and the values of the various quantities obtained as before. From this data, the polar diagrams Figs. 15-20 were constructed. In these the direction of the primary current is taken as vertical, fixed in direction, but varying in magnitude. The primary electromotive force is constant in magnitude, but varies in direction according to the value of the angle θ_1 between it and the fixed primary current. A diagram thus drawn does not show the

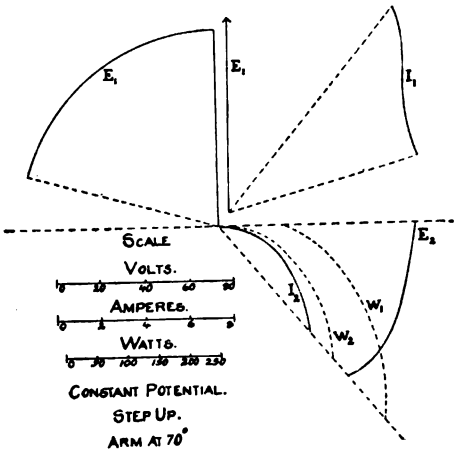


FIG. 16.

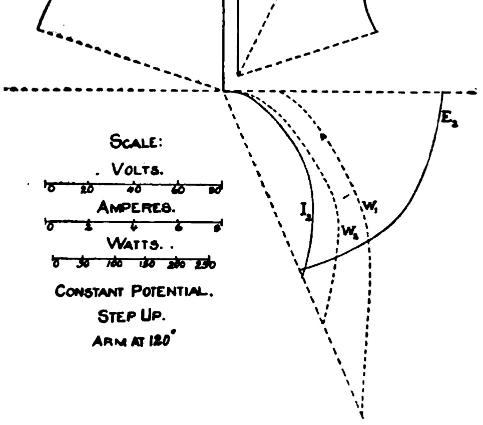


FIG. 18.

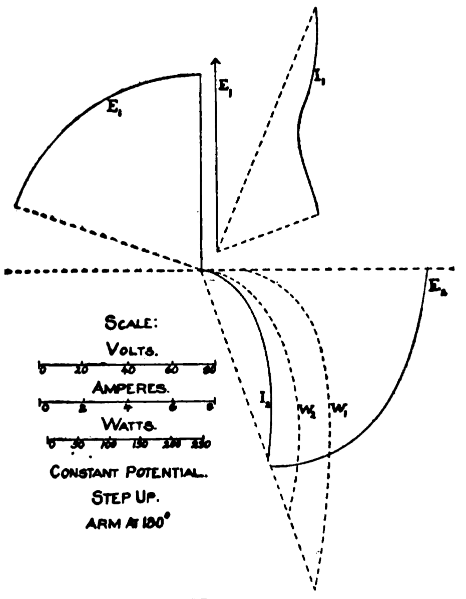


FIG. 20.

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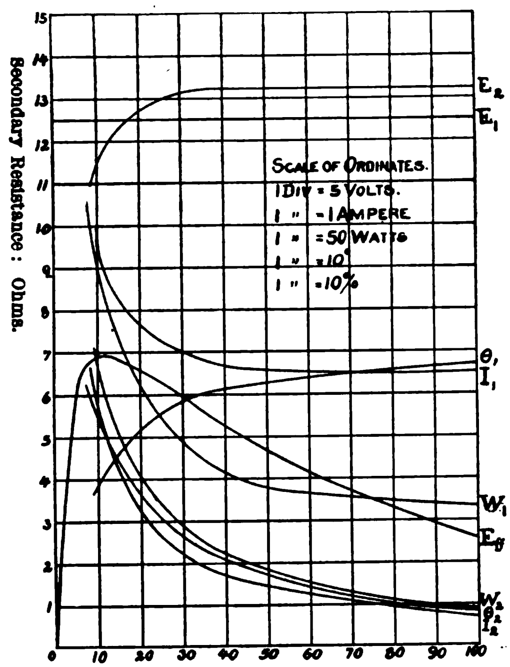
* For Parts I and II see ELECTRICITY Vol. V, Nos. 17 and 18.

† Read before the International Electrical Congress, Chicago.

changes in the magnitude of the primary current, and therefore an additional diagram is given in the upper right hand corner of each figure in which the primary electromotive force is constant both in magnitude and direction.

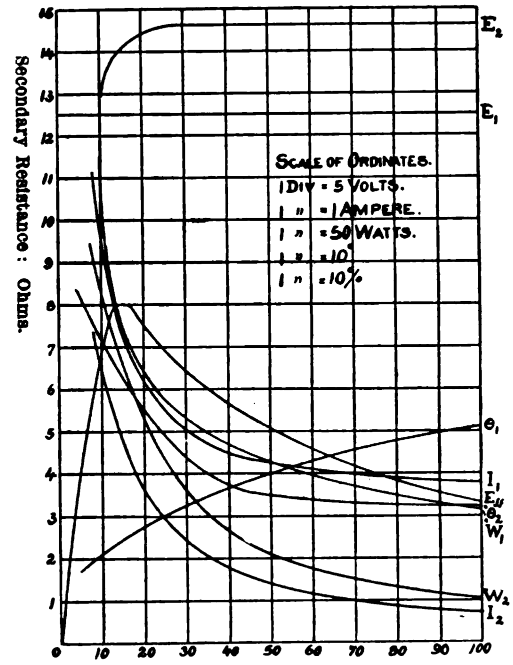


Constant Potential. Step Up. Arm at 0°

Fig. 21.

The locus of the primary current in this supplementary diagram shows clearly the changes in the magnitude of the primary current as well as its direction. As in all the polar diagrams in this paper, the loci are drawn to show the variation in the different quantities represented, caused by a change in the secondary resistance, the direction of the variation with increased secondary resistance being indicated by an arrow.

Figs. 21 and 22 are rectangular diagrams, drawn from the corresponding polar diagrams Figs. 15 and 20, representing the relative magnitudes only of the various quantities.



Constant Potential. Step Up. Arm at 100°

Fig. 22.

CONCLUSION.

When this investigation was undertaken with a view of experimentally developing the method of polar diagrams just described, it was with a little uncertainty as to whether the method would admit of ready practical application, and would give a clear exposition of the results obtained. It not only proves to be a convenient method for showing results, but tells the whole story in a comprehensive way, bringing out many points not otherwise shown. Furthermore, it proves valuable for comparison with similar theoretical work, based upon the assumption of harmonic currents, with which it agrees throughout, thus establishing the practical value of analytical treatment of problems with alternating currents.

The work was first taken up under the direction of the writer by Messrs. Berresford, Craft and Gherardi, as thesis[*] work at Cornell University. The investigation was conducted by them, and valuable assistance given by them in the preparation of this paper.

The curves here given are shown as representative and as illustrative of the method of showing the variation in certain quantities when one quantity is changed under certain conditions. Other curves were obtained, some of which showed the effects of the variation in the coefficients of induction, but those which are here described, showing the effects of a variation in the secondary resistance, have been given as being among the most interesting and instructive.

Cornell University, Ithaca, N. Y.

(Concluded.)

Legal Notes.

General Wing, of Auburn, Me., one of the bondholders of the electric street railway at Battle Creek, Mich., has begun proceedings for the appointment of a receiver. The city council has passed a resolution permitting the road to suspend operations for the winter, upon the understanding that it will resume May 15 with a good equipment.

The suit of the First National Bank against the City Electric Railway Company at Little Rock, Ark., for the sum of $110,341.61, an indebtedness which the street car company denies, has been referred to a master in chancery; as was also the case of Nick Kupferle, as trustee, against the same company, for $137,500 on a claim assigned by H. G. Allis for the benefit of the First National Bank. The street railway company deny this debt and set up that the First National Bank is indebted to them in the sum of $397,500.

Judge Andrews, of the Supreme Court, has ordered the dissolution of the National Electric Light and Power Company, of No. 120 Broadway, New York. The company was incorporated on November 20, 1879, with a capital stock of $300,000, and has ceased to do business since April, 1888, having been leased to another company. There are no assets and the only creditor is the United States Electric Lighting Company, whose claim is $4,551.

Personal.

Mr. Louis D. Brandeis, who is well remembered from his connection with the Beacon lamp case last winter, has given to Harvard University the additional sum of $1,000, to provide for the course in the law school for 1893-94 on the peculiarities of Massachusetts law.

Mr. James E. Hewes, formerly representative of the Baxter Electric Railway Motor Company of Baltimore, has left the above company and now holds a corresponding position in the recently reorganized Wenstrom Electric Company of Baltimore. The outlook for business in the South is very bright, and in Baltimore particularly so.

Mr. Walter C. McKinlock, secretary of the Metropolitan Electric Company, Chicago, has been confined to his house for some time on account of illness, but is again at work.

The Canal Experiment.

Electricity will Supplant the Mule.

The Difficulties Apparently all Overcome by the Westinghouse Company.

On Saturday, November 18, electricity was first applied for the propulsion of canal boats, and the demonstration was a thorough success.

Readers of Electricity are familiar with the progress in this important matter up to date, with its suggestion by Governor Flower, and the final designation of the Westinghouse and General Electric Companies to make the experiments. The test of the latter company's apparatus will not be made until next spring, and the Westinghouse Company have been the recipients of a good many columns of free advertising as the company which made the first successful experiment.

It was looked upon as a great event not only by the yeomanry in the vicinity of Brighton, where the trial took place, but by public spirited men throughout the State who have for a number of years been grappling with the canal problem in its various phases.

At 10 o'clock Governor Flower and party left Rochester for Brighton in two special cars placed at their disposal by President Beckley of the Rochester City Railroad Company, going on board the boat an hour later.

The banks were lined with an interested crowd of spectators from 3,000 to 4,000 in number.

The boat, formerly a steam propeller, was christened (after the gentleman who has had charge of the experiment) the Frank W. Hawley. The electrical apparatus had been carefully designed, and with the exception of the trolley itself no material changes will be required in practical work. The trolley used was underrunning, but the intention is to adopt an overrunning trolley, with flexible wire, allowing for the necessary lateral motion of the boat of from twelve to fifteen feet.

The trip was for about one mile, from lock 63 to lock 65, this section having been chosen because of its sharp curves and other features which represented all the main obstacles throughout the entire length of the canal.

The current was supplied from the circuit of the Rochester Railway Company. The trip was eminently a success, and was held by all present to practically demonstrate the feasibility of discarding mule power at an early date and substituting the trolley system.

The Westinghouse Company was represented by Messrs. George Westinghouse, Jr., Brayton Ives, Lemuel Bannister, Nikola Tesla, Paul D. Cravath, Albert Schmid, H. S. Clark, A. S. Morris and E. Chesrown.

Among the other gentlemen present were the following :

William S. Kimball, John N. Beckley, Frank S. Upton, F. W. Warner, Henry C. Brewster, Horace C. Brewster, David Hays, Charles P. Ford, Max Brickner, Bishop McQuaid, J. G. Cutler, Louis Wiley, Eugene T. Curtis, James W. Whitney, F. P. Allen, Senator Parsons, State Engineer Schenck, Deputy State Engineer Chapman L. Johnson, State Engineer-elect Campbell W. Adams, Superintendent of Public Works Hannan, Superintendent McDonough, Special Agent Halligan, Superintendent Miller, General Brinker, ex-State Engineer Bogart, Alderman Dewey, City Electrician Barnes, John Van Voorhis, J. C. Kalbfleisch, President Evan Thomas and Vice-President Alfred Romer, of the New York Produce Exchange; G. W. Balsh, chairman of the Canal Committee of the New York Produce Exchange; Dr. Coleman Sellers, president of the Niagara Falls Power Company; Francis Lynde, of Drexel, Morgan & Company;

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[*] Thesis in Cornell University Library: "Effects of the Change of Reluctance in a Transformer."

Vice-President Wickes, of the Cataract Construction Company; W. B. Rankin, secretary and treasurer of the Cataract Construction Company; Anthony N. Brady, president of the Albany Electric Company; William Mertens, of Von Hoffman & Company, and Charles T. Lewis, of the Mutual Life Insurance Company.

As the boat was being raised in lock 64, Governor Flower made a brief address, in which he said:

"In 1829, when DeWitt Clinton started from Buffalo to Albany on a canal boat, he had a military company as an escort, but there was no electricity to move boats or transmit news. They sent the fact of his starting from Buffalo to New York by the successive discharge of cannon along the bank, and the time occupied was an hour and fifty minutes. The people gathered along the canal rejoicing at the improvement. Only forty tons of merchandise were sent from Buffalo to New York that year, but now 3,000,000 tons are sent through annually. I believe when this electric system is perfected there will be 12,000,000 tons sent from the West to the seaboard and without cost to the people. This experiment will give new life to the commerce of States along the great lakes and make the transportation on the Erie Canal equal to that on the Mississippi. I regard it as a great privilege as Governor to witness this experiment which marks the change from horse and mule power on the canal to electricity, which I believe will quadruple the usefulness of the canal."

A New Kind of Steal.

Two Young Men in Tacoma Make Money Rapidly.

T. H. Headrick and Orville Shaw, employed by the Tacoma Light and Water Company, have been arrested on a unique charge.

They had organized the Headrick-Shaw Electrical Company, and while retaining their positions with their employers, had been doing lighting on their own hook whenever they could get a contract for a building. Then they stole the wire, lamps, etc. (which they could do easily, having charge of this department), and connected their job to the circuit of the Tacoma Light and Water Company, or the Commercial Electric Company, a rival concern. They were reaping a harvest of $200 to $300 a month, when their bid on a new contract was so low as to cause an investigation of their source of supply.

What the Boys are Doing.

From reports made to the secretary of the Massachusetts Institute of Technology it is learned that of the 132 members of the class of '93, those who have secured positions are distributed among the various professions as follows: 15 electrical engineers, 9 civil engineers, 7 mechanical engineers, 5 chemists, 3 general and 2 mining engineers, 2 biologists, 1 chemical engineer, 1 geologist, 1 railroader, 2 in the employ of the United States Government, 1 traveler, 1 athletic trainer, 6 who are still students and 10 instructors.

It may be added that 85 per cent. of the members of this class did not smoke.

Electrical Quackery.

A singularly transparent attempt has been made in England to sail under false colors in the placing on the market of an "electric porous plaster." It is claimed that this plaster, "in addition to having undoubted electric energy, is made from a vegetable extract possessing valuable properties, and is the best porous plaster in the world." The plaster consists of a piece of coarse linen or canvas, 7½ inches long by 5 inches wide, perforated and having one side covered with the vegetable extract. Stuck on the "extract" are two very thin pieces of copper and zinc foil, about 1¾ inches long and 1⅛ inches wide, connected together by an attenuated strip of the zinc. The ends of this strip are simply placed about an eighth of an inch under the pieces of metal foil, no attempt at soldering or good contact being made. As the whole thing is not worth a cent and the selling price is 28 cents, there is a liberal margin of profit. A leading English electrical journal, in warning the public not to be duped by the artifice, shows that the copper and zinc connected by a strip of the latter metal, uninsulated, are in actual contact in the electrolyte, that is, on the humid skin, and adds: "We therefore have no hesitation in saying that the statement, 'when applied to the body real and effective electric force is generated,' is utterly untrue, so far as any operative effect on the body is concerned, and we trust that some steps may at once be taken to put an end to this misuse of electricity."

Boston Notes.

That little dispute or difference of opinion which recently sprang up between the Cambridge City Council and the New England Telephone and Telegraph Company, the result of which was the discontinuance of free telephone service for the city government, has not terminated as the city fathers hoped it might. The Telephone Company is inexorable. It refuses to continue the courtesy of free service as heretofore, consequently the city government is now having to pay at the rate of about $1,000 per annum for talking over telephone lines when transacting city business.

A project is on foot for extending the electric railway system of Haverhill, Mass., through to the neighboring manufacturing town of Manchester, N. H. As is well known a most extensive railway system unites Lowell, Lawrence, Haverhill and other manufacturing towns in that district. These roads are owned by a rich syndicate of Eastern capitalists. They are doing much to enchance the value of property in the territory through which they pass. It is felt that the system will not be complete until Manchester is united. Local boards of trade and other representatives are holding meetings to discuss the project and every indication warrants the belief that a deal will be soon consummated.

While the transaction is not yet concluded there appears to be a good deal of truth in the report about the Boston and Maine Railroad wanting to purchase the new foundry buildings erected by the General Electric Company on the marshes contiguous to the Saugus River. It is well known that the General Electric Company have found the foundry an expensive failure; and considering the financial straits which they are in and the chaotic condition of their affairs generally, which is fast becoming chronic, the chances are that within a few days the transfer of ownership will be completed.

Some time ago the Cambridge City Council appointed a committee to look into the question of municipal ownership of electric light and gas plants. That committee has been since busy collecting and tabulating data bearing on the subject. They have communicated with municipalities which now own and operate lighting plants, learnt all they could about the comparative costs, etc., etc. A few nights ago this committee presented its report, which is a very elaborate and exhaustive document, in which they summarize their unanimous opinion and make a recommendation that the city government should avail itself of the provisions of the Municipal Lighting Act of 1890. The matter is now being taken under further consideration.

Professor Elihu Thomson had a magnificent audience to listen to his brilliant lecture on "Lightning and High Potential Electric Currents" in Odd Fellows Hall, Lynn, Thursday evening. Prof. Thomson was able to produce most wonderful lightning effects with a current raised to an enormously high potential. The splintering and burning of wood as done by a real live thunder and lightning storm were done to perfection, though some of the audience got a little nervous, but were reassured when they realized that Prof. Thomson received the force of the powerful current into his body without being in the slightest degree harmed. The current for the high potential experiments was taken from the wires outside the hall, passed through a transformer which raised the 100-volt current to a higher voltage, and then a vertical transformer with a core surrounded by many turns of copper wire closely wound, and a 20,000-volt current was obtained.

Discharging more hands and reducing wages to the extent of 10 per cent. continues to be the prevailing order of things at the factories of the General Electric Company. Consternation and dread seem paramount among the employees who regard with fear and dismay the rapid approach of winter, which means for many pinching hard times and blank uncertainty as to the future. The 10 per cent. reduction goes into effect Monday morning.

Outside the General Electric Company there is not a single electrical manufacturing concern in or about Boston that is not busy, and in some cases actually more than busy. We know of one firm which quoted so ridiculously high a price for a contract offered that it was refused. The company didn't want the job.

General News.

What is Going on in the Electrical World.

St. Charles, Mo.—The city electric light plant is to be reconstructed.

Wallingford, Conn.--The electric road to Meriden is nearing completion.

Howard City, Mich.—The people here are talking in favor of getting electric light.

Portsmouth, Ohio.—The formal opening of the electric street railway took place last week.

Columbus, Ohio.—The electric street railway between Columbus and Worthington has been completed and cars will be running in a few days.

Omaha, Neb.—One hundred and fifteen miles of the telephone line between Omaha and Norfolk are now completed. The whole distance is 160 miles.

Chester, Pa.—The Arnold Electric Company, which made an assignment last week, will resume under the assignee, the Delaware County Trust Company.

Lansing, Mich.—The question of bonding the city for $85.000 for electric light and bridge purposes has been settled affirmatively by popular vote.

Los Angeles, Cal.—The San Bernardino Electric Light and Power Company has been awarded the contract for lighting the city for the next three years.

Rochester, Minn.—The Western Electric Company of Chicago, which has the contract for putting in the new electric light plant, is pushing the work with energy.

Hanover, Pa.—The Hanover Electric Light Company is getting matters into such a shape that within the next month the town will be lighted by electricity.

Hartford, Conn.—The Hartford, Manchester and Rockville Electric Railway Company was organized here last week. No action was taken in regard to building the road.

Northampton, Mass.—The Northampton Electric Light Company has voted to issue $60,000 6 per cent. bonds on its new building, and to sell the old property on Masonic street.

Sioux City, Iowa.—Judge Gaynor has signed a final order in the cable road receivership matter authorizing the receiver to contract to change the cable line into an electric road.

Springfield, Mo.—The city council has instructed the clerk, Mr. Noe, to correspond with various electric lighting experts about the making of plans and specifications for a plant to be put in by the city.

Meridian, Miss.—The Edison Electric Light and Power Company's plant has been offered by the assignee to the city for $14.500, and the probability is that the city will take it at that price and operate it in city lighting.

Adamstown, Pa.—At a meeting of citizens here a committee of ten was appointed to solicit subscriptions toward the construction of an extension of the Reading and Southwestern Electric Railway from Mohnsville to Adamstown.

Newington, Conn.—An electric railway running through this place, and connecting it with New Britain and Hartford, is a topic of the greatest interest here, and several meetings of prominent citizens have been held to further the scheme.

San Francisco, Cal.—A number of electric roads are being built or projected to the Mid-Winter Fair Grounds. The Southern Pacific's spur track to the ocean beach, contiguous to the grounds, is to be turned into an electric road.

Pawtucket, R. I.—Of the nine street car lines coming into or passing through this city seven are now operated by electricity and the two still depending upon horses as motive power are the Broad and Cottage street routes, and they expect to change to electricity in the spring.

Ambler, Pa.—The taxpayers of this town have held a meeting at which it was decided to submit the question of lighting the town by an electric plant to be owned by the borough to a vote of the residents. The town has heretofore been lighted by a private corporation.

Carmi, Ill.—The city council has granted a franchise to Jerome Wallis, George Wurt, Jr., and Charles Faulkner, of this city, to establish an electric light plant here. The city contracts for thirty arc lights of 2,000 candle power at $90 per arc, the contract to last ten years.

Long Branch, N. J.—The Gas and Electric Companies have consolidated. The company will be incorporated under the new name of the Long Branch Lighting Company. The officers elected are : H. E. Gawtry, president; C. Henry Irwin, secretary, and George N. Curtis, treasurer.

Toronto, Can.—Electrician Davis, of the Street Railway, seems to have had no hesitation in saying this of his road: "This is the best electric railway in America. We have better cars, better motors, better rails, better roadway and a better service than any place in America."

Salem, Ohio.—The Salem Electric Light and Power Company has just closed a contract with the city authorities to put up and operate for ten years one hundred 1,200 c. p. arc lights, to displace the 325 incandescent lamps of 25 c. p. which the company has hitherto furnished. The new system is to be in operation by February 1 next.

Conshohocken, Pa.—The Norristown, Bridgeport and Conshohocken Traction Company, of which James P. McQuaid is president, has leased the line of the Montgomery Railway Company, extending from Bridgeport to Matsunk for 999 years. It has also offered to lease the Norristown Passenger Railway Company's lines. Both leases guarantee interest on the stock and bonds.

Montreal, Can.—The Standard Light and Power Company has sold to the Montreal Street Railway Company the Bickerdike Street Railway charter, which includes a thirty-years' exclusive street railway franchise for St. Henri and St. Cunegonde. The company by the purchase of this charter has now exclusive rights west of Montreal to Lachine, east to Longue Pointe and north to the city limits.

Gravesend, N. Y.—This town, which has lately attained unenviable notoriety in politics, has been slumbering in darkness hitherto, but will soon have electric lights, as the plant is fast nearing completion. The boiler and engine house is about furnished with engines, dynamos and boilers. Poles and wires are put up in all parts of the town, and it is expected that by December 1 the town will be lighted by electricity.

Brooklyn, N. Y.—The Brooklyn, Bath and West End Railroad has discarded steam locomotives and substituted electricity as a motive power. The cars will be run in trains and electrically heated and lighted, thus affording every comfort and convenience to patrons.—Details are nearly completed, it is said, for the consolidation of the Long Island Traction Company and the Brooklyn Traction Company, and before many mouths pass it is expected that all the roads in the city will be under one management.

Nashua, N. H.—The project of connecting Nashua with Manchester, Haverhill and other towns by electric railway has been lately discussed at meetings attended by delegates from the towns interested, and there seems every probability that it will be carried out successfully. At a meeting held last week in this city speeches were made in favor of immediate construction of the road by President Sanders of the local board of trade; Prof. Campbell, principal of the Pinkerton Academy, Derry; G. D. Bartlett, of Derry; Gilman Corning, of Salem, N. H. ; A. K. Welcomb, of Chester, N. H., and G. W. Dobbins, of Plaistow.

Paterson, N. J.—The stockholders of the Paterson and Little Falls Consolidated, the Paterson and Passaic, and the Passaic, Rutherford and Carlstadt Electric Railway Companies have agreed to consolidate the three roads. The name of the consolidation will be the Paterson, Passaic and Rutherford Electric Railroad Company. The officers of the new company are : President, Charles A. Johnson, Brooklyn ; vice-president, James A. Morrisse, Paterson ; second vice-president, Francis C. Van Dyke, Paterson; treasurer, Louis Fitzgerald, New York; secretary, John J. Scanlan, Paterson. The system when complete will connect Jersey City and Paterson.

Chicago.—The city council has passed the ordinance giving the Mutual Electric Light and Power Company "permission and authority to erect and maintain and use one or more systems of electric conductors above or under ground for the transmission of electric light, power and heat, or either of them, in the streets, alleys and public ways of the present limits of the city south of the centre line of Thirty-ninth street, and of said streets extended west to the city limits and west of the centre line of State street." The ordinance prohibits the company from furnishing power for any surface railroad, and provides that but one system of conduits may be laid in any street.—At the same meeting of council resolutions were read and referred to the finance committee recommending the purchase of dynamos, boilers, etc., from the Exposition exhibits, in order to extend as fast as possible the municipal electric street lighting plant.

New Orleans, La.—The City Railroad Company and the Traction Company have combined their interests on the following basis: The Traction Company, in consideration of $3,000,000 worth of 5 per cent. first mortgage gold bonds and $500,000 worth of capital stock, issued as full paid and not liable to assessment, would pay for and deliver to the railroad company a fifty years' extension of its franchise, retire its present bonded indebtedness of $423,000, and entirely rebuild all its tracks and equip the road for service with the trolley system of electric locomotion, doing from time to time all such work as may be required of the road by city ordinance, and keeping the road fully equipped. The Traction Company guarantee annual dividends of 8 per cent. after January 1 next. The mortgage to be recorded against the road to contain a provision for a sinking fund sufficient to retire the entire amount of the mortgage within fifty years.

The Armature Bell.

The Armature Bell, illustrated herewith, is a new device for the efficient and reliable operation of electric front door bells, call-bells, annunciators and door-openers, and is also specially adapted for use in watchmen's clocks and like purposes.

For residences, flats, apartments and hotels it is well adapted, no batteries of any kind being required, and the uncertainty, expense and trouble which attend the use and care of electric batteries being avoided.

The Armature Bell has nothing to get out of order, also replaces the old-fashioned door-bell, which causes more or less trouble as the wire stretches or breaks, as the case may be, whereas this bell can be relied upon for constant and efficient service, which is not the case where batteries are used, these being liable to give out at any moment without warning. The importance of this, especially in the case of front door bells, will be apparent to all users.

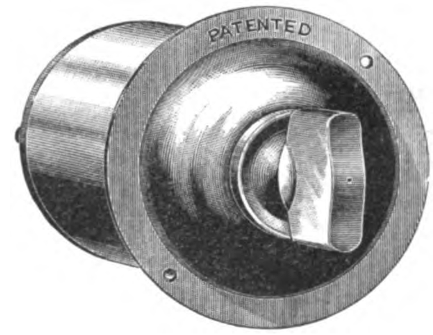


Fig. 1.

Cut No 1 represents a Call Armature Bell which is adapted for hotel, private house, apartment, office or factory use. A half turn of the key either to the right or left will generate instantly current sufficient to ring the bell. The armature occupies a space about 1⅝ inches in diameter and about 1¾ inches in depth, and while being a substitute and doing away with the use of batteries can be attached to wiring now in use without necessitating any rewiring. In the mechanical construction o the Armature Bells the best material has been used in order to combine in the highest degree durability with efficiency.

Cut No. 2 represents the Straight Pull Front Door Be with armature attachment. This is for direct work fo door bell use, being constructed on the same principle as the Call Bell, only instead of a key turning to the right or left, the usual straight pull knob is used, which revolving the armature in the field, generates a strong electric current to a bell located in any part of a building.

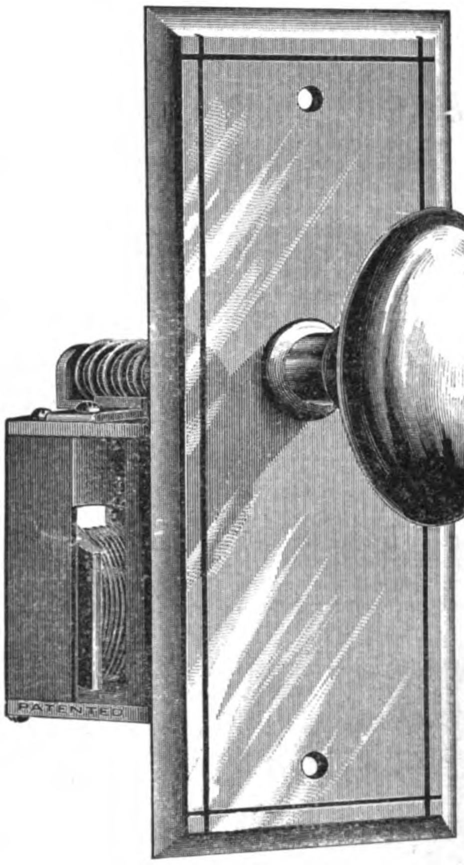


Fig. 2.

Cut No. 3 represents the bell used in connection with these armatures, which combines also the elements of simplicity and certainty, there being no springs or contacts requiring adjustment and liable to get out of order.

This system can be applied by manufacturers to watchmen's clocks, door-openers, annunciators, etc., now in use, at only a slight additional outlay, the same system of wiring being used as at present with the batteries.

The advantages of the Armature Bell are compactness, durability, efficiency and absolute reliability for giving uninterrupted service.

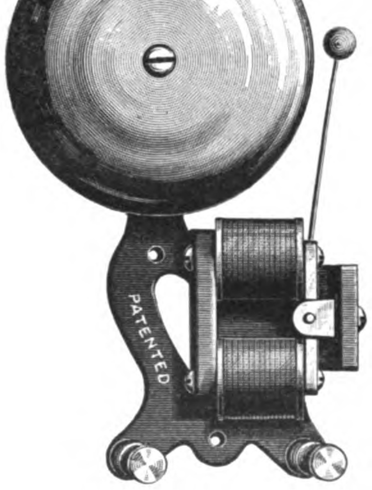


Fig. 3.

While the original cost is perhaps somewhat higher than that of the battery outfit, the cost and annoyance of renewals of batteries in connection with the old system is avoided, and when once installed these Armature Bells have the advantage of requiring no further attention or expense.

These Armature Bells are made by the **Armature Bell Company, 216 High street, Newark, N. J.**

The Stirling Boiler.

Office of Jno. J. Shipherd, Vice-President,
Cleveland, Ohio, Sept. 23, 1893.

FREDERICK E. BRUCE,
Agent Stirling Company, Cleveland.

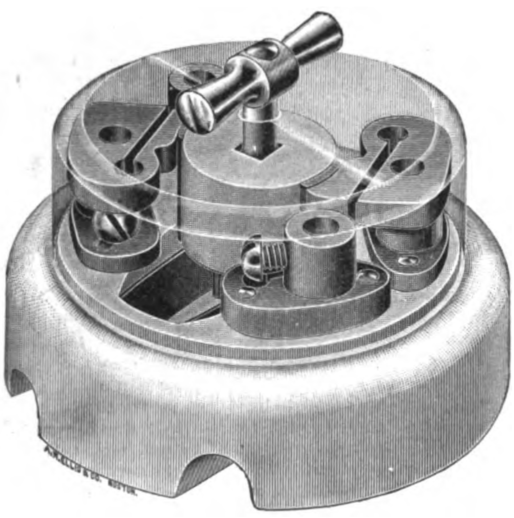
Dear Sir: Replying to your request as to the relative result both as to efficiency and economy between the Stirling Boiler and the Babcock & Wilcox, working side by side in our street railroads of Cincinnati, Newport and Covington, would say; at Cincinnati we have 500 H. P. Stirling Boilers and 564 H. P. Babcock & Wilcox Boilers. The Stirling Boilers, while of less heating power rating, will run our three 500 H. P. compound condensing engines with one-third less fuel than the Babcock & Wilcox.

We prefer the Stirling Boiler on account of its simple construction, there being no numerous tube caps to remove; and we find the Stirlings keep free from scale, while the B. & W.'s are constantly requiring attention. We are satisfied that the Stirling has better disengaging surface and furnishes dryer steam. Our use of the Stirling Boilers at the Evansville Street Railroad led us to the adoption of this boiler in our additions, in preference to the B. & W., which we have used for about four years, and not with the result expected; the question of difference in price not entering as a factor, but we believe should be in favor of the Stirling. We cannot hesitate to recommend them to anyone desiring boilers. I remain yours very truly,

JNO. J. SHIPHERD, Vice-President,
Cincinnati, Newport and Covington Railway Company,
Evansville Street Railroad.

The Iona Double Pole Switch.

The double pole switch which we illustrate below is already a great favorite with the trade, and although smaller than any on the market, it has a greater carrying capacity than many twice its size. The switch is simple in construction, convenient to wire, and is durable and reliable. Every switch is marked "on" and "of," thus showing at a glance its actual condition.



THE IONA DOUBLE POLE SWITCH.

The above is being manufactured and placed on the market by the Iona Manufacturing Company, 336 Congress street, Boston, who have just issued a catalogue showing the above and other specialties which they manufacture. This they will mail on application.

Commercial Notes.

The Auburn Electric Motor Company, Auburn, Me., reports a lively business. The prospect is for sufficient work to keep the full force employed all winter.

The Metropolitan Electric Company, Chicago, have just received a boatload of electric light carbons, consisting of ½ x 12 and 7-16 x 12, and ½ x 7 and 7-16 x 7, both plain and plated. This will enable them to fill their orders without any delay, and handling them in such large quantities enables them to make factory prices.

INCORPORATIONS.

The Colebrook Electric Light Company (incorporated in New Hampshire), principal office, 209 Washington street, Boston, Mass.—to furnish electric light, heat and power to the inhabitants of Colebrook and vicinity. Capital stock, $12,000. Promoters: Henry F. Holland, Clarence F. Eldridge, both of Boston, Mass.: W. E. Drew, Colebrook, N. H.

The Carbondale and Forest City Passenger Railway Company, Carbondale, Pa.—to construct and operate an electric railway in Lackawanna County. Capital stock, $150,000. Promoters: Jno. W. Aitken, Edwin Corey, J. M. Nicol.

The Anthracite Electric Railway Company, Pottsville, Pa.—to construct and operate an electric railway in Schuylkill County, Pa. Capital stock, $500,000. Promoters: Jesse Newlin, Edw. S. Newell, Lewis B. Walker.

The Penn Traction Company, Philadelphia, Pa.—to operate passenger railways by cables, electrical appliances, etc. Capital stock, $10,000. Promoters: Isaac M. Thomas, Geo. W. Shonk, John B. Yeager.

The Manayunk Passenger Railway Company, Philadelphia, Pa.—to construct and operate an electric railway in Philadelphia. Capital stock, $12,000. Promoters: Fletcher Pearson, James Rawle, John T. Dunlap.

The Anderson Electric Company, Anderson, Ind.—to supply electric light for city and public use. Capital stock, $50,000. President and treasurer, Charles L. Henry; secretary, L. M. Cox; directors: E. E. Hendee, J. W. Wild, E. M. Campbell.

The Pittsburg Electric Company, Pittsburg, Pa. Capital stock, $5,000. Directors: James A. Curry, Wilkinsburg; William H. Warwick, Bellevue; Robert A. Johnston, William M. Gillespie, Pittsburg, and Edwin L. Allen, Allegheny City.

The Whitestone and College Point Railway Company, Flushing, L. I.—to build a double track surface road in Flushing. Capital stock, $60,000. Incorporators: Israel J. Merritt, Jr., Moses Worms, Oliver Taff, Diederich Steffens and Harvey Peace, all of Whitestone; John J. Delaney, College Point: Walter C. Foster, Long Island City; Harry D. Loux, Mount Vernon; John F. Anderson, Bay Side, and others.

The Baker Lamp Electric Company, Portland, Me.—to manufacture and deal in arc and incandescent electric lamps, etc., under letters patent granted to Elbridge Baker, of Winchester, Mass. Capital stock, $400,000. Promoters: F. A. Whiting, Lowell, Mass.; Chas. A. Stellman, West Newton, Mass.; B. C. Mudge, Lynn, Mass.

The Baltimore Electric Company, Baltimore, Md.—to do a general electrical business. Capital stock, $10,000. Incorporators: Robert C. Rhodes, Phœbus H. Alexander, Charles C. Rhodes, Clarence C. West and Frank V. Rhodes.

The Cataract General Electric Co.—for the purpose of purchasing and selling electric power and the negotiation of contracts for the production, distribution and use of such power within the county of Monroe, N. Y., and in such other places on or near the lines of railroad entering the county as may furnish a market for such power. The principal office will be in New York City. Capital stock, $8,000. Directors: William Hortens, Thomas C. Platt, Commodore P. Vedder, Frank W. Hawley and Charlton T. Lewis, of New York.

The Brooklyn, Bergen Beach and Canarsie Railroad Company, Brooklyn, N. Y.—to construct a street surface railroad about nineteen miles in length to be operated by electricity. Capital stock, $200,000. Directors: Thomas Adams, Jr., and Louis R. Adams, of Brooklyn; Percy G. Williams, of New York City; Frederick Rosebush, of Ozone Park, Henry E. Hughes, Charles E. Morrell and F. W. Lemken, of Canarsie; Daniel I. Wright and Alexander Stafford, of Flatlands.

The Marble City Electric Company, Rutland, Vt.—to manufacture, sell, furnish and supply electric light and power for public and private use, etc. Capital stock, $50,000. Promoters: Jno. A. Sheldon, F. M. Butler, Harry M. Bates, Jas. Caruthers, Rutland; Harry B. Thayer, New York City; Jno. M. Jackson, Chicago, Ill.

The Commercial Electric Engineering Company, Detroit, Mich.—to do general electrical engineering and contracting, etc. Capital stock, $50,000. Promoters: Jos. B. Moore, Geo. E. Fisher, Orville D. Chase, all of Detroit.

The San Francisco Bonet Electric Tower Company, Chicago, Ill.—to build and operate electric tower in Court of Honor on grounds of California Mid-Winter International Exposition. Capital stock, $150,000. Promoters: Leo Bonet, Marie Dubois, W. H. Munnich.

The Metropolitan Electric Company, Chicago, Ill.—to manufacture and deal in electrical apparatus and supplies, etc. Capital stock, $300,000. Promoters: Edw. S. Elliott, John E. Campbell, Henry A. Ritter.

The American Stethophone Company, Chicago, Ill.—to manufacture stethophones, lines, exchanges, etc., and deal in electrical instruments, appliances, etc. Capital stock, $5,000,000. Promoters: R. D. A. Wade, John B. Phelps, Walter Olds.

The Boardman River Electric Light and Power Company, Traverse City, Mich.—to manufacture and sell electricity for light, heat and power, etc. Capital stock, $100,000. Promoters: Loraine K. Gibbs, Mayfield, Mich.; Jas. S. Hodges, Jas. L. Gibbs, Traverse City.

The Reed Electric Company, Camden, N. J.—to manufacture and sell storage batteries and other electrical apparatus and devices. Capital stock, $500,000. Promoters: Gustav Stahl, Philadelphia; Chas. J. Reed, Wm. A. Robbins, Camden.

The Belmont Manufacturing Company, Chicago, Ill.—to manufacture and deal in vegetable and mineral compounds for illuminating purposes, electric car renovator, furniture polish, carpet renewer, etc., etc. Capital stock, $250,000. Promoters: A. T. Robinson, Chas. F. Knowlan, I. K. Hall.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED NOVEMBER 7, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

507,997. Electric Locomotive. Joseph I. Conklin, Brooklyn, N. Y. Filed Dec. 8, 1892.
508,083. Electric Railway System. Carl T. B. Brain, Liverpool, England. Filed Aug. 29, 1891.
508,089. Safety Apparatus for Electric or Other Street Railway Cars. William Cox, Hamilton, Can. Filed Dec. 31, 1892.
508,104. Conduit Railway Trolley. Herbert A. Goreham, Decatur, Ill. Filed Jan. 31, 1893.
508,199. Closed Conduit Electric Railway. Otis B. Benton, Cleveland, Ohio. Filed May 31, 1893.
508,236. Conduit Electric Railway. Jacob Pawolowski, Cincinnati, Ohio. Filed Feb. 27, 1893.
508,373. Electric Car Attachment. Isaac H. Davis, South Butte, Mont. Filed June 15, 1893.
508,388. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Electric Car Company of America, same place. Original application filed Nov. 30, 1886. Divided and this application filed April 21, 1893.

ELECTRIC LIGHTS AND APPLIANCES.

507,978. Incandescent Electric Lamp. Craig R. Arnold, Sharon Hill, Pa. Filed Feb. 28, 1891.
508,006. Electric Light Fixture. Larsen Filstrup, Chicago, Ill. Feild Aug. 12, 1891.
508,314. Carbon Holder. Clark C. Hill, Newport, R. I. Filed Jan. 18, 1893.
508,343. Extension Electrolier. Alvin Rivenburgh, Greenfield, Iowa, assignor of one-half to Frank David Mears, same place. Filed July 27, 1893.
508,392. Electric Arc Lamp. Benjamin Adair and Charles H. Klewer, Denver, Col. Filed March 6, 1893.

DYNAMOS, MOTORS, ETC.

508,000. Electric Motor Apparatus. John C. Davidson, Prince's Bay, N. Y., assignor to the S. S. White Dental Manufacturing Company, Philadelphia, Pa. Filed May 2, 1893.
508,129. Electric Motor. William P. Carstarphen, Jr., Denver, Col. Filed Nov. 18, 1892.
508,188. Alternate Current Electric Motor. William Stanley, Jr., Great Barrington, Mass., assignor, by mesne assignments, to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Filed Oct. 23, 1888.
508,208. Regulator for Dynamo-Electric Machines. Albert M. Cullingworth, New York, N. Y. Filed May 6, 1892.

BATTERIES.

508,069. Polarity Switch for Secondary Battery Systems. Allen H. Whiting, New York, N. Y. Filed June 1, 1893.

TELEPHONE AND TELEGRAPH APPARATUS.

507,983. Automatic Signal for Trunk-Lines of Telephone-Exchanges. Oro A. Bell, Brooklyn, N. Y., assignor to Western Electric Company, Chicago, Ill. Filed Feb. 7, 1893.
508,054. Multiple-Switchboard System for Telephone-Exchanges. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Feb. 7, 1893.
508,214. Telegraph-Key. John R. Frank, Minneapolis, Minn. Filed May 29, 1893.
508,255. Telephone-Circuit. John S. Stone, Boston, Mass., assignor to the American Bell Telephone Company, same place. Filed Jan. 31, 1893.

ALARM AND SIGNALING APPARATUS.

508,215. Electric Time Signaling System. James H. Gerry, Brooklyn, N. Y. Filed Aug. 10, 1892.
508,356. Railroad Signal System. George L. Thomas, Brooklyn, N. Y., and Edward C Seward, Montclair, N. J.; said Seward assignor to said Thomas. Filed July 1, 1893.

MISCELLANEOUS.

508,050. Circuit-Breaking Device for Reciprocating Electric Machines. Charles H. Richardson, Philadelphia, Pa. Filed June 2, 1892.
508,068. Lightning-Conductor. Gustav T. Walch, Kaufbeuren, Germany. Filed Feb. 21, 1893.
508,084. Diaphragm Used in Electrolytical Processes. August Breuer, Iserlohn, Germany. Filed September 14, 1892.
508,262. Electric Tool. George H. Williams, New York, N. Y. Filed Dec. 28, 1892.
508,284. Electrically-Heated Soldering-Iron. Charles L. Coffin, Detroit Mich., assignor to the American Electric Heating Company of Maine. Filed Dec. 10, 1892.
508,295. Electric Cable. Henry W. Fisher, Pittsburg, Pa., assignor to the Standard Underground Cable Company, same place. Filed Aug. 7, 1893.
508,322. Electric Regulator and Switch. Walter N. Jones, Jr., Petersburg, Va. Filed July 20, 1893.
508,370. Covering Electric Conductors. William A. Conner, Pittsburg, Pa., assignor to the Standard Underground Cable Company, same place. Filed Dec. 6, 1890.
508,380. Electric Rotary Flue-Cleaner. Fulton Gardner, Chicago, Ill. Filed Feb. 23, 1893.

To Inventors and Others.

United States and Foreign Patents Procured.

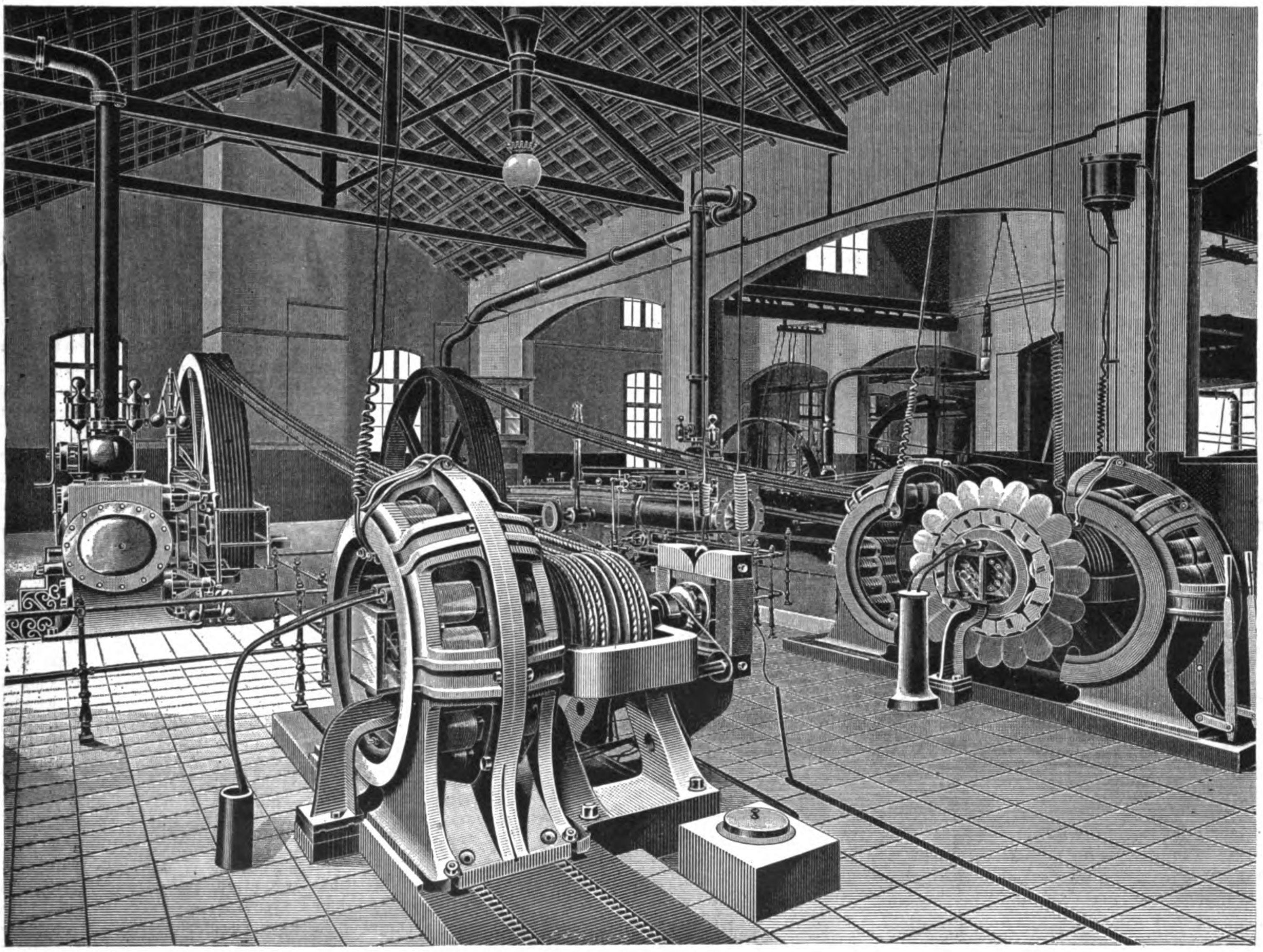
A PATENT DEPARTMENT has been established in connection with the publication office of ELECTRICITY, for the transaction of all business connected with the procuring of patents on inventions and devices of all classes. The object is to furnish inventors and others, at moderate cost, with a reliable, well-equipped and accommodating bureau through which they may be aided in procuring United States and foreign patents and obtain all information necessary to a successful prosecution of their claims.

Immediate attention will be given to inquiries and orders by addressing

T. F. BOURNE,
Manager Patent Department ELECTRICITY,
6 Park Place, New York City.

ELECTRICITY.

VOL. V. NEW YORK. NOVEMBER 29, 1893. CHICAGO. No. 20



THE BARCELONA CENTRAL STATION. (SEE PAGE 234.)

The Barcelona Central Station.

The Central Station of the Barcelona Electric Lighting Company, which is illustrated in our Frontispiece, is on the high tension alternate current system, the dynamos being of the Ferranti type.

The capacity of the station is equal to 11,000 lamps of 16 candle power, and it serves both arc and incandescent lighting.

The Buffalo Electrical Society.

"Electricity at the World's Fair" was the subject of an interesting lecture delivered before the Buffalo Electrical Society at its last meeting, held November 16. The society's president, Mr. Philip K. Stern, was the lecturer. He gave a general outline of the Electrical exhibits at the Fair, touching on those of scientific importance, and others equally important on electrical engineering.

The attendance was large and there promises to be a revival among local electricians this winter. President Stern, Frank Kitton and Frank C. Perkins were appointed a committee to secure, if possible, for the next meeting Prof. George Forbes, the Electrical Engineer of the Cataract Construction Company. The secretary has written to Mr. Nikola Tesla with a view to making arrangements for a lecture in the near future.

Modern Uses of Electricity—II.

MEASUREMENT OF ELECTRICITY.

The second lecture of the course was delivered at Boston, Mass., on Thursday evening and was on the subject of "Measurement of Electricity," in introducing which Prof. Cross said that it was between 1820 and 1825 when Ampere and Arago discovered the effects of a wire being placed in a magnetic field, which was to produce a current of electricity.

In 1830 Michael Faraday was led by his speculations and experiments to believe that with a wire in a magnetic field there ought to be some way of generating a current, and this he accomplished.

He worked a long time on his experiments, and from the results he achieved the dynamo of to-day has been evolved. He found that by taking a ring of iron and winding several coils of wire round it of varying thickness and direction, as well as of a different number of turns, he could make a current to flow through one of the coils, discovering at the same time that there was a temporary current set up in the next coil though flowing in an opposite direction. The coil through which flowed the current connected with a battery he called the primary coil, while that in which was set up temporarily the other current he called the secondary coil. After much hard work Faraday found that the secondary or temporary current was generated just when the primary circuit was made and broken, "or make and break" as it is called. By means of an oblong magnet, between the sides of which was suspended a compass needle connected by wire to a battery, Prof. Cross showed the deflection of the needle of the galvanometer in opposite directions just according to the make and break of the circuit. Several other of Faraday's experiments were utilized to demonstrate the action of the current. The changes that occurred in the flow of an electric current produced a difference of potential. The direction of an electric current is very easily discovered by the principle that whenever a current traverses a circuit in a magnetic field the circuit will tend to expand in every direction, and so includes the greatest possible number of lines of force passing through it. The effect of any motion in a circuit is to produce a motion. Whenever the conductor moves in a magnetic field it tends to produce a current that hinders that current.

According to the law of Lenz an induced current flows in a direction opposite to that of the hands of a watch when the current is increasing, while it moves in the opposite direction when the current is decreasing in quantity.

In illustrating this fact the lecturer made some further experiments with a powerful magnet connected with a battery, also using a loop of iron and the earth as a magnet; beautiful effects were produced in the galvanometer according as the loop was held as near as possible in the earth's plane or at angles of 80° and 160° to it.

It was not to be thought that these induction currents were always of a temporary character. Formerly it was thought that these currents were of brief duration and consisted of pulsations only, but that was not according to facts, for such induction currents were sometimes very strong and of continuous variations.

By using an alternating current dynamo a wave-like motion was produced in the current, which in other words meant that the direction of the current was reversed—that is to say, the lines of force were reversed.

This was illustrated by using a machine giving about 125 alternations per second. This was connected to a large coil which produced an induced current of sufficient strength to cause an incandescent lamp to light up. The use of such currents had been utilized in the modern electric gas lighting appliances. By taking two wires directly from a battery a current is set up in two coils of wire so connected that the vibrations are sufficiently numerous to enable the gas to be turned on and ignited at the same time.

Prof. Cross then continued his lecture by making a series of interesting experiments illustrative of the discoveries of Faraday, and showing the effects of various objects being placed within the influence of powerful magnetic fields.

ELECTRICAL UNITS.

Prof. Cross's third lecture in the course at Huntington Hall attracted another large and interested audience. It was a continuation of the subject of the previous lectures, the "Measurement of Electricity." The lecturer said that as electrical units have been determined quite recently it was useful to discuss the terms now in common use in this country for the measurement of electricity. As to the derivation of the units that had been adopted and now employed, they were of a purely scientific character. The employment of them is now so general that a consideration of them could not be omitted from a course of lectures on electricity. We read occasionally of the welding of rails by electricity, the execution of criminals, and other uses of the current, so that we ought to have some notion of the definitions technically employed.

The history of the derivation of electrical units is very interesting, for it shows the way in which they have been evolved. The necessity for them has been such that the scientific men of the world have found themselves, as it were, compelled to adopt them. Electrical apparatus have been adopted from time to time, as have electrical terms, only to be changed from time to time.

The derivation of these units goes back some fifty years, though the full development of them originated in the behavior of the first Atlantic cable, which was laid successfully in 1860 and after a few years gradually fell into disuse. The failure of this and other similar enterprises led to the appointment of a Parliamentary Commission, which sat for months and examined all the prominent scientists and practical engineers in England and from other countries. By this means they ascertained about all that the scientific men understood or knew on the subject. It became manifest then that the adoption of some units was imperative for electrical measurement, so that contractors could be held to their undertakings. The British Association appointed a committee to look into the matter and adopt a series of units such as are now in use all over the world.

In considering this matter, then, it will be necessary to fix upon certain things or conditions to which the units will apply. These are among others bulk, strength, capacity, time, etc. In measuring electricity the French use a resistance of so many kilometers of ordinary telegraph wire. The Germans use a Siemens mercury resistance, which consists of a column of mercury at a temperature of the freezing point of water. Of course all these are quite arbitrary processes.

There are standard units in use for various purposes, and all alike useful for what they stand. In the first place there is the meter, the 100th part of which is called a centimeter. Prof. Cross then showed a bar composed of iridium and platinum, the same being marked off in meters and centimeters when the bar was at a temperature of the melting point of ice.

The standard unit for mass or bulk was a *gramme*. In allusion to the unit of time, the lecturer said the *second* was so used the world over.

The unit of force showed that an object would be heavier at the earth's poles, while the same substance would be lighter at the equator than it was in the lecture room. To secure accuracy of measurement the fractional part of a gramme must be used.

The lecturer proceeded to show how to measure the magnetic strength of dynamo fields, and illustrated how the poles of a magnetic field tended to move along the plane of the earth's motion.

The method of measuring the force in a magnetic field is analogous to the modus by which the force of gravitation, or the force of gravity, is ascertained. That is done by the swinging of a pendulum at different points of the earth's surface. A pendulum swinging at a certain rate in Boston would move faster if nearer the earth's poles and slower if nearer the equator; in like manner the strength of a magnetic field could be ascertained or measured accurately.

In considering electrical units it was necessary to define a unit. The unit of strength was defined as being that current a centimeter of whose length acts with the force of one dyne upon the poles of a magnet, and this is ascertained by the use of a tangent galvanometer. This unit has been derived from and agrees with Ohm's law, first made known to the world in 1827. From this it can be inferred that a thing we can most readily standardize is something that can be kept without danger of loss. In measuring electric strength or force we must have a standard resistance, and this has been accomplished by a coil of wire of some kind of metal. This wire can be made of a definite diameter and used as a standard under all conditions and circumstances.

Prof. Cross then described the simplest method of determining the unit of resistance known as the British Association method, which is an ideal rather than a practical method. He said if we can produce a known electromotive force in any way so as to estimate its value, then the strength of the current can be accurately measured. To calculate electromotive force a commutator is used which induces the current always to flow in the same direction, and from our knowledge of the strength of the earth as a magnetic field we can get at what we desire to know.

The unit of pressure is known as the *volt*, which is the absolute resistance of pressure or electromotive force. An *ampere* is the unit of mass, the *coulomb* the unit of quantity.

The resistance coil wherewith to test or measure electrical currents was first constructed by a committee of the British Association, but through some mistake it was found to be incorrect, and so more accurate ones had to be made. At the present time what is known as the Clark cell, which is a curious kind of battery, is used as the unit of electromotive force. It has been found by scientists that silver is the best metal for standard measuring purposes and it is used by many for that purpose. There are also, said the lecturer, standards of self-induction. If a coil or ring of iron be inserted in a circuit the current is cut down by a definite amount and the unit is like other units by means of which one can accurately measure the current. For this purpose no unit had been adopted until the recent congress at Chicago, when it was finally decided to give to the unit of self-induction the name of *henry*, after Prof. Henry, of Princeton College, who first discovered self-induction.

In order that his hearers might not be wearied with the numerous definitions of units, the lecturer said, he would pass on and say a few words about electric meters, by means of which the quantity of electric current a person was using in a commercial way could be ascertained. It was clear that as soon as electricity came to be supplied regularly it was necessary to have a meter that would keep a record of its consumption. At first so many lights were supplied, and so much was charged for them. Various types of meters have been placed on the market, but there are only two or three in general use. One system of supplying current is where the pressure is kept constant, as in incandescent lighting. Another system includes a clock which runs only when the current is being used and stops as soon as the use of the current ceases. The latter was invented by Mr. Brush, and was used chiefly for charging batteries.

One of the best electric meters now in regular commercial use is that known as the "Edison," which has been in use for about ten years. There is also the Ayrton and Perry meter, which is well known and highly efficient.

Prof. Cross then caused to be thrown on a screen pictures of various types of electric meters, including the Thomson, Forbes, Shallenburg and others, a lucid explanation of the principle of construction adopted in each one and the method of their operation being given. There were also exhibited on the platform Edison, Thomson, Shallenburg and other types of meter, which the lecturer called the attention of his audience to, and showed their working by turning on current to first one and then another of them.

PRODUCTION OF ELECTRICITY FOR INDUSTRIAL PURPOSES.

Prof. Cross delivered another lecture in the course at Huntington Hall, Boston, November 9, his topic being "The Production of Electricity for Industrial Purposes; Dynamo-Electric Generators." In beginning this address the lecturer said the modern dynamo considered as a generator of electric current consisted of two kinds of machines, those operated by direct and those operated by alternating currents, the latter making from 50 to 200 reversals per second.

All the modern direct current machines were evolved from the originals of Pacinotti and Gramme, two inventors who lived only a few years apart.

He would speak of the direct current machines first, having already shown that by constantly rotating a hoop of metal in a magnetic field an electric current was produced, and with the use of a properly constructed commutator such current could be collected and utilized. Utilizing the earth's magnetism, it was shown that by taking a metal hoop and rotating it on its axis in line with the plane of the earth's surface, according as the lines of force through which the hoop rotated diminished the current would flow in a direction to the right hand, whereas if the lines of force were increased the current would flow in the opposite direction. When the hoop was in the line of the earth's plane, that is, north and south, the current was at zero, and as the hoop or coil rotated so the current was reversed.

Considering next the magnetic field with a single metallic ring rotating in it, the current was reversed according as the ring changed its face. If a series of whorls or turns of wire were extended round the circle, it would be seen how the current moved and was rapidly changed as it entered and left the different whorls. The electromotive force moving in opposite directions from the two poles neutralized each other, and so lost its potential.

Taking an oblong square iron frame, Prof. Cross said that the result of moving it through the lines of force would be to induce the flow of current upward on both sides of the square frame. If a piece of soft iron were placed in a magnetic field, it would be found that the lines of force passing through it were diverted by the piece of iron, and instead of passing through in straight direction, the lines take a curved course, following the current of the iron ring rather than through the air existing in the interior of the ring. This was discovered by Gramme in his original ring. A diagram was then shown illustrating how a series of wires was run along a ring with their ends joined one to another and connected by brushes resting against a number of copper bars separated from each other by suitable insulating material.

Figures of a Gramme ring, commutators of the Westinghouse type, Thomson-Houston armature winding, core of a drum armature and other parts of dynamo machines were then shown by the aid of a powerful lantern, and described.

Proceeding, Prof. Cross said it had been found absolutely necessary to laminate the armature of dynamos to prevent the occurrence of eddy currents, which formerly were excessively great and were a danger to the machines themselves. The dynamo designed and built by Moses G. Farmer in 1878 was described and approvingly commented upon.

Prof. Cross next proceeded to explain the different parts of a dynamo, and the processes through which it passed in building, reminding his hearers that there were many different types of machine now in regular and satisfactory use, some of them being known as shunt and others as compound wound dynamos. In the latter the current was not so steady as in a shunt wound machine.

In order to secure high efficiency, it was necessary to use coils wound with fine wire, the coils offering a high resistance which was necessary to secure a high electromotive force. For incandescent lighting, what was known as a series machine was used.

Having given in some detail the principles involved in making these different types of dynamos, the lecturer showed a small Gramme machine that would run a single arc light, a Siemens machine with a drum armature, a separately excited machine made in the Massachusetts Institute of Technology, an Eddy shunt wound machine, an Edison current type and an old type Edison machine, a Westinghouse and Thomson-Houston machine, pointing out the salient points and characteristic features of each in succession.

Recollections of Werner Von Siemens.*

II.—Saved to Science by a Timely Discovery.

We soon learnt that as punishment we were all to be sent back to our brigade—or our regiment, as it is now again called. For me this was an almost insupportably hard blow, disturbing all my life-plans, and making it impossible for me to go on providing for my younger brothers. The problem was to find a way to prevent this removal. That was only to be attained by an important military discovery, which should necessitate my presence in Berlin. Telegraphy, in which I was specially interested, could not perform this service, for only few then believed in its great future, and my projects were still undeveloped. By good luck gun-cotton occurred to me, which a little while before had been discovered by Professor Schönbein in Basle, but had not yet been brought into use. It appeared to me indubitable that it could be so improved as to be made available for military purposes. I therefore went immediately to my old teacher Erdmann, professor of chemistry at the Royal Veterinary School, told him of my trouble, and begged permission to institute experiments with gun-cotton in his laboratory. He willingly granted it, and I went eagerly to work.

I had the idea that by employing stronger nitric acid and by more carefully washing and neutralizing a better and less easily decomposable product could be obtained. All the experiments however came to nothing, though I used fuming nitric acid extremely concentrated; a greasy easily destructible product was always the result. My stock of extremely concentrated nitric acid having run short I once tried the effect of adding some concentrated sulphuric acid in order to strengthen it, and to my astonishment got a gun-cotton with altogether different properties. After washing it became white and firm like the unchanged gun-cotton and exploded very energetically. I was overjoyed, made till late in the night a considerable quantity of such gun-cotton and placed it in the drying-stove of the laboratory.

When after a brief sleep I went again early in the morning to the laboratory I found the professor standing mournfully among ruins in the middle of the room. On heating the drying-stove the gun-cotton had exploded and destroyed the stove. A glance made this clear to me and showed the perfect success of my experiments. The professor, with whom I in my joy tried to waltz round the room, seemed at first to think I had gone wrong in the head. It cost me some trouble to set his mind at rest, and to induce him to resume the experiments at once. About eleven o'clock I had packed a goodly quantity of faultless gun-cotton, and sent it with a formal explanatory letter to the war-minister.

The result was glorious. The Minister of War instituted a shooting-trial in his large gardens, and as it went off brilliantly immediately induced the heads of the Ministry to make a regular trial with pistols. On the very same day I received an official order direct from the Minister to repair to the powder manufactory at Spandau, which had already been instructed to place everything requisite at my disposal, to institute experiments on a large scale. It is seldom I fancy that a memorial to the War Office has been so quickly acted upon. Of my returning to the brigade there was no more talk. I was soon the only one of my brothers in misfortune who had not been obliged to leave Berlin.

The experiments on the large scale, which were made under my directions in the powder factory at Spandau, did not lead to the result expected in the first glowing moments, viz., that gun-cotton would generally supersede gunpowder. It is true that trials with small arms as well as with cannon yielded excellent results; it appeared, however, that gun-cotton was not a sufficiently fixed combination, since it gradually decomposed in the dry state, and occasionally also would go off of itself. Moreover its effectiveness depended on the degree of compression of the gun-cotton and on the mode of its ignition. My report therefore ran, that the gun-cotton produced according to my method by means of a mixture of nitric and sulphuric acid possessed excellent properties as a blasting material, and seemed well suited to take the place of blasting powder for military purposes but that it could not in general be substituted for gunpowder, as it presented no sufficiently stable chemical combustion, and its action was not constant enough.

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* Selected from "Personal Recollections of Werner Von Siemens," recently published in America by D. Appleton & Company, New York, 416 pp., 12mo, uncut edges, wide margin, photogravure portrait.

I had already sent in this report when Professor Otto in Brunswick discovered anew and published my method of preparation of serviceable gun-cotton. My earlier action in the matter and my report to the War Office remained of course secret, and Otto therefore must rightly be held the discoverer of serviceable gun-cotton, since he was the first to make public the method of its production. It has often been so with me. It appears at first sight hard and unjust that any one may by earlier publication appropriate the honor of a discovery or invention which another, who has worked at it long with ardor and success, would only make known after the most thorough testing. On the other hand it must however be admitted that some definite rule must be established in regard to priority, since for science and the world it is not the person but the thing itself and its publication that is of importance.

After the danger of removal from Berlin had been in this manner successfully averted I was able to devote myself with a tranquil mind to telegraphy. I sent General Oetzel, the chief of the optical telegraph department under the immediate direction of the staff, a memoir on the condition of telegraphy and the improvement to be expected therein. In consequence of this I was ordered to place myself at the service of the commission of the staff, which was deliberating on the introduction of electrical instead of optical telegraphs. I succeeded in gaining the confidence of the general and his son-in-law, Professor Dove, in so high a degree that the commission almost always assented to my proposals and entrusted me with their execution.

It was then regarded as altogether out of the question that a telegraph wire easy of access, attached to posts, could be really serviceable, since it was imagined the public would destroy it. Accordingly, wherever on the European continent it was desired to introduce electric telegraphs, experiments were first made with subterranean conductors. The best known were those of Professor Jacobi in St. Petersburg; he had tried resin, glass-tubes, and indiarubber as insulators, but had obtained no permanently satisfactory results. The Berlin commission likewise had begun such experiments, which however just as little yielded a satisfactory durable insulation.

By chance my brother William in London had sent me as curiosity a sample of a substance which had recently appeared in the English market, gutta-percha. The remarkable properties of this material of becoming plastic in the heated state, and when cooled of being a good insulator of electricity, aroused my attention. I covered some pieces of wire with the heated material, and found that they were thoroughly insulated. At my suggestion the commission gave orders for more considerable experiments with such wires insulated by gutta-percha, which were begun in the summer of 1846 and continued in 1847. In samples placed on the track of the Anhalt Railway in 1846 the gutta-percha was rolled round the wire. It turned out however that the coil got loosened in course of time. I accordingly constructed a screw-press, by which the heated gutta-percha was cohesively pressed round the copper wire under the application of a high pressure. The conducting wires, coated by the help of a sampler press constructed by Halske, proved to be well insulated and permanently retained their insulation.

In the summer of 1847 the first long subterranean wire from Berlin to Grossbeeren was laid by me with such insulated wires. As it stood the test perfectly the question of the insulation of subterranean wires by the employment of gutta-percha and my press appeared to be now successfully solved. In fact since that time not only the subterranean land lines but also the submarine cable lines almost without exception have been insulated in this manner.

The commission had under consideration the employment both of the wires coated with gutta-percha by pressing and also my dial and printing telegraph, in the telegraph system about to be introduced into Prussia.

The resolution to devote myself entirely to the development of telegraphy was now fixed. Accordingly, in the autumn of 1847 I induced the mechanician J. G. Halske, with whom our common labors had bound me closely, to hand over his business to his partner and to start a telegraph factory, into which I reserved to myself the right of entry on my discharge. As Halske just as little as I had available resources we had recourse to my cousin, George Siemens, a barrister residing in Berlin, who lent us 6,000 thalers for the erection of a small workshop on condition of a share in the profit for six years. The workshop was opened on the 12th of October, 1847, in the back part of a house in the Schöneberger Strasse—where Halske and I also took rooms—and grew rapidly and without the aid of outside capital into the world-known establishment of Siemens & Halske in Berlin, with branches in many of the chief cities of Europe.

The enticing prospect, in virtue of my dominating position in the telegraph commission, of rising to be the head of the future Prussian State telegraphs I had put aside, as a position of dependence was not congenial to me, as I had the conviction I should be of more service to myself and the world if I obtained my full independence. But I resolved not to renounce the military service, and therewith my place on the military commission, before the latter had completely accomplished its task, and a definite settlement of the future telegraph system had been arrived at.

I urged in the commission that the public should also be allowed the use of the telegraph lines, which met with considerable opposition in military circles. The great celerity and certainty with which my new patented dial and printing telegraphs worked on the overhead line between Berlin and Potsdam and on the underground line between Berlin and Grossbeeren—performances with which those of the old semaphores were not to be compared—contributed however in no small degree to produce an opinion more favorable to the public interest. The report of astonishingly favorable results of these experiments went the round of the higher circles in Berlin, and brought me a command from the Princess of Prussia to give a lecture in Potsdam on electric telegraphy to her son, afterwards Crown Prince Frederick William and Emperor Frederick. This lecture, accompanied by experiments on the Berlin-Potsdam line, and a memoir connected therewith, in which I enlarged upon the great future in store for telegraphy, supposing it to be made the common property of the people, no doubt considerably assisted in gaining over the higher circles.

At my instigation the commission instituted a public competition for March, 1848, and settled the conditions to be satisfied in regard to the telegraphic communications and apparatus. Prizes were assigned to the conquerors, who were also to have the reversion of consequent orders. I had a pretty safe expectation of obtaining the victory with my own proposals at this competition, which opened on the 15th of March, 1848, when on the 18th the competition as well as the commission itself came to an abrupt end.

(*To be continued.*)

Legal Notes.

In the Circuit Court at Eau Claire, Wis., on the 16th inst., Judge Bailey confirmed the sale of the National Electric plant by Receiver Rust to Peter Truax for $7,500. The attorney for the receiver asked the court for an order restraining the Chicago creditors who filed their claims at Eau Claire under the receivership from going on with suits instituted in Chicago against the National Electric. Arguments on this motion are to be heard December 11.

The receiver of the Electric Power Company of Philadelphia has presented an audit of the company's accounts which will give the creditors about 5½ per cent. of their claims, there being $2,001.09 with which to pay $36,383.58. The Electric Power Company was originally a New Jersey corporation, but secured a charter in Pennsylvania on November 29, 1889, and had a contract for lighting a section of the city of Philadelphia. Mr. Wray was appointed receiver on March 30, 1891, under a bill in equity filed by George V. Cresson, who alleged that besides judgments held by him there were other claims against the company, and that it was unable to meet its obligations. Among the largest creditors were the Fort Wayne Electric Company, $7,586.97; Electric Dynamic Company, $3,086.06; Bank of the Metropolis, $7,458; estate of Elizabeth Maitland, $8,000; Joseph Ogden, $2,500; William Thornton, $563, and about twenty-five others in different amounts.

A verdict was rendered at Pittsburg, Pa., on the 21st inst., in the United States Circuit Court case of the Edison General Electric Company vs. the Connellsville, New Haven and Leisenring Street Railway Company for $12,023 in favor of the plaintiff. It was an action to recover for machinery sold.

In the Common Pleas Court at Cleveland, Ohio, on the 20th, Amos Townsend and Wm. M. Brown filed a petition asking for an accounting, injunction and equitable relief against the Euclid Avenue National Bank and the General Electric Company, Boston. The plaintiffs are joined as Townsend & Brown, owners of a street railroad at Montgomery, Ala. The bank holds their note for $6,000, with certain collateral security which was given to the General Electric Company as part payment for certain electrical apparatus supplied Townsend & Brown. They claim the apparatus is inferior to the specifications and they object to paying the full sum agreed upon. For this reason they ask for an accounting. The injunction prayed for is to prevent the note and collateral being taken outside the State to be negotiated. They claim the bank demands usurious interest on the note, and this they refuse to pay.

The Pennsylvania General Electrical Company of Philadelphia has brought suit against the Carbondale Traction Company to recover $8,000. It is alleged by the plaintiff that the amount is due by the Carbondale Company for equipment furnished.

New York Electrical Society.

On Wednesday, the 29th inst.. the New York Electrical Society will hold a symposium at Columbia College, Forty-ninth street and Madison avenue, at 8 P. M. The subject of the evening will be "Electricity at the World's Fair and its Lessons."

Brief addresses will be given by J. J. Carty, on Telephones; Prof. F. B Crocker, on Electrical Congresses; Charles Cuttriss, on Cables; Dr. C. E. Emery, on Electric Light Engines; James Hamblet, on Electric Clocks; C. O. Mailloux, on Storage Batteries; T. C. Martin, on Electric Lighting; Nicola Tesla, on his new Electrical Oscillator; Jos. Wetzler, on Transportation; and Schuyler S. Wheeler, on Electric Motors.

National Electric Light Association.

At a meeting of the Executive Committee of this Association, held at the Lafayette Hotel, Philadelphia, November 24, it was unanimously voted that the next meeting place of the Association should be Washington, D. C. The date of meeting will be February 27, 28, March 1, 1894.

The following committees were appointed:

Committee on Arrangements: C. O. Baker, Jr., Chairman; F. W. Royce, Washington, D. C.; Samuel M. Bryan, Washington, D. C.; M. J. Francisco, Rutland, Vt. Committee on Programme: A. J. De Camp, Chairman; C. W. Price, New York; H. H. Fairbanks, Worcester, Mass.

A Check on Contract Customers.

An invention known as the Martin check apparatus has been designed in France for limiting the current which can be used by customers supplied on a contract basis to the maximum amount called for in their contracts.

The following description of this device is given in the *Foreign Abstracts* of the Institution of Civil Engineers: "It is very usual in France for an electric lighting company to furnish current by contract to consumers, and in such cases a consumer may have any number of lamps installed so long as he never has more than a certain fixed number lighted at once. It is therefore necessary to use some apparatus for the purpose of preventing fraud and making it impossible to use more than the stipulated number of lamps at one time. As a rule, this object is accomplished by using switches with two or more different contacts, so that when the current is shut off from one circuit it is admitted to others. This method, however, complicates the internal wiring, and the grouping of the lamps easily permits of fraud. On the other hand, the reliability of cutouts is very doubtful. The Martin apparatus is designed to prevent the use of more than the stipulated number of lamps, while permitting absolute freedom in the grouping or wiring of such lamps. Such an apparatus is also of use in a private installation, to prevent overloading of the generating plant. The apparatus is placed in one of the main leads, and consists of two mercury-cups provided with a metal contact-maker attached to the end of a lever, and provided with a spring to cause a quick break in the mercury-cups. The lever is commanded by one or other of six pins standing at right angles to the flat face of a wheel, which is stationary when the stipulated current is not exceeded, and holds the contact in the mercury-cups. Clockwork is so arranged as to always tend to rotate the pin-wheel, and if this motion were not controlled, the circuit would be made and broken at short intervals by the contact-piece in the mercury-cups. One of the train wheels is, however, provided with a single pin, which is held by a projection on a spring lever during the whole time that the current in the circuit does not exceed the quantity stipulated. The spring lever carries at its free end the armature of an electromagnet, which is placed in the main circuit, and the strength of the spring upon the lever is so adjusted that, so soon as the maximum stipulated current is exceeded, the armature is attracted and the train of wheels set free. Contact is then made and broken at short intervals of time, and the customer is obliged to take one or more lamps off the circuit, thus bringing the current down to the normal when the train of wheels is stopped and the permanent contact is again made. In actual practice a clock movement of the Japy type is employed, but only the five wheels of the striking mechanism are preserved, with the detent spindle and its lever, and the spindle of the hammer. The hammer shaft is retained, but the head is replaced by a piece of hard rubber, carrying a copper fork dipping into the two mercury-cups. The author gives some further details of the method of manufacturing this particular type of clock. He states that the act of switching in a 5 C. P. lamp on a circuit of 110 volts is sufficient to actuate the apparatus—supposing, of course, that such a lamp be in excess of the stipulated number of lamps which are already lighted. The loss of pressure upon the circuit is said never to exceed 0·2 volt. The whole is covered with a glazed lid, and can be sealed up. A counterpoise is so arranged that it is impossible for a consumer to keep too many lamps lighted until the clock has run down, in which case the circuit would become permanently closed; the counterweight causes the circuit to remain permanently open until the number of lamps in use is reduced to the stipulated maximum. This instrument has, it is stated, given satisfaction in one of the eastern towns, and a servant of the company calls once a month upon each customer for the purpose of winding up the apparatus. Such a clock-movement would run for fifteen days and give 2,700 interruptions, and it is found that the spring is very seldom run down in a month."

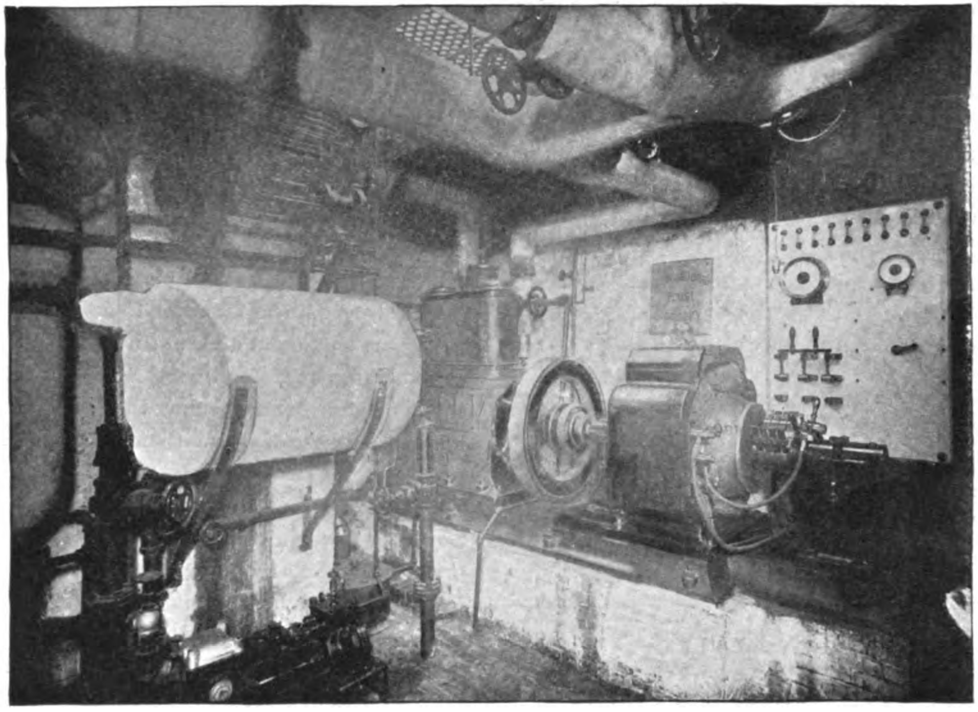
A Model Installation.

The drift to-day in the field of electric lighting is in the direction of slow speed machines, and of late some striking and highly satisfactory results have been attained in this new departure. Combined with the saving effected in wear and tear as the outcome of reduced speed in the running of dynamos and generators is another important factor, the economizing of space actually required for the installation of a steam and electric plant.

Direct coupled engines and dynamos have largely solved the problem bearing on the advantages of electric lighting on shipboard and in buildings where space for such apparatus is not always available even to a limited extent. Many a man eager to equip his building with electric machinery has had to abandon the idea because he couldn't afford the space a plant would call for. Such policy is now a thing of the past. The objection has been fully overcome, and this article gives a description of a unique installation of this kind, where the space at command was very limited, but which was so utilized that quite a plant has been installed and is doing extensive and most efficient work.

The International Trust Company of Boston, one of the leading banks in that city, has recently erected a magnificent stone building of nine stories close by the Post Office. This handsome block has just been finished, and is open for business. To light the whole building a 500-light plant was necessary, and to accommodate such a plant a very limited floor space in the basement was available. The Mather Electric Company, of Boston and Manchester, Conn., was intrusted with the contract, and with such limited space as could be afforded it was decided to install what is known as the "Kodak" type.

The accompanying cut gives a good view of this plant, in the running of which neither belts, shafting or pulleys are required. The plant consists of one 30 kilowatt or 500-light Standard Multipolar Mather Dynamo, which makes 350 revolutions per minute, the armature shaft being coupled direct to a 9½" x 9" Westinghouse engine. Unusual as it may seem, engine and dynamo are both mounted upon one bed plate and occupy a space of only 86½" x 35", whereas the ordinary method of belting a dynamo to an engine would require nearly three times that space. A handsome marble switchboard having every modern improvement is fixed on the wall near by so that the engineer in charge has everything at hand.



Dynamo Room, International Trust Company's Building, Boston.

This, we believe, is the first plant of this type that has been installed in New England, but it is giving such full satisfaction, is so unique in design and compact in installation, and is evoking so much favorable comment from all who have seen it, that inquiries are frequent and the manufacturers are looking forward with great confidence to doing quite an extensive business with the "Kodak" type of electric lighting plant.

Current for 500 lights generated in a space, as we have above stated, of only 86½" x 35" is something so unique that the system cannot fail to become popular.

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Electric Power on Canals.

The experiments in electric propulsion for canal boats which were recently undertaken on the Erie Canal near Rochester call to mind the importance of this method of transportation, which it is safe to say is not generally appreciated at its true value. New York's supremacy as a seaport is largely due to this waterway connecting it with the great lakes, and in order to maintain this position it is essential to provide for the constantly increasing freight traffic in Western produce which has already begun to seek outlets through other channels, thus diverting from the State a large amount of commerce which proper facilities would secure to it.

Governor Flower, who has strongly advocated some method of improvement in the facilities of the Erie Canal, said in a recent speech: "What a great stride this Empire State took when the Erie Canal was built! It wasn't the canal it is now, either. It was four feet deep instead of six feet and a half. But it brought this State to the front. Massachusetts and Pennsylvania were both in the lead of New York up to that time. But as soon as the waterway tapped the commerce of the great West, cities and villages sprang up all along the line. These cities and villages didn't spring up along the line of the Central-Hudson Railway, but along the line of the Erie."

It is also significant that the Canadian Government is reaching out after much of this Western grain traffic and improving the facilities for transportation by deepening the St. Lawrence channel and the Welland Canal at a very large expense.

The average speed attained by canal boats is now about two miles an hour, and the canal will probably admit of its being increased to four or five miles. The doubling of the rate of speed would mean that each boat could make twice as many trips during a season, double its earnings and increase the total annual tonnage of the canal very largely without further deepening of the channel.

It is estimated that with power from the Niagara station the expense of bringing a bushel of grain from the wheat fields to New York would only be in the neighborhood of five cents, and at that price, with the enormous carrying capacity of the large canal boats, the shipping of grain from New York would be more than quadrupled, with a corresponding increase in the carrying trade of the State.

The experiments near Rochester indicate that electric propulsion is feasible, although the conditions of the test were not perfectly satisfactory. The steam canal boat used was equipped with two twenty-five horse power street railway motors arranged for a pressure of 500 volts, and current was supplied from a neighboring electric railway, but this was, according to the readings on the test, only at from 200 to 500 volts, which was an unfavorable condition for the machinery.

Notwithstanding this circumstance the boat attained a speed of nearly four miles an hour, and no difficulty was experienced with the underrunning street-car trollies either in passing the lock or rounding the curves. Before the start, however, some trouble was found in placing the boat in position under the trolley line, and this suggests the use of overrunning trollies in order to give the boats more freedom of position.

As a whole the test may be considered as a success as it demonstrated very clearly the possibility of this style of propulsion. The details of the apparatus were crude and the supply of current insufficient, so there is little room to doubt that with the apparatus and current which would be used in the practical application of electricity on boats the greatest speed which the canal would allow could be easily attained.

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American Practice Criticised.

Our London contemporary, *The Electrician*, seems to resent the idea that England can learn anything from American electrical engineering practice except what is to be strictly avoided, and paints a most unflattering picture of nearly everything electrical in this country. The New York and Chicago telephone line is thus depreciated: "We venture to suggest that, electrically, the London-Paris, or the Glasgow-Belfast telephone cables are each a 'bigger thing,' except in mere pounds of copper and hundreds of miles, than the New York and Chicago line."

The electric railways come in for the most severe criticism of all, and the Chicago-St. Louis scheme, in which no one but its promoters have any faith, is held up as a terrible example. The horrors of our street electric railways are described as vividly as even the New York daily papers could desire. Other examples of our engineering practice are noticed as follows: "A fortnight ago a shocking accident occurred at Oregon, when a tramcar with thirty passengers dashed through an open drawbridge into the river, killing, it appears, twenty-five people. Last month a flywheel burst at Brooklyn, wrecking the engine-house, stopping all the cars in the city driven from this station, and injuring three persons. Two days later the whole of the street lighting plant of Baltimore was destroyed by fire, together with plant for running 12,000 glow lamps."

It also charitably hopes that in the Niagara power plant no gigantic breakdown of the huge alternators will compete for magnificence with the Falls themselves. From the tone of our contemporary we infer that accidents in any class of engineering work are totally unknown in England, for which it is to be congratulated, and while the plea for better construction and more substantial work is to be commended, the examples mentioned above are hardly fair illustrations of all the electrical engineering work in this country. We certainly have a large proportion of plants of various kinds which are creditable specimens of engineering work, and the comparison of percentage of accidents to the total amount of work installed in both countries might look more favorable to American engineering practice. As the English practice in electrical work has generally waited for the benefit of American experience, we naturally look for some improvement over the older work.

Personalities were Justified. There has been some criticism of Electricity's conduct of its protracted campaign against the General Electric Company by men who believed an attack justifiable, but whose sensitive souls shrank from the idea of doing anything more than condemning its policy on broad generalities. We have frequently labored with these critics privately, and have almost invariably convinced them that they were wrong and that Electricity was wholly right.

But in the progress of events the truth is coming out, and it is generally becoming evident to even the most obtuse observer that personalities were fully justified—nay more, demanded—if Electricity was to have any marked force in forming public opinion; and that is what we have endeavored to do, to enlighten the public as to just what the sham Trust was, what its success in selling stock meant in frightening capital away from electrical investments, and what its success in the trade would mean to honest competitors and to the public. We believed that the make-up of the company was disreputable, and honest men were handicapped in competition for business. We have therefore labored to spread the truth. That we have fully succeeded in our undertaking any one who mixes much with his fellow-men can easily prove by observation. The name of the company is despised and derided in the money centres and in the trade, and their business has utterly dissolved. They are totally wrecked, and in a worse condition than if legally declared bankrupt.

It is proper to inquire why this is so, and the only answer is found in the fact that the unloading of the stock on the public was little better than a swindle, and that the entire business machinery of the company has been honeycombed with corruption and rascality.

Honest men cannot engage permanently in a dishonest business, and dishonest and corrupt men must not be looked to to carry on a legitimate business. It was therefore the duty of Electricity to point out, not alone that the business methods of the General Electric Company were corrupt, but that men occupying the highest positions were corrupt, and must be cleaned out of the management before better things could be expected.

Garfield, the absconding Controller of the city of Detroit; McDonald, the wrecker of the Madison Square Bank; Sunny, accused of being a party to a $200,000 steal and discharging the man who discovered it, and Coffin, the bosom friend and confidante of all three, are object lessons which cannot be argued away.

The General Electric Company has failed because it deserved to fail, and because decency was not in it.

……

It is a good legal opinion that the entire Board of Directors of the General Electric Company could be indicted, tried, and convicted under the New York State statute which makes it a felony for any corporation to pay dividends which have not been earned and the payment of which impairs the capital stock.

……

It seems that Mr. Coffin has been told that his libel suit against Electricity was very heavily loaded. A few of us suspected as much six months ago, but we wonder where Fidus Achates found it out.

……

Electricity has made few prophecies, and those we have made have been fulfilled. We feel safe at this time in expressing the opinion that the merchandise creditors of the General Electric Company have no cause for anxiety. These bills cannot fail to be paid in full. A receivership, furthermore, seems very improbable, and if there is one it will be brought about by the undecided fight between Mr. Coffin and the respectable portion of the management. If there is any change in this situation, we shall be perfectly free in printing the news. The probable solution of the present difficulty is a reorganization, and a surrender by the common stockholders of 50 per cent. of their holdings.

……

The Sham Trust loses whatever of sympathy might be aroused by its pitiable plight by scratching and biting like a dying dog. The lessons of the long campaign of lamp litigation seem to have been utterly lost upon those brilliant intellects who thought the entire electrical trade could be bottled up. The decision in the Oconto case can scarcely be looked for now before January and the application for an injunction against the Novak people may not be decided so soon as that. Meantime we are in position to assure our readers that *the question of the time of expiration of the Edison patent will be rushed to an early decision.*

……

The Grand Jury has found indictments against nine men concerned in the wrecking of the Madison Square Bank. Among them, deeply implicated according to the findings, is Mr. R. T. McDonald, a gentleman who is not unknown to the readers of Electricity.

General Electric.

(*From the Boston Herald.*)

"Holland," the versatile writer of the Philadelphia *Press*, tells a General Electric story which many people will like to read. He says General Electric's peril last summer was probably greater than any of the other industrials, and the rich men who were associated with it made greater losses than in any other business investment. Mr. Morgan, D. O. Mills and F. L. Ames were enthusiastic about the property. Then came the fall in the stock, and the many stories to account for the great decline, but it has always been a mystery. The rivalries of the New York and Boston capitalists were never confirmed. The drop came in spite of Mr. Morgan's efforts, and he seems to have raised the white flag of surrender. He went into his own pocket to protect those who relied upon his name and invested in this property. The loss of capitalists must aggregate $10,000,000. One says he lost $2,000,000, another says $1,000,000, and Mr. Ames probably lost $3,000,000. A combination was made last spring to support the stock around 70, and here comes in one of the most confidential and dramatic of Wall Street stories. One day when the Street seemed combined against the stock the pool sent to Mr. D. O. Mills that it must have at least a quarter of a million dollars instantly if the stock was to be protected, and he must furnish it. Mr. Mills replied "But I can't furnish it, and therefore I shan't." A messenger was sent back to tell Mr. Mills that if he did not furnish this money he would be frozen out. Mr. Mills sent back word that he could not get the money without making a fearful sacrifice, and therefore he could not furnish it. It was suggested to go to Mr. Sage, but his unfriendly eye for Mr. Morgan prevented, and so that day witnessed the greatest fall in General Electric stock. Mr. Morgan about that time formed a new resolution, which is said to have been made by him with great emphasis: "Henceforth I shall never spend a dollar to maintain the price of a security upon the exchange, or to put the price to any figure. I have done with that forever. I shall attend to banking business and shall stand under no security." Soon after this a great block of General Electric was dumped on the market, and it would be very hard to find a capitalist who is not persuaded that this stock was Mr. Morgan's. Holland thinks Mr. Ames was killed by the fall in General Electric. He had 40,000 shares which cost more than 90, and below 40 Mr. Ames began to buy heavily, but his anxiety over the matter was greater than he could bear, and he died.

(*From the Boston Bulletin.*)

GENERAL ELECTRIC.

General Electric has been an especially weak sister during the last few days and has declined amid all sorts of rumors. This column was the first to expose the actual weakness of the company by a thorough analysis of its first annual report. The stock was then 105 and the press and everybody was bullish on it. Our original claims have since been justified, and there is no longer any reason or need to criticise the company's affairs. Nearly every one understands that its business has been scattered and has escaped through other channels, and that it has had continuous difficulty with maturing paper of sub-companies which it endorsed. That the Fort Wayne Company has already severed its connections with the General Electric, and that others are likely to do so at the January meeting.

The Street also has a fixed idea that this January meeting will produce other important results. It is thought that a plan of reorganization will be discussed which will include the scaling down of the capitalization. The payments of the preferred dividend in January is questioned and the sales of the stock this week "seller 60" have doubtless some significance. The General Electric knows now it made some grave mistakes, both as to the financial and business management of the company. Let it then gather itself together and begin afresh, trying to do less business, but more for cash than in the past.

Why They Will Give Thanks.

Various People for Various Causes, as Reported by our Divinator.

Charles Schieren—Because at least 100 of the 900,000 people in Brooklyn want no offices.

Edwin J. Houston—Because he sold his General Electric at 115.

S. Dana Greene—Because he does not know any less than he did a year ago.

C. H. Coster—Because all of Drexel, Morgan & Company's money is not in General Electric.

Henry Hine—Because Pittsfield is so near New York.

W. J. Johnston—Because the advertising public is so easily humbugged.

W. A. Kriedler—Because he is not eating turkey alone this year.

J. H. Rhotehamel—Because Trusts are not in it in Missouri.

C. A. Coffin—Because Ravvy was found out first.

R. T. McDonald—Because John R. Fellows, and not De Lancey Nicoll, will try his case.

E. I. Garfield—Because Electricity did not publish his record.

Robert Corey—Because he is no fatter than he is.

Charles D. Shain—Because he is not quite so fat as Bob Corey.

A. H. Reece—Because he is not half as fat as Shain.

T. C. Martin—Because Brother Johnston's guns were only loaded with mud.

Nelson W. Perry—Because he resigned the editorship of the *Electrical World* and once again has a clear conscience.

Paul T. Brady—Because he is no longer compelled to earn his daily bread by digging postholes in Cooperstown.

B. E. Sunny—Because his superiors are tarred with the same stick.

Many Others—The same.

H. M. Byllesby—Because he has got Sunny's job.

Pennock—Because there is a sucker born every hour.

Wellington Adams—The same.

Eugene Griffen—Because he can re-enter the army when General Electric busts.

Samuel Insull—Because there are no flies on the Chicago licensee company.

W. S. Barstow—Because he will soon be superintendent of the finest central station in America.

C. O. Baker—Because he has never known any reason for doing otherwise.

T. Carpenter Smith—Because he can say, like the late Governor of Wisconsin, "I seen my duty and I done it."

Lemuel Bannister—Because the Westinghouse Company has landed the choicest contracts of the year.

James Godfrey—Because the feeder patent can be knocked into smithereens.

Thomas A. Edison—Because the American patent system, notwithstanding its faults, made him a rich man.

Elihu Thomson—Because he was never in sympathy with the policy of extermination.

D. P. Perry—Because he kept out of all combinations.

Sigmund Bergmann—Because he got out at the proper time.

Edward H. Johnson—Because if the next president of the General Electric Company could be elected by popular vote he would be the winner.

A. D. Newton—Because the Eddy Company is working full time.

Sam Booker—Because he has been reconstructed.

James A. Roberts—Because the Democrats knew how to vote better than he gave them credit for.

John Muir—Because he made hay when the sun shone.

H. J. Smith—Because Nelson's is in easy walking distance from Pearl and Elm streets.

E. E. Bartlett—Because the electrical trade appreciates high art.

The Electrical Corporation—Because their millions of worthless bonds are at least unassessable.

Frank Sprague—Because he can survey the Edison wreck with perfect composure.

The Ames Heirs—Because they have escaped from Mr. Coffin's clutches.

H. S. Kaliske—Because all his eggs are not in one basket.

Dan Spruance—Because he is not compelled to spend all his time in Philadelphia.

E. J. Spencer—Because he is not as other men are.

Alex. Lewis—Because he is now working for an honorable concern.

John Seeley—Because he has boundless faith in the future.

Charles Huntley—Because his company is making money.

James Ayer—Because some other town will have to entertain the gang this year.

Eugene Phillips—Because the boys are all fond of clams.

John I. Beggs—Because he didn't lose all that he had.

O. T. Crosby—Because he gets credit for other men's work.

Siemens & Halske—Because they declined Mr. Coffin's million-and-a-half bonus.

Charles G. Curtis—Because even his competitors admit that he has got a good thing.

Parry Browning—Because it is a long lane that has no turn.

The Canal Mule—Because he has lost his job.

The Canal Boatman—Because the trolley is less dangerous than the hind legs of the mule.

Chicago Men—Because they don't live in New York.

New York Men—Because they don't live in Chicago.

Everybody—Because Electricity is published fifty-two times a year.

Electricity—Because it is better to be right than to be affluent.

CORRESPONDENCE.

To the Editor of Electricity.

Dear Sir: The article in Electricity of the date of November 22, in regard to the Ansonia Electric Company's affairs, was evidently written under a misapprehension, or in ignorance of the facts, and is therefore so apt to work an injury to the company's creditors and an injustice to the previous management of the company that it seems to the writer proper that you should be in possession of the actual facts of the case.

When through shrinkage of assets, losses by failures, and inability to make collections, owing to the general financial troubles and to the failure of the company from whom it purchased most largely its material, and with whom it had an established credit for same, and who were large holders of its notes, given in payment of such material, the Ansonia Electric Company was unable to meet its obligations it put its property under the protection of the courts, without a single attachment or preference of any kind, for the benefit of all its creditors alike.

The proposition referred to was made after a careful analysis of the character, condition and availability of the assets, and consultation with a number of the larger creditors and with their approval; and it involves the creditors' abating 40 per cent. of their claims to enable the company to continue business, and thereby realize for them, free of expense, 60 per cent. of same in cash. The whole amount is secured by assets held for them in trust, and unless same is paid in full in eighteen months the claims remain in full force, and it is thought the payments can be completed in much less time.

No one who has carefully investigated this matter questions, and it is a fact, that much more can be realized, and more quickly, by this plan than by liquidation of the company, with the sacrifices that would necessarily follow; and it is submitted to the creditors simply as a business proposition, whereby the greatest amount possible will be realized by the creditors, and an old-established trade saved to the stockholders.

It rests entirely with the creditors whether this plan be carried out or liquidation be enforced, and must be promptly decided. This proposition has already the approval of nearly all of the large creditors and a majority of the smaller ones, and in case it is carried through, the management of the company will be in the hands of a board of directors composed of men of the highest standing in business circles, and will include representatives of creditors. In view of these facts, the article referred to seems unwarranted, and, as before stated, evidently written under a misapprehension of the facts, and whatever action the creditors or any of them determine shall be taken, we wish them to understand now, what in case of liquidation they will surely realize, that we have in good faith presented a proposition involving the least possible loss to them through our misfortune.

The writer will in any case continue in the business, and has given his whole time since the failure to the creditors' interests; and even should they decide to liquidate the business, will assist wherever he is able in realizing the largest possible amount for them out of the assets.

Your truly,

November 25, 1893. J. B. Wallace.

Current Items.

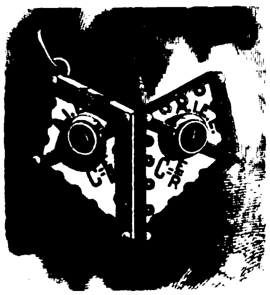
An apparatus which might apparently be of use in the arid sections of the West, which depend upon irrigation to render the land productive, is described in the Proceedings of the Institution of Civil Engineers of Great Britain as having been devised by Mr. Diendenne. It serves to indicate the water level in a reservoir, boiler, etc., at any distance by means of electric signals conveyed by a telegraph wire. The float is connected by a cord to the edge of a circular sector free to turn on its centre, and the pull of the cord is counteracted by that of a dead weight, so that the angular motion of the sector always corresponds to the rise or fall of the float. The sector is of metal, and passes over, in its rotation, a number of metallic arms equally spaced. The electric current reaches these arms through the sector, so that in various positions of the sector different numbers of the arms are in the circuit. Another part of the transmitting apparatus is a semi-circle of ebonite, on which are a number of metal plates, each of which is separately connected by wire with one of the arms above spoken of. On this ebonite plate is a radial arm, which, when it revolves, successively touches each of the metal plates. At the receiving station, when it is desired to know the water level, all that is necessary is to complete the circuit by pressing a button. Suitable electro-magnetic apparatus then causes the radial arm to travel over the ebonite plate, and in doing so the circuit is made and broken for a number of times, which indicates the position of the sector, and so of the float. A telephone is used to count the number of breaks in the circuit, and any degree of precision may be obtained by choosing the number of radial arms to correspond with any desired scale.

The Harrisburg (Pa.) *Independent* says: "It is the mission of the city electric railroads to build up all outlying villages in the near and distant suburbs of such centres of population precisely as it has been the work of the monster trunk lines of steam railroads to increase prosperity and population of cities through and along which they run. Any one who has carefully studied the progress in the improvement of Harrisburg has not failed to notice the steady system under which it has grown in population, real estate improvement and manufacturing and mercantile prosperity. Even the sudden appearance of a crisis in financial stringency could only temporarily check this prosperity, from which retarding influence the entire country is being also rapidly delivered. Our outlying villages and boroughs, now linked to Harrisburg by electric motor railroads, will have their first winter's experience this and next year, in being so closely connected with a centre of large population, in the advantage of which they all profit."

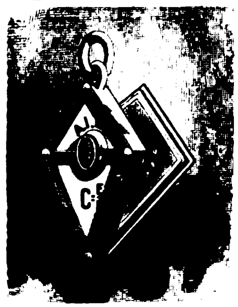
The San Francisco and San Mateo Railroad Company has met the necessity of relieving funeral parties of the tedious and fatiguing journey to distant cemeteries on hackney coaches by adding to its plant cars becomingly furnished for such service. A car lately put on the road for this purpose is not unlike a diminutive specimen of the regular passenger car of the steam railroads, the only marked difference being the long plate-glass windows of the mortuary chamber. It is a dark olive green, trimmed with gold, and the name "Cypress Lawn" appears upon the sides. The interior is fitted up in black walnut, with dark olive upholstery. The ceiling is done in blue and silver. The car is divided into two compartments. In one is the truck for the casket, with appliances for instantly bolting it to the floor, and in the other, separated from the casket chamber by a ground-glass door, seats for the mourners. It seats twenty-four persons in the passenger compartment, with room for twelve or fourteen more in the seats in the chamber with the casket. The car is pulled by an electric locomotive.

The A. I. E. E. Badge.

The Committee upon Badge and Certificate of the American Institute of Electrical Engineers has completed its labors, which have resulted in the adoption by the Institute of a standard pin or badge, that has already been described in these columns, and to meet with demands of certain of the members the badge has been made up in a number of different forms, illustrations of which we present herewith. These can be secured upon application to the secretary, Ralph W. Pope, 12 West 31st street, New York.

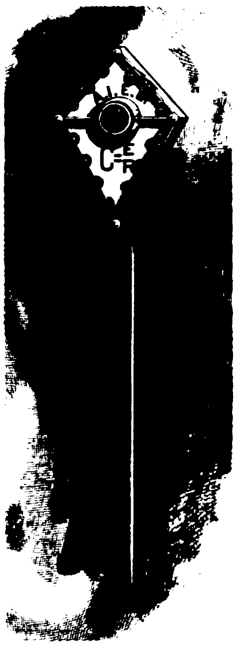


DOUBLE LOCKET.



DOUBLE LOCKET.

The exposed portions of these articles are made of 18 karat gold with a backing of 14 karat gold, and are of the same general character as the badge, of which several hundred have already been issued to members. The prices of the pin, lapel button, scarf-pin and watch-charm are alike, namely, $3; that of the single locket $8, and of the double locket $10.

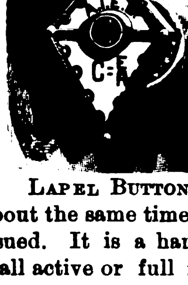


PIN.

SINGLE LOCKET.

WATCH CHARM.

The certificate of the Institute, which was adopted at about the same time as the badge, is now being issued. It is a handsome steel engraving, and all active or full members are entitled to receive it upon application to the secretary and upon the payment of $2 to cover cost of printing and engraving.



LAPEL BUTTON.

The Westinghouse engine which operated the electric dynamos at the World's Fair made 35,806,500 revolutions from the opening of the Fair up to October 30 without stopping. It turned five times every second and ran eighty-three days, two hours and fifteen minutes without a break.

Boston Notes.

The New England Street Railway Company, which owns and operates an extensive system of electric street railways, is to pay its regular quarterly dividend of 14 per cent. notwithstanding the extraordinary depression that has prevailed so long throughout the territory covered by the company.

This year the American Bell Telephone Company paid to the State of Massachusetts a tax of $147,432. This money, assessed by the tax commissioner and collected by the treasurer, is distributed among the towns and cities where the stockholders reside. About 80 per cent. of the stock is held by citizens of Massachusetts, so four-fifths of the tax is distributed in this way, and the tax on the other 20 per cent. swells the revenue of the State. This State tax of $147,432 indicates a valuation of $9,908,300 after a deduction of the market value of the shares of foreign corporations held by the American Bell Telephone Company May 1, 1892, and must indicate an asserted market valuation for these Bell telephone treasury stocks of $22,561,200. If these stocks were held by any other persons, natural or artificial, residing in the commonwealth, they would have been subject to taxation, and if discovered by the assessors might have yielded, at the average rate, $335,710.

We note with pleasure the gradual improvement that is taking place throughout New England in the electrical business. Accounts are being more promptly paid, orders continue to come in freely and everybody is growing increasingly happy. This statement, however, as a fact, does not apply to the General Electric Company, the disintegrating process having become quite chronic, and everybody identified with the Trust is agog as to what is going to happen next. The heads of departments, of whom there are very few now left, make no secret of the chaotic condition into which everything has drifted, and as the process of thinning out the ranks goes on apace, the inquiry goes round—"Whose turn is it next to go?"

Phillipsdale is the practical title by which in future the new factory of the American Electrical Works, Providence, will be known. It needs scarcely to be stated that the above name has been adopted as a compliment to Mr. Eugene Phillips, the genial and universally esteemed president of this prosperous company, whose guests the electrical fraternity have been year after year at the annual clambake on the beautiful Providence River.

The movement in favor of an electric road at Winthrop, Mass., is still agoing, and lively times are being experienced in that popular seaside resort. The younger citizens of the place, appreciating the advantages accruing from better transportation facilities, are very anxious to get a road put in before next summer, while the old residents, those who prefer to maintain things just as they were in grandfather's day, are up in arms against the suggested modern innovation, and so the fight is an interesting one.

There are at the present time in process of construction in Boston some of the largest and handsomest switchboards for theatre and central station work that have ever been built since electric lighting and power became a business. Boston is rapidly becoming one of the most important electrical manufacturing centres in the country.

The rubber insulated shield for application to the brake and motor handles on electric cars as a protection against shocks to the motormen has become a popular success. ELECTRICITY had the pleasure of introducing them to the railway fraternity for Mr. J. J. Lewis, inventor, Boston, and they have been adopted everywhere.

It has just been asserted by a local financier that the shrinkage in General Electric stock during the past few months has reduced the fortunes of Boston and New York parties who hold that stock by more than $10,000,000, and the shrinkage still continues.

A somewhat serious fire] occurred on Wednesday night in Eliot street, Boston, just at a point where is a very thick network of overhead electric wires. While the firemen were handling one of the aerial ladders it came in contact with the wires and became strongly charged with current, with the result that several of the firemen received severe shocks and had to be removed in a semi-unconscious condition. This experience has stirred up the fire underwriters and fire commissioners to the point where they are demanding that all wires shall be placed underground. A lively fight is anticipated.

General News.

What is Going on in the Electrical World.

Seattle, Wash.—The Union Electric Company, which has a 10,000 incandescent lamp lighting capacity, has added a 2,000 light machine to its plant.

Minneapolis, Minn.—A movement is begun here for the annulment of the lighting contract of the Brush Electric Company, and in favor of installing a municipal plant.

Utica, N. Y.—The Utica Electric Light Company has been awarded the contract for lighting the city for three years from January 1, at which time its present contract expires.

Halifax, N. S.—An electric road is needed here, and the newspapers are urging its construction, using the success of the electric street railway in Yarmouth as an argument.

Baltimore.—Some of the city papers are advocating the adoption of a municipal lighting system, and contend that the present lighting companies fail to give the city proper light.

Canonsburg, Pa.—The Electric Light, Heat and Power Company have about concluded contracts for boilers, engines and electric appliances, and will proceed at once to the erection of a power house.

Ottawa, Ill.—There is a growing opinion here that an electric road is needed between Ottawa and Marseilles, and will certainly be built unless the Rock Island Railway officials give Marseilles better service.

Newark, N. J.—A committee of the Board of Trade has recommended an electrical conduit system for Broad street, the principal business street of the city. Among those who favored its adoption was Prof. Edward Weston.

Holland, Mich.—The $12,000 electric light bonds have been taken by outside capitalists, and now the Detroit Electric Light Company will commence immediately to put in the city plant, both for street and commercial lighting.

Trenton, N. J.—Engineers representing the electric railroad syndicate were in Trenton last week overlooking the proposed route lying within the city limits for the road between Newark and Trenton. Surveys will be made in the spring.

Chillicothe, Ohio.—The affairs of the Chillicothe Electric Railway have got into a muddle, and the courts are now engaged in righting matters. The indebtedness of the road amounts to $110,000 in round numbers, and a sale of the road would not, it is said, realize that sum.

Montreal, Can.—The Street Railway Company laid over forty-five miles of track during the past summer, and the Park and Island Railway Company laid about eight miles of track to Back River in the latter part of the season. Both companies are using electrically propelled cars.

Yonkers, N. Y.—The dispute between the city and the electric road having been settled, the company intend to materially improve the service of the road. New cars will be put on, the capacity of the power house will be increased and the running time shortened. New lines are also contemplated.

Springfield, Mass.—The United Electric Company intend building a line from Winchester Park to Indian Orchard, for the purpose of conveying to this city a portion of the electric power produced at the temporary station of the company at Indian Orchard, where they have a water power of 600 H. P. already in use.

Natchez, Miss.—Mayor W. G. Benbrook of this city has published notice that sealed proposals will be received at the office of the city clerk until Thursday, December 7, at 4 P. M., for lighting the streets, alleys, parks and public buildings of this city with electricity for a term of five years from March 1, 1894, in accordance with plans and specifications on file in said clerk's office.

San Francisco.—There is some likelihood that when the new Mission street electric road goes into operation the storage battery system will be used instead of the overhead wires. Under the direction of the officers of the road experimenting with the storage system has been in progress for some time and it is thought now that so far as the batteries are concerned every obstacle has been removed.

Bel Air, Md.—The United States Automatic Service Co. have shipped from Boston to Bel Air generators for 650 incandescent lights and 300 arc lights with equipments, for the purpose of lighting Bel Air and for railroad uses. The same company has asked for a franchise for laying rails through Bel Air, with the view of connecting it with the proposed electric railroad from Bel Air to Havre de Grace and Aberdeen.

Goshen, Ind.—The franchises and street railway so far constructed of the Indiana Electric Power Company have been sold at receiver's sale to Hatch & Chadwick, the contractors, for $20,000. The court also granted an order for the sale of the electric street railway of Elkhart for $40,000. The sales are in the line of a consolidation of the two companies, and the connection of Goshen and Elkhart by an electric road next spring.

Little Rock, Ark.—The city council has appropriated $30,000 for a new city electric lighting plant. The ordinance provides for an entirely new plant, with a new brick, slate roof, fire proof building on the site of the old one, with four sixty light dynamos, two engines—one a new one—entirely new modern-high tension machinery: the old plant to be taken in exchange for the new as part, but additional, payment to the $30,000.

New Haven, Conn.—The stock of the Edgewood Avenue Street Railway has been transferred to a new set of owners, principally New York capitalists. The new officers are: President, Winthrop G. Bushnell, of New Haven; vice-president and general manager, Fred. S. Wardwell, formerly of Duluth; secretary and treasurer, W. A. Spaulding, of New Haven; directors, including the above named gentlemen, Judge David Callahan, Harry I. Thompson and John S. Bradley.

Leavenworth, Kan.—The city council and Receiver Newman Erb of the Leavenworth Electric Railway Company being unable to agree on a franchise, all the horse cars were stopped by the receiver on the 18th, he announcing that the company will abandon the present street railway until such time as the council will permit it to be converted into an electric line. The company is changing the dummy line between the Fort and Soldiers' Home into an electric line as permitted by an old franchise.

Rome, N. Y.—The contract for the lighting of the city by electricity will be let in the spring if the authorities do not decide before that to install a plant to be owned by the city, a project which seems to be favored by many prominent citizens. The city charter says that a contract shall not be let by the council to extend over a year, but an effort will be made at the next session of the Legislature to have a bill passed whereby a contract for lighting the city may be made for a term of years.

Milwaukee, Wis.—The plant of the Milwaukee Electric Power and Light Company was to be sold on the 16th inst. to satisfy a mortgage of $10,000, but a half hour before the time for the sale friends of the company put up the money and the sale was declared off. There has been a reorganization of the company.—The Milwaukee Arc Light Company has been incorporated with a capital stock of $100,000, by Gottleib Wenninger, Henry A. Adler and Bernhard Conrad. The business will be to furnish electric light and power. The new company will use the plant of the Milwaukee Power and Lighting Company, which it purchased.

Denver, Col.—The Greeley circuit was opened by the Colorado Telephone Company on the 15th, adding Berthoud, Loveland, Fort Collins and Greeley to the system. The following places are now connected by telephone in Colorado: Denver, Alma, Black Hawk, Berthoud, Boulder, Canon City, Cassels, Central City, Clifton House, Coal Creek, Colorado Springs, Como, Deer Creek, Erie, Fairplay, Fort Collins, Georgetown, Greeley, Golden, Idaho Springs, Jefferson, Lafayette, Leadville, Littleton, Longmont, Louisville, Manitou, Monument, Morrison, Nevadaville, Pueblo, Rockvale, Silver Plume, South Pueblo and Williamsburg.

Brooklyn, N. Y.—Permission has been granted the Broadway Ferry and Metropolitan Company to change its motive power from horses to electricity.—A patent has been granted to T. A. Remsen, of Brooklyn, for an automatic switch for street railroads, particularly those operated with electric power, though the invention may be used upon any kind of a car. The switch is operated by means of an inner tread on one of the wheels, which, as the car approaches the switch, presses down a lever rising on the inside of the track to the height of the rail.

Chicago.—The telephone girls of the Chicago exchanges have organized the Chicago Telephone Operators' Beneficiary Society, with the following officers: President, Allie Timms; first vice-president, Nora Wells; second vice-president, Emma Doolittle; treasurer, Julia McMahon; financial secretary, Mary Kelly; corresponding secretacy, Ida Sylvester; recording secretary, Carrie Babcock; inspectress, Lizzie Jackson; outside sentinel, Lizzie Lane; sergeant-at-arms, Irene Dover; chaplain, Sarah Elder.

Cincinnati.—The Gas Company, after a prolonged struggle, has been granted the right to furnish electric lighting for public and private use for twenty-five years for 20 cents per thousand watts.—The Board of Aldermen have passed a series of resolutions providing for the extension of existing electric lines of the Cincinnati Street Railroad Company over existing horse-car lines, and subsequently provide that all the street railroad lines in Cincinnati shall be equipped for rapid transit, fare to be five cents, and the city to receive 5 per cent. of the gross receipts of all routes.

Philadelphia.—The *Inquirer* says: "The great success of the application of the trolley system of motive power to canal boats exhibited at the test made on the Erie Canal, near Rochester, last Saturday, has had the effect of stimulating interest in waterway transportation, and the fact was developed yesterday that for some time past a survey of the canal of the Schuylkill Navigation Company has been in progress with a view to determining its availability for the introduction of the trolley system. The result has been to demonstrate that there is no canal in the country to which electric traction can be applied so successfully or so cheaply."

New York.—The stockholders of the Edison Electric Illuminating Company have decided to issue $1,750,000 new bonds under the mortgage held by the Central Trust Company. The new issue is for purposes of construction. It will be devoted to the completion of the new building at Pearl and Elm streets, and to construct the underground system.—The Park Board has received a communication from the General Electric Company of Chicago, requesting the board to examine an electric fountain used during the World's Fair, with the idea of having it erected in Central Park. It was referred to Superintendent Parsons.—The Telephone Subscribers' Association hope to induce the State Legislature to pass a bill at the next session to cut down the present rental charged by the Metropolitan Telephone and Telegraph Company for instruments, $240 a year, to a reasonable figure. The company claims that $240 a year is a reasonable rental, alleging that its net earnings for the last two years have not averaged six per cent. on the actual cost capital invested and that the dividend has been less than 7½ per cent.

Rochester, N. Y.—"Some additional experiments," says the *Democrat and Chronicle*, "were made with the electric canal boat at Brighton yesterday (20th) in the presence of City Electrician Barnes, acting for the State authorities. Under the direction of Electrician Chesrown, of the Westinghouse Company, the rigid street railway trolleys, which were used in the experiment on Saturday, were replaced by flexible cables provided with simple hooks to attach to the trolley wires. By the use of this simple expedient the electricians were enabled to manipulate the boat to much greater advantage than on Saturday. With the boat lying at the berm bank, the trolley hooks were passed out to the trolley wires by means of a pikepole, and the hooks placed in position. The boat was then backed into the channel by the operation of the motors, and sent up the line at the speed of about four miles an hour. It passed under the bridges and through the lock, no difficulty being experienced with the improvised flexible trolleys. The boat was steered from one side of the channel to the other, and at the terminus of the line was turned around and started on its return trip, without the aid of the tug or pike poles. At the eastern terminus the boat was brought to its mooring place without the use of appliances other than the flexible trolleys. The voltage was about 300, and the current was somewhat less than on Saturday, leaving the developed electrical horse power about twenty as on the official trial."

The Seesawing of Arc Lamps.

Where arc lamps are run two in series on incandescent circuits much annoyance has been caused by their interfering with each other's regulation, the result being an alternate feeding and separating of the carbons which has been termed "seesawing." For those who do not wish to go into theory of this action, the simple analogy in the accompanying cut may be interesting. It will be remembered that all lamps of this class have the feeding mechanism controlled by two magnets, one being on the main circuit and in series with the arc itself, while the other is a shunt around the arc. Then as the carbons burn away and the arc lengthens, the comparative resistance of the two paths for the current changes and allows the lamp to feed the carbon. In the case of series lamps the main current is kept practically constant by the dynamo or its regulator, and the voltage at the lamp varies. But with a pair of lamps on a constant potential circuit the sum of the voltages remains unchanged, so that the increased consumption at one lamp will rob the voltage from the other, and vice versa. In other words the left hand arc in the cut will have very little counter-electromotive force, so that most of the voltage will be left for the other one and will draw the right hand pair of carbons far apart. But this action exaggerates the difference in voltage still more, until the left hand arc touches its carbons and then separates. In this way one pair of carbons will approach while the others are separating, the action being just as if they had a mechanical lever suspension as pictured. Mr. George Cutter, of Chicago, holds this matter of seesawing to be one of the greatest problems met in adapting arc lamps to incandescent circuits, but he thinks it is well met by the peculiar design of the Waterhouse lamps, and it is said that users bear out his statement. At any rate the pictured analogy is interesting as showing a drawback which has at last been overcome.

THE SEESAWING OF ARC LAMPS.

Queen & Company's Non-Inductive Direct Current Wattmeter.

A dynamometer wattmeter constructed so as to work satisfactorily on alternate current circuits will work with equal satisfaction on continuous current circuits. The reverse, however, is not true. Masses of metal in proximity to the moving parts introduce no errors in continuous current measurements, but in alternate current measurements their presence becomes fatal. Aside from a metal case, small pieces of metal near the system, and even the binding posts on the outside, are likely to introduce serious errors. Not only this but the inductance and capacity of the fine wire or potential circuit must also receive consideration.

The instrument shown in the Figure is constructed on the inclosed dynamometer principle, the case being of brass mounted on a wooden base built up of a number of sections to prevent warping. The extra resistance, about 3,000 ohms for a 110 volt circuit, is wound non-inductively and in sections on wooden spools placed inside the base, which is suitably ventilated. Within the case, half of which may be easily removed, are to be found both the fixed and movable coils, the latter coil consisting of from 100 to 200 turns, depending on the range desired, of No. 34 copper wire wound on a light mica form. This coil is suspended from a rigid support by means of a fine phosphor bronze strip 1⅛ inches long, a spring being provided at the bottom for the return current. Suitable guides and a clamping device are provided, the former to prevent the coil from being used when slightly out of centre due to improper leveling. A spiral spring attached to the torsion head serves as the control. The upper end of the pointer attached to the system plays over the zero of the scale, the same as in the dynamometer. The use of mercury being entirely avoided renders the instrument perfectly portable, and the employment of a large amount of extra resistance, along with the delicately constructed and suspended system, reduces to a minimum the power consumed by the wattmeter itself, and at the same time leaves it quick to respond to any change in the power being measured. In order that the instrument may be applicable throughout a wide range of current, two pairs of fixed or current coils are provided, the one pair consisting of ten turns each with a carrying capacity of 25 amperes, and the other of one turn each with a carrying capacity of 250 amperes, placed over the other coils. Thus, either 25 or 200 amperes may be made to effect a complete revolution of the torsion head. The potential circuit may be made applicable to the higher voltages by the mere insertion of more extra resistance.

Premier Motors and Batteries.

M. R. Rodrigues, manufacturing electrician, 17 and 19 Whipple street, Brooklyn, has been actively engaged lately in making small electric railway cars to be run by his No. 1 Motor, an exceedingly interesting contrivance for the pleasure and edification of young folks who are fortunate enough to get them as presents during the holidays or at any other time. The car is about twelve inches long and the truck four inches gauge. It will carry over eight pounds at good speed. It is provided with a reversing switch of Mr. Rodrigues's design which automatically reverses current, and the car can run on straight, serpentine, horseshoe or circular track. The complete outfit, with eighteen feet of track, costs only $25.00. Samples can now be seen at the manufactory at above address.

Mr. Rodrigues's motors and batteries have a wide sale, and are highly approved by the trade. During the past week he has shipped motors and bluestone batteries to Central America, and has a large order for a full line of motors and the new No. 2 Premier Battery for a California State Fair exhibit.

The E. P. S. Company's Batteries.

The Birmingham Central Tramways Company, England, after trying plates of other manufacturers for more than a twelvemonth, decided to renew the whole of the battery with plates manufactured by the E. P. S. Company.

Two batteries of the original plates manufactured by the Electric Construction Corporation (the then owners of the E. P. S. patents), supplied more than two years ago, have been regularly working and giving excellent results. The following order speaks for itself:

Birmingham Central Tramways,
November 10, 1893.
To ELECTRICAL POWER STORAGE CO. LTD.
4 Great Winchester Street, E. C.

Dear Sirs: With reference to your favor of the 1st inst., we beg herewith to order from you on behalf of the Birmingham Central Tramways Company: 960 Positive Sections each of nine plates: 960 Negative Sections each of ten plates. Yours faithfully,

KINCAID, WALLER & MANVILLE.

The Worthington Condenser in Electric Lighting Plants.

Many of the plants that were erected during the early period in the history of electric lighting were located but the advice of qualified steam engineers or the benefit of advanced practice. The boilers and engines were not by any means the most economical, but answered well for time.

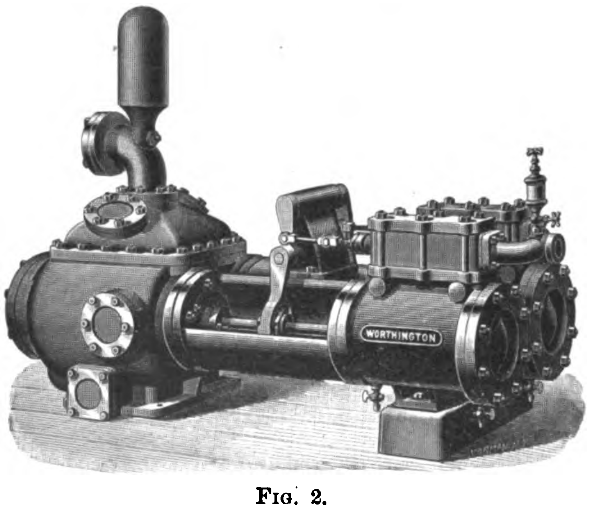


Fig. 2.

A large number of steam engines in electric lighting lants are situated so that an adequate supply of water can easily be had for condensation, but are at the present time non-condensing. They are laboring under a back pressure of 14.7 pounds that is caused by exhausting against the atmosphere, where they should by all means be run condensing.

The value of a vacuum to an engine under normal conditions is at a low estimate equal to 25 per cent. of the power developed by the engine running non-condensing. This means that by the use of a Worthington Condenser the coal consumption can be reduced one-quarter to one-fifth with the same production of light, or the number of lights may be increased a fifth without burning more fuel.

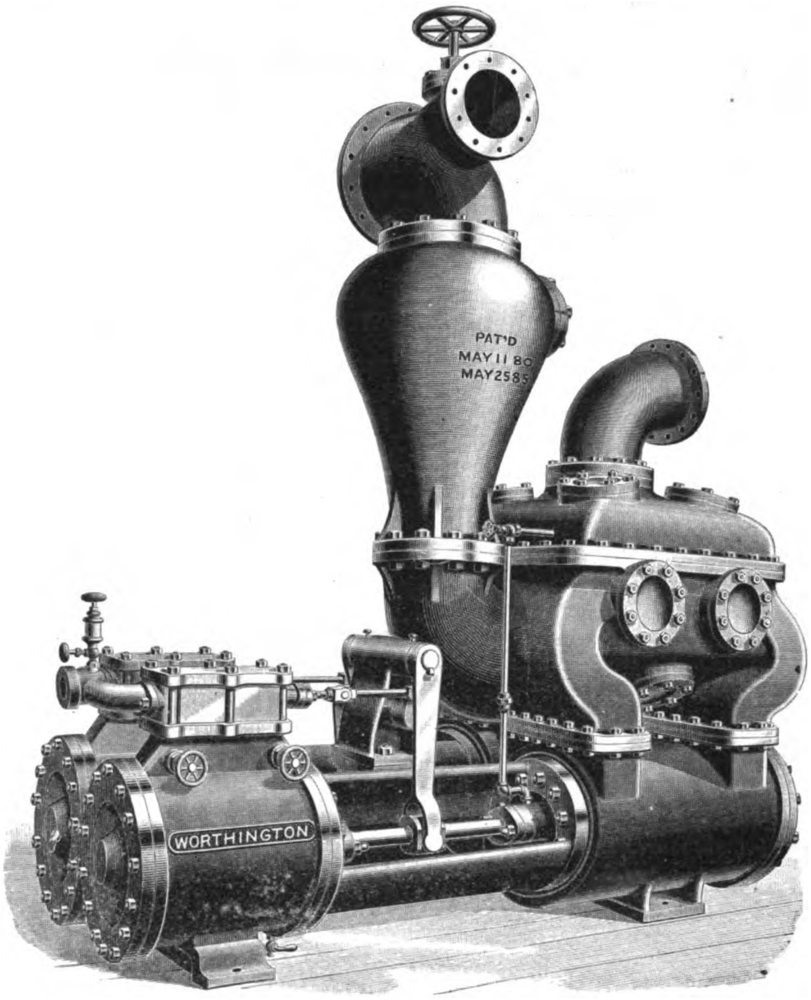


Fig. 1.

It is hardly necessary to more than intimate that this result is acceptable to any electric lighting company, and that this matter of Worthington Condensers, as an adjunct to dynamo engines, should have the most careful consideration.

In cotton mills the steam plants are carefully arranged and have the attention that is necessary to insure the highest economy, and condensing engines are quite generally used; but the money paid for coal is of small importance when compared with the value of cotton manipulated by the company. Flour mills are also large users of power, and every effort is made to have the fuel bill as small as possible, but still the much greater cost of the wheat places the cost of the coal in a secondary position.

With electric light and power companies, however, the thing is very different; the cost of fuel is the great expense of maintenance. By the combustion of coal a latent energy is aroused, which, through the agency of steam and the steam engine, becomes motive power. The function of the dynamo is to change this power into its equivalent electricity and electricity in turn produces light. This light is the material that the company offers for sale. The cost of the light is dependent primarily upon the cost of the coal, and any increased economy of the boilers or engines, improved belt transmission or dynamo efficiency, directly affects the profits in nearly like proportions.

Upon changing an engine from non-condensing to condensing it is found that the boiler pressure in many cases may be lowered fifteen to twenty pounds with nearly as high results. Doing this often lengthens the life of the boilers considerably, and is very desirable to such as have had long service.

Fig. 2 illustrates the ordinary Worthington pump having two double-acting pistons and fitted with water valves of rubber or metal as required. These pumps are designed for boiler feeding, fire, hydraulic elevator and general service.

Morse's Lightning Calculator.

Messrs. Cushing & Morse, General Western Agents for Day's Kerite Wires and Cables, 225 Dearborn street, Chicago, are distributing to the trade and friends a new device for determining at sight the size wire required for any number of incandescent lamps any distance from point of distribution. It is not a cumbersome book of tables, but consists of two cardboard disks on a single pivot. You simply multiply the distance by the number of lamps; the result is the number of lamp feet. You then turn your disk to the nearest corresponding number, and the size wire wanted, at any percentage of loss, is at once indicated.

As there may be many persons in their territory whom they unintentionally have overlooked, they desire that all such send their address to them and they will receive this really valuable article.

An Electric Car Elevator.

An electric car elevator has recently been placed in the Bartlett Street Car House of the West End Street Railway Company, Boston, which is probably the largest electric elevator in the United States.

The platform of this elevator is 40 feet long, 12 feet wide, weighs some five tons and carries a system of locks which support the platform at the floor, rendering it rigid while running on and off the heavy cars. The machine is supported on I beams directly over the wellway.

It comprises a system of gearing so constructed that friction is reduced to a minimum, and the power applied to move the load is distributed over the whole area of the platform.

The elevator is of very simple and efficient construction;

it raises the heavy cars quickly and easily, and is under the perfect control of the operator. It was built by Geo. T. McLauthlin & Company, 120 Fulton street, Boston, who have constructed a similar elevator for the Union Railroad Company, Providence, R. I.

Commercial Notes.

The Metropolitan Electric Company, Chicago, are receiving a great many orders for the Paiste Adjustable Clutch for T.-H. Arc Lamps. This is the only clutch made that can be adjusted to the carbon rod, and can never wear out. They are also selling the Paiste Lower Contact Bushing for T.-H. Arc Lamps. This bushing insures a perfect contact to the carbon rod without the aid of small brushes.

On December 1 Cummer, Craig & Company will consolidate their office, stock rooms and workshop at No. 69 Broad street, Boston, Mass. With increased facilities they will be able to exhibit the productions of the manufacturers for whom they are selling agents, to wit: American Wire Glass Manufacturing Company, Bishop Gutta-Percha Company, Crocker-Wheeler Electric Company, Frisbie Elevator and Manufacturing Company, General Incandescent Arc Light Company, Interior Telephone Company, Star Electric Lamp Company, Waddell-Entz Company.

INCORPORATIONS.

The Monett Electric Light, Power and Ice Company, Monett, Mo.—to manufacture electric light, power and ice. Capital stock, $50,000. Promoters: D. J. Young, Fort Smith, Ark.; J. F. Carr, Springfield, Mo.; W. T. Hamilton, Monett.

The Georgetown Water and Electric Company, Georgetown, Texas—to supply water, light, heat and power to the public. Capital stock, $100,000. Promoters: A. S. Fisher, W. K. Makemson, E. E. Taylor, J. W. Robertson, Georgetown, Tex.; W. L. Vining, Austin, Tex.

Wauconda Telegraph and Telephone Company, Wauconda, Ill. Capital stock, $2,500. Incorporators: A. J. Coykendall, Robert Harrison and others.

The Globe Electric Light Company, Portland, Me.—to manufacture and deal in all kinds of lamps for electrical and other uses. Capital stock, $300,000. Promoters: Reinold Berrenburg, Carl Bartels, Joseph P. Sprang, all of Boston, Mass.

The Home Industrial Association, Port Angeles, Wash.—to operate electric light and power plants, water works, etc. Capital stock, $50,000. Promoters: Geo. Venable Smith, J. F. Smith, Thos. Jarvis, J. E. Beam, Elliott E. Beaumont, Port Angeles.

The Freeland Electric Light, Heat and Power Company, Freeman, Pa.—to supply light, heat and power by electricity to the public of Freeland, etc. Capital stock, $15,000. Promoters: Fred. W. Bleckley, Scranton, Pa.; Harry E. Sweeney, Drifton, Pa.; Wm. H. Boyer, Scranton, Pa.

The Commercial Electrical Engineering Company of Detroit, Mich., has filed articles of incorporation. Capital stock, $50,000.

The South Jersey Electric Company, Jersey City—to generate and supply electricity to be used for motors, lighting and heating, and the manufacture of all machinery and appliances used in electrical business. Capital stock, $100,000. Incorporators: Dr. Henry A. Mandeville, William H. Curtis, Stevenson Constable, J. R. Weeks, Frank Brewer, Frank A. Wright and Charles A. Cregan.

The Conduit Construction Company, New York City—to construct electrical conduits in connection with electrical railways; to introduce improved methods of propelling street and tram cars by underground trolleys, and to replace street railroad tracks and install thereon improved devices for propelling cars electrically. Capital stock, $25,000. Directors: Thomas C. Buck, Charles W. Keep and Julien Meyers, of New York City; Robert L. Keon, of Montclair, N. J., and John J. Green, of Boonton, N. J.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED NOVEMBER 14, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

508,472. Fender for Electric Cars, etc. Caleb N. Homan, Lawrence, Mass. Filed Jan. 9, 1893.

508,538. Electric-Railway Trolley. James Chase, Rochester, N. Y. Filed April 8, 1893.

508,539. Electric-Railway Trolley. Stephen D. Field, Stockbridge, Mass. Filed March 2, 1891.

508 578. Conduit for Electric Railways. Archibald J. Robertson, New York, assignor to himself, George S. Brush, Brooklyn, and Henry Carey, Elm Park, N. Y. Filed Jan. 6 1891. Renewed April 4, 1893.

508,615. Electric Railway. John C. Henry, Westfield, N.J. Filed Sept. 10, 1892.

508,622. Electric-Railway Trolley. Walter H. Knight, New York, N. Y. Filed Aug. 10, 1888.

508,633. Electric-Railway Motor. Edward D. Priest, Lynn, assignor to the General Electric Company, Boston, Mass. Filed Feb. 23, 1893.

508,669. Trolley for Electric Railways. Norman C. Bassett, Lynn, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed July 18, 1892.

508,672. Switch for Electric Railways. Edward M. Bentley, New York, N. Y. Filed Aug. 31, 1889.

508,673. Brake Apparatus for Electrically-Propelled Cars. Francis O. Blackwell, New York, N. Y., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Sept. 16, 1889.

508,743. Electric-Railroad-Track Cleaner. Hugh O'Connor, Passaic, N. J. Filed June 26, 1893.

508,771. Construction of Trolley-Lines. George Q. Seaman, Brooklyn, N. Y., assignor to himself, Alexander Wilson and William Jones, same place. Filed July 22, 1893.

508,805. Electric Brake for Railways. Armand de Bovet, Paris, France. April 23, 1892.

508,807. Converter System for Electric Railways. Charles S. Bradley, Yonkers, N. Y. Filed May 31, 1887.

ELECTRIC LIGHTS AND APPLIANCES.

508,482. Electric Lamp for Bicycles. George Mayr, Brooklyn, assignor of one-half to Elkin Farmer, New York, N. Y. Filed March 27, 1893.

508,559. Electric-Lighting System. Theodore A. Willard, Norwalk, Ohio, assignor to the United States Wind Engine and Pump Company, Batavia, Ill. Filed Aug. 29, 1893.

508,616. Electric Car-Lighting System. John C. Henry, Westfield, N. J. Filed April 3, 1893.

508,623. Stand for Testing Electric-Arc Lamps. Edward R. Knowles, Middletown, Conn., assignor to the Schuyler Electric Company of Connecticut. Filed Nov. 29, 1892.

508,642. Search-Light. Albert L. Rohrer, Lynn, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed June 20, 1892.

508,647. Electric-Lighting System. Elihu Thomson, Swampscott, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Aug. 12, 1891.

508,656. Electric-Arc Lamp. Elihu Thomson, Swampscott, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Feb. 4, 1892.

508,659. Leading-In Wire for Incandescent Lamps. Elihu Thomson, Swampscott, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed May 23, 1892.

508,678. Apparatus for Treating Filaments for Incandescent Electric Lamps. Henry D. Burnett, Lynn, and Samuel E. Doane, Swampscott, Mass., assignor to the General Electric Company of New York. Filed Aug. 23, 1893.

DYNAMOS, MOTORS, ETC.

508,493. Method of Regulating Self-Exciting Alternate-Current Electric Generators. William Stanley, Jr., Great Barrington, Mass., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Filed Oct. 18, 1888.

508,624. Brush-Holder for Dynamo-Electric Machines. Edward R. Knowles, Middletown, Conn., assignor to the Schuyler Electric Company of Connecticut. Filed March 20, 1893.

508,630. Fluid-Pressure Device for Controlling Electric Motors. Horace F. Parshall, Lynn, Mass., and John W. Darley, Jr., Baltimore, Md., assignors to the General Electric Company, Boston, Mass. Filed May 6, 1893.

508,634. Mounting Armatures for Dynamo-Electric Machines. Edward D. Priest, Lynn, assignor to the General Electric Company, Boston, Mass. Filed May 15, 1893.

508,636. Connector for Dynamo-Electric Machines. Henry G. Reist and Jonathan P. B. Fiske, Lynn, Mass., assignors to the Thomson-Houston Electric Company of Connecticut. Filed July 3, 1891.

508,639. Machine for Boring out the Standards and Field-Magnets of Dynamo-Electric Machines. John Riddell, Saugus, assignor to the Thomson-Houston Electric Company, Boston, Mass. Filed Aug. 26, 1892.

508,649. Protection for the Insulation of Dynamo-Electric Machines. Elihu Thomson, Swampscott, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Aug. 26, 1891.

508,658. Dynamo-Electric Machine or Motor. Elihu Thomson, Swampscott, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed May 23, 1892.

508,710. Fan Motor. Warren S. Hill, Hyde Park, Mass. Filed June 7, 1893.

508,721. Alternating-Current Motor. John F. Kelly and Cummings C. Chesney, Pittsfield, Mass., assignors to the Stanley Laboratory Company, same place. Filed Jan. 16, 1893.

508,880. Electric Generator. Warren S. Hill, Hyde Park, Mass., assignor to the W. S. Hill Electric Company, Portland, Me. Filed April 12, 1893.

BATTERIES.

508,'51. Battery Element. William Mills, Elizabeth, N. J., assignor to the New York Carbon Works, New York, N. Y., and Newark, N. J. Filed Oct. 18, 1892.

508,897. Battery Element. William Mills, Elizabeth, N. J. Filed Nov. 11, 1892.

TELEPHONE AND TELEGRAPH APPARATUS.

508,829. Telephone-Transmitter. Eloy Noriega, Mexico, Mexico. Filed Feb. 4, 1891.

508,830. Electric Telephone. Eloy Noriega, Mexico, Mexico. Filed Aug. 25, 1892.

SWITCHES, SWITCHBOARDS, ETC.

508,625. Switch-Box for Controlling Electric Circuits. Edward R. Knowles, Middletown, Conn., and Edwin H. Park, Millbury, Mass., assignors to the Schuyler Electric Company of Connecticut. Filed March 31, 1893.

508,626. Stand for Controlling Electric Circuits. Edward R. Knowles, Middletown, Conn., assignor to the Schuyler Electric Company of Connecticut. Filed May 10, 1893.

508,638. Means for Regulating Multiphase Currents. Edwin W. Rice, Jr., Lynn, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Jan. 19, 1892.

508,641. Switchboard for Power-Stations. Albert L. Rohrer, Lynn, and George W. Mansfield, Melrose, Mass., assignors to the Thomson-Houston Electric Company of Connecticut. Filed March 5, 1891.

508,646. System of Electrical Distribution. Elihu Thomson, Swampscott, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Dec. 19, 1890.

508,838. Electric Distribution. Edwin W. Rice, Jr., Swampscott, assignor to the General Electric Company, Boston, Mass. Filed May 13, 1893.

508,839. System of Electric Distribution. Edwin W. Rice, Jr., Swampscott, assignor to the General Electric Company, Boston, Mass. Filed May 31, 1893.

508,898. System of Electric Distribution. Walter S. Moody, Lynn, assignor to the General Electric Company, Boston, Mass. Filed March 17, 1893.

TRANSFORMERS.

508,422. Current Transformer. William H. Hornberger, Elkhart, Ind. Filed Dec. 17, 1892.

508,650. Electrical Transformer. Elihu Thomson, Swampscott, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Aug. 28, 1891.

508,654. Cooling Transformer. Elihu Thomson, Swampscott, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Feb. 4, 1892.

508,655. Electric Transformer. Elihu Thomson, Swampscott, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Feb. 4, 1892.

508,688. Electric Transformer. Axel Ekstrom, Lynn, Mass., assignor to the General Electric Company of New York. Filed Nov. 16, 1892

MISCELLANEOUS.

508,489. Device for Indicating Synchronism. Charles F. Scott, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, same place. Filed Sept. 28, 1892.

508,518. Electric Door Opener. Harry T. Johnston, New York, N. Y. Filed May 19, 1893.

508,618. Underground Electric Conductor. John C. Henry, Westfield, N. J. Filed Aug. 8, 1892.

508,620. Field Magnet Coil and Method of Manufacturing Same. Joseph Johnson and Caryl D. Haskins, Lynn, Mass., assignors to the General Electric Company of New York. Filed May 2, 1893.

508,629. Safety Cut-Out. Olof Offrell, Middletown, Conn., assignor to the Schuyler Electric Company of Connecticut. Filed Dec. 5, 1892.

508,632. Electric Arc Disrupter. William B. Potter, Lynn, assignor to the General Electric Company, Boston, Mass. Filed July 13, 1893.

508,637 Armature Core. Henry G. Reist, Lynn, assignor to the General Electric Company, Boston, Mass. Filed May 24, 1893.

508,643. Connector for Electro-Magnet Coils. Martin O. Southworth, Lynn, assignor to the General Electric Company, Boston, Mass. Filed Jan. 31, 1893.

508,648. Lightning Arrester. Elihu Thomson, Swampscott, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Aug. 26, 1891.

508,651. Contact Apparatus. Elihu Thomson, Swampscott, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Sept. 17, 1891.

508,652. Electric Cut-Out. Elihu Thomson, Swampscott, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Sept. 17, 1891.

508,653. Insulating Composition. Elihu Thomson, Swampscott, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Nov. 2, 1891.

508,657. Reactive Coil. Elihu Thomson, Swampscott, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Feb. 15, 1892.

508,660. Detector for Electric Current Meters. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company of New York. Filed Nov. 25, 1892.

508,661. Electric Meter. Elihu Thomson, Swampscott, assignor to the General Electric Company, Boston, Mass. Filed May 12, 1893.

508,662. Indicating Apparatus for Electric Circuits. Elihu Thomson, Swampscott, assignor to the General Electric Company, Boston, Mass. Filed July 1, 1893.

508,674. Rheostat. John B Blood, Lynn, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Feb. 23, 1892.

508,680. Electric Elevator. Arthur T. Chase, Cambridge, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Dec. 16, 1891.

508,687. Cleat for Electric Wiring. Frederic A. Duggan, Trenton, N. J. Filed June 28, 1893.

508,691. Electric Elevator Controller. Jonathan P. B. Fiske, Lynn, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed July 18, 1891.

508,692. Rheostat for Controlling Electrically Operated Dental Apparatus. Jonathan P. B. Fiske, Lynn, assignor to the General Electric Company, Boston, Mass. Filed July 10, 1893.

508,804. Process of and Apparatus for Dissociating Salts of Alkalies by Electrolysis. Henry S. Blackmore, Mount Vernon, N. Y. Filed Sept. 8, 1892.

508,827. Magnetic Permeameter. Edgar D. Knap, Schenectady, and Severn D. Sprong, East Greenbush, N. Y. Filed June 28, 1893.

508,851. Electric Brake. Ernest B. Skinner, Ogden, Utah. Filed Jan. 21, 1893

508,871. Electrical Contact Making Device. William F. Z. Desant, New York, N. Y., assignor to the Desant Electric Company of Ohio. Filed Dec. 14, 1892.

508,887. Electrical Condenser. John F. Kelly, Pittsfield, Mass., assignor to the Stanley Laboratory Company, same place. Filed June 10, 1893.

RE-ISSUES.

11,386. Multiple Switchboard. Milo G. Kellogg, Chicago, Ill. Filed Dec. 8, 1890. Original No. 382,477, dated May 8, 1888.

11,387. Multiple Switchboard. Milo G. Kellogg, Chicago, Ill. Filed Jan. 8, 1891. Original No. 388,052, dated Aug. 21, 1888.

11,388. Multiple Switchboard. Milo G. Kellogg, Chicago, Ill. Filed Jan. 23, 1891. Original No. 393,508, dated Nov. 27, 1888.

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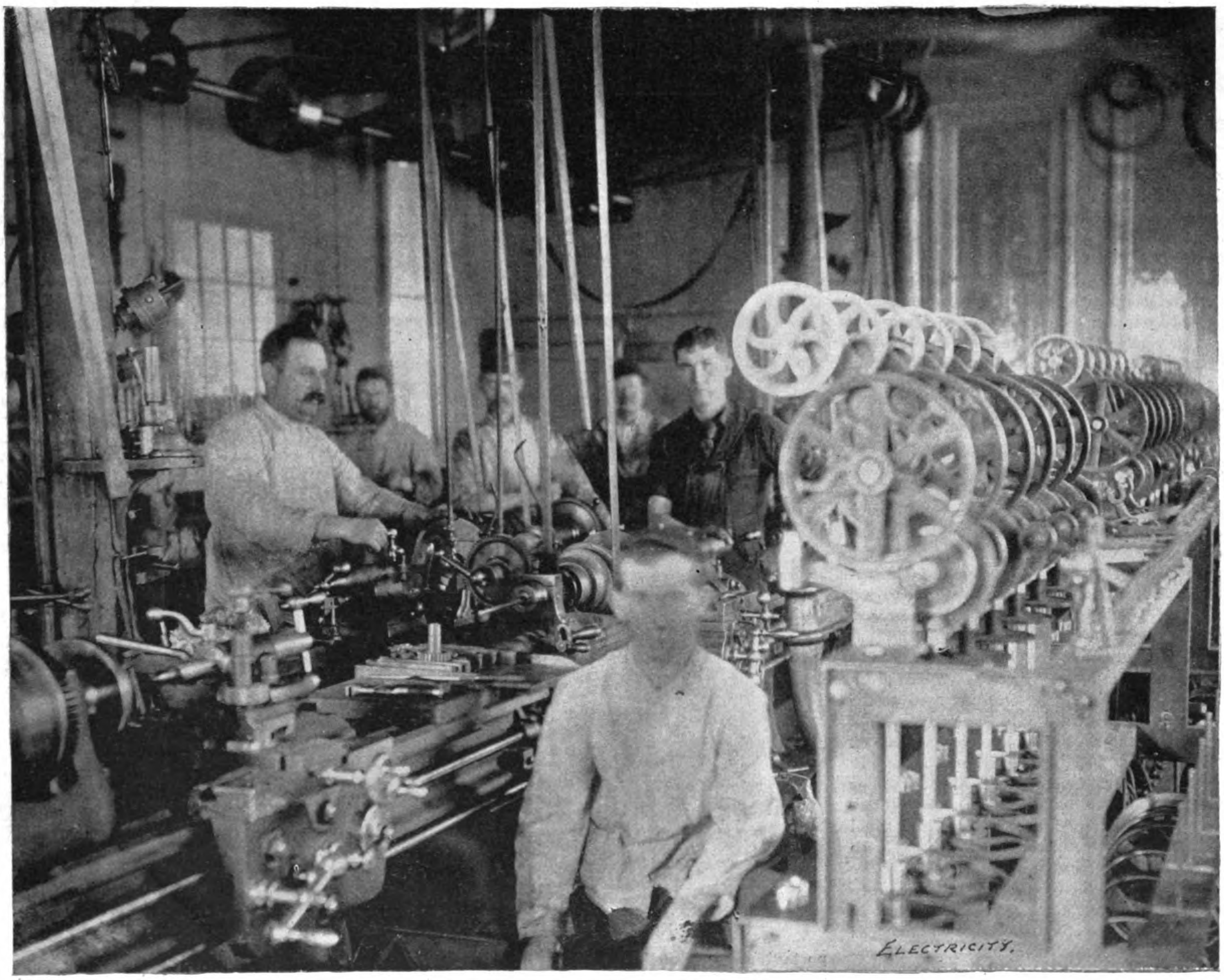
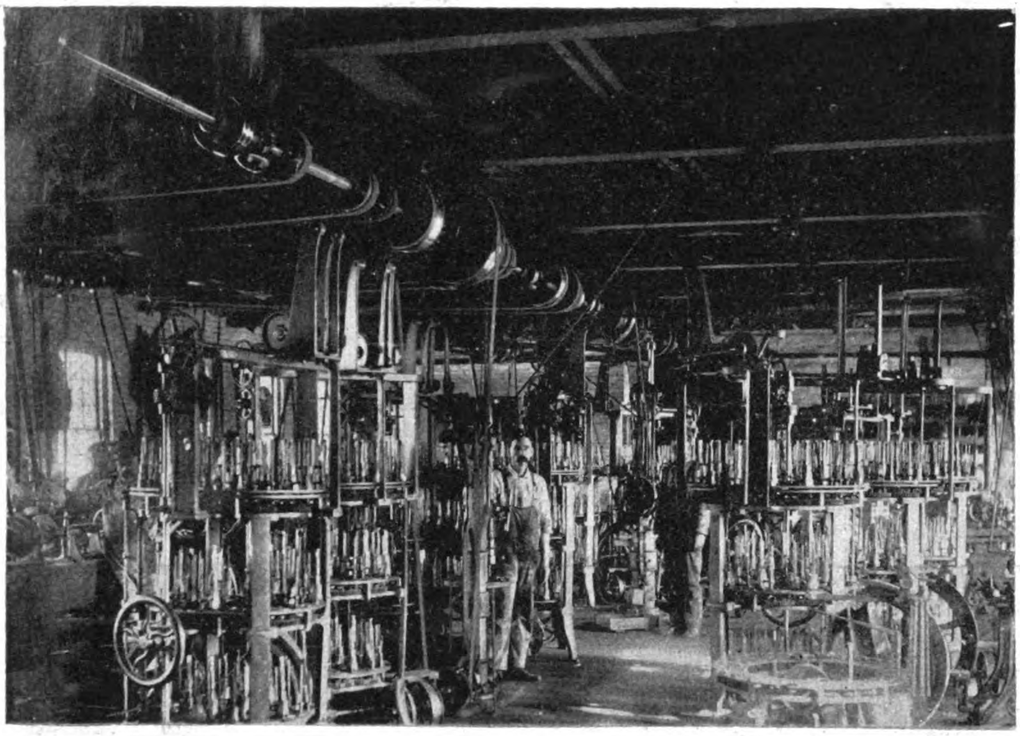


NEW ENGLAND BUTT COMPANY—MODEL ROOM. (SEE PAGE 246.)

New England Butt Company.

A Brief History of a Great Manufacturing Concern—Its Enterprise and Productions.

The city of Providence, R. I., is entitled to rank as one of the foremost cities in the United States for the diversity of its manufactures of an engineering and electrical character, its famous engines, electric cables and wires, fine engineering tools, locomotives and other apparatus being known all over the world. It was in Providence that some of the earliest engineering works and foundries were established, and the fine reputation made years ago is still maintained and is surpassed by none; hence it is that so many factories of various kinds have been equipped by the genius and skill that have found a habitation and a name in the capital of "Little Rhody."



New England Butt Company—Braider Machine Shop.

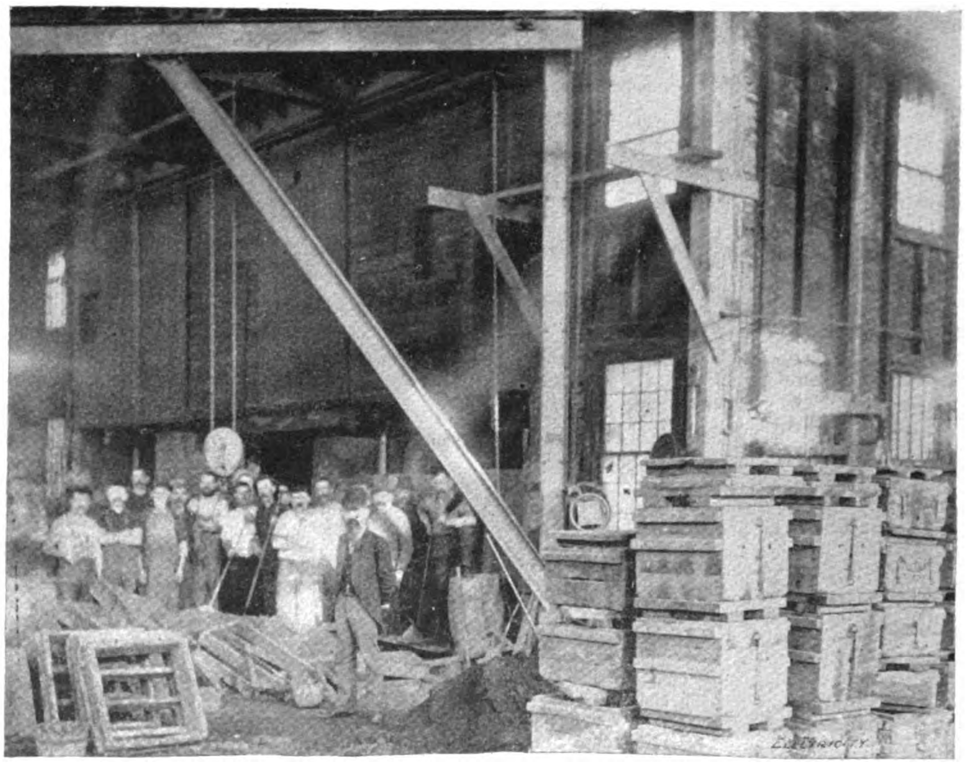
In Providence is located the well known firm whose title, familar to everybody, appears at the head of this article.

It is now over half a century since Mr. Nicholas A. Fenner established himself in Providence as a manufacturer of butt hinges, a specialty which was embodied in the original title of the concern and which is still retained, though the manufacture of that particular class of goods today forms but a small part of the large and varied business now done by this prosperous company. Fifty years ago this country had entered on that period of growth and development which has known few, if any, pauses in the march of progress. The laying out and building up of towns and cities from the Atlantic to the Pacific called for an enormous output of builders' hardware, and hinges formed an important item. To supply the extraordinary demand Mr. N. A. Fenner contributed largely by his genius, skill, enterprise and push. Soon the fame of his goods had reached everywhere and the market became so wide that his manufacturing facilities had to be constantly increased. Gradually he worked into other lines, and began the manufacture of a large variety of domestic or household appliances wrought in metal, until he ranked as the foremost in his line of business.

Then, as time rolled by, the manufacturing industries of the land required special machinery of many kinds, and so, gradually, the hinge factory became an engineering works of considerable importance. First-class engineers, draughtsmen, iron-founders and machinists only were employed. Inventors needing their inventions developed and perfected soon found that the managers of this company were the men with whom to trust their ideas, with the assurance that they could and would be worked out there satisfactorily if anywhere. Thus it was that the Butt Company rapidly expanded into one of the best and most widely known firms in the country, and enjoyed a measure of prosperity and success of which any firm might be proud. Then when the electrical business took tangible shape and bore evidence of some day becoming an important factor in modern civilization, the managing head of the New England Butt Company was not slow to appreciate the prospective possibilities of the new business, and began the designing and manufacture of braiding machines for covering electric wires. In this they soon became as successful as in every other department, and ere long had on the market some of the very best machines known to the trade. All and everything that human ingenuity could devise was incorporated in these various machines, and the demand for them grew rapidly. Everything in the shape of a machine for preparing wires, whether small or large, to be used for the transmission of the electric current was designed, made and sold; and so high class in material and workmanship, as well as efficient in design, were these special devices that they quickly assumed a foremost position on the market and commanded a ready sale everywhere.

This necessitated frequent enlargements of their facilities and the employment of more hands, until in a few years the works covered several acres. But the manufacture of braiding machines did not by any means exhaust the resources of this company. They branched forth into the manufacture of machinery for making cables, tapeing machines, both vertical and horizontal, for covering wires with adhesive tapes; also winding machines.

To attempt to describe any or all of these machines in an article like the present one would be impossible; they are so full of detail, so ingenious in construction and perfect in operation that they have been adopted by almost every manufacturer of electric wires and cables throughout the world. As we have said, these machines are made for covering wires of all diameters up to armoring of submarine cable and down to the finest magnet wires. These processes are carried on not with short lengths simply, but are so adapted that wires of any required length can be as easily manipulated. A great many of these machines have been made and shipped. Hundreds of them are now in use in South America, England, all over Europe, and even China and Japan are good customers. Machines are also made for the manufacture of fancy trimmings such as are now in such general use for ladies' wearing apparel—indeed, the machines of this company are adapted for every conceivable use.



New England Butt Company—A Corner in the Foundry.

Determined to keep up with the times, the New England Butt Company went more extensively into the electrical business, and with the extensive foundry they were running they undertook the manufacture of high-grade castings for all electrical purposes, and soon achieved distinguished success. One of their largest departments, both foundry and machine shop, is kept constantly running on electrical work; and having made a close and thorough study of the making of castings of the right magnetic quality for electrical work, this company enjoys an enviable reputation for this class of castings. They possess one of the largest and best equipped foundries in the country. Their mixtures of iron for the electrical business cannot be surpassed; and in the finer and smaller castings, as well as the larger and heavier ones, they do a business aggregating many hundreds of tons every year, and every one of their customers has learnt to know that the orders entrusted to the New England Butt Company will be filled in a manner that leaves nothing to be desired.

The Frontispiece and illustrations, showing interiors of some of the shops, together with a portrait of Mr. H. N. Fenner, son of the original founder of the firm, and now the treasurer and general manager of this prosperous company, will give some idea of the general character of one of the best known firms in the country, and one to whom the electrical fraternity is largely indebted for most valuable aid in the development of the great electrical industry.

H. N. FENNER,
Treasurer and General Manager of New England Butt Co.

A Mammoth Chimney.

The Division Avenue electric plant of the Brooklyn City Railroad Company is regarded as the largest in existence, and its massive chimney has taken its place among the wonders of the world. It surpasses every chimney known in the world in the size of its flue, the latter measuring 17 feet. The chimney is 332 feet 8 inches in height. At Glasgow, Scotland, there is a chimney 425 feet high, but its flue does not exceed 9 feet in diameter. The chimney at Frieberg, in Saxony, has a height of 552 feet 6 inches, but its flue is several feet less in diameter than the Brooklyn chimney. Other chimneys in this country exceed the Brooklyn chimney in height, but none is said to equal it in capacity. Thirty-six boilers will feed their smoke to the great shaft. These will run six engines of 1,000 horse power each. This is the minimum power, but each engine can be counted on for nearly 50 per cent. increase in that figure, which will make the combined power aggregate nearly 10,000. The big building, or series of buildings, which in conjunction with the boilers, engines, dynamos and the big chimney form the company's plant, has a fronting on the river of 281 feet. The depth from Kent avenue on the south side is 255 feet, the depth on the northern or Division avenue side is 216 feet, and the frontage on Kent avenue is 173 feet. Fully $60,000 has been expended in the erection of the chimney, and the total expenditure in the plant as a whole will approach $3.000.000. The consulting engineer of the work was F. S. Pierson and the chief engineer M. G. Starrett.

Electricity in the U. S. Weather Bureau Exhibit at the World's Fair.

BY C. W. SWOOPE.

A little to the west and north of the Government Building in the "White City" stood a small, neat, and apparently an insignificant building, known as the United States Weather Bureau Station and Exhibit. No doubt many passed this little building in their tour of the grounds, but the casual observer who chanced in ought to have felt well paid for his curiosity, for here the Government had gone to considerable pains to give the public an opportunity to see, understand and learn the mysteries of the Weather Bureau Service and just how "Uncle Sam's Prophets" decided what the future condition of the weather was going to be. The station was fitted up similarly to those established throughout the country, and all of the instruments were in actual working order, thus affording an excellent opportunity to those interested in meteorolgy.

We read naturally enough in the daily papers the reports and statistics of the Weather Bureau Service, but how few realize and understand how such results are obtained. It is in formulating and gathering these results that electricity plays such an important and useful part, much material progress having been made in the last few years, as will be seen in the instruments manufactured to-day for such purposes, which would not be possible were it not tor electricity.

One of the most interesting instruments on exhibition was the anemometer, used in measuring the force or velocity of the wind. It consists of two parts, the revolving vanes or anemometer proper and the graphical recording instrument.

The former consists of four hollow hemispherical cups, the concave parts facing in the same direction around a circumference, mounted upon cross arms at right angles to each other. At the intersection of the cross arms they are fastened to a vertical axis suitably supported but free to move with a small amount of friction. Upon the lower end of axis is an endless screw which gears into a train of wheels connected with a dial in such a manner that every revolution of the axis is mechanically recorded. The relation between the speed of the revolving cups and the wind is known, so that the dial is calibrated to read so many revolutions of axis equal to one-mile wind velocity. The dial so records this, and at every mile (so many hundred revolutions, as 500) electrical contact is mechanically made with two wires leading from this exposed instrument to the recording register located indoors. The latter consists of a drum actuated by a clock mechanism, an electro-magnet, and a recording pen influenced by armature of magnet; upon the drum is fastened a ruled paper scale, upon which the record is recorded. Thus, the drum revolves a certain space per period of time, and each mile wind velocity being recorded, we have upon inspection of a record the rate of wind velocity in miles per hour, etc. Scales are prepared for drums to be replaced every twenty-four hours, or a weekly record may be taken by slowing down speed of drum, fifty-two records being much more readily handled than three hundred and sixty-five sheets of paper. The instrument or registering portion much resembles some forms of graphical recording voltmeters now upon the market.

The anemoscope, for indicating the wind direction, utilizes the electric circuit in a similar manner for recording the directions graphically. The common form of weathervane in shape of an arrow is used. Upon the lower end of the vertical revolving axis is mounted a body upon which are four cams; leading off spring contacts press upon each of these, and the cams are so adjusted with reference to the position of the vane that for each particular position, such as north, an electric circuit will be completed through one of the sliding contacts; thus each of the four cardinal points of the vane completes a separate circuit through the sliding contacts. The contact spring is quite novel and somewhat different from the brush used on small dynamos. A roller or disc is mounted on a shaft held in place by two arms and a spring pressing against the same; thus while the cams revolve in one direction, the discs revolve in the opposite direction. It was designed to eliminate friction loss. Such a form of sliding contact might be used as a brush for dynamos, but its disadvantages would most likely outweigh its advantages.

The recording register, besides the drum and clock mechanism, contains four electro-magnets, one for each of the four circuits, north, east, south and west. One pole of the battery passes direct to the four cams, while the other goes to a switch in the clock, and is then completed through the magnets and contact springs. The switch in the clock is closed and again broken each minute, thus influencing the recording pen in a particular direction according to the electro-magnet in circuit. On open circuit the pen produces a straight line; thus is given the graphical record of the wind direction on one sheet of paper every minute for a day or week as the case may be. Combining the records of the anemometer and the anemoscope, we have the rate of velocity of the wind in every direction.

Two forms of instruments were exhibited for recording the hours of sunshine. In one the sun was permitted to pass through a small aperture in the instrument and affected a sheet of sensitized paper in different portions for the various angles of the sun. Upon being developed the paper showed a line, the intensity of which indicated the record of sunshine.

A more interesting instrument was the electrical sunshine recorder, recently invented and adopted by the U. S. Weather Bureau. This instrument is composed of a glass tube with a small bulb blown at each end, and the principle upon which it works is essentially that of a differential thermometer. Each bulb contains air, the two being separated by a small column of mercury, and upon the lower bulb is a heavy coating of lampblack. When the instrument is exposed to the rays of the sun the lower bulb receives more heat than the upper one (by virtue of the absorbing power of the lampblack), and thus causes the air in the lower bulb to expand more than the top, and the mercury consequently rises. This, through leading-in contacts sealed in the glass, completes an electric circuit through a register, as already described, and at minute intervals a record is made. Of course, when the sun is not shining the record is a straight line.

The rain or snow gauge is also dependent upon electricity for its operation. In one form, styled the tipping bucket gauge, a small pair of buckets is mounted upon a knife-edge, the point of support being below the centre of gravity. As the bucket is filled it tips and discharges, the other one being brought immediately under the delivering nozzle; thus a tipping backward and forward motion, and with every discharge an electric circuit is completed through the register and recorded in the usual manner. An improved form of weighing rain and snow gauge quite recently invented is considered quite an achievement of ingenuity among meteorological instruments. It works upon the principle of the balance beam and is always in equilibrium. Upon one end of the beam is a bucket, and a very few drops of water depresses the beam far enough to discharge same and also completes an electrical circuit through the recording register; the register at the same time closes another circuit through an electro-magnet, which restores the beam to equilibrium.

Each $\frac{1}{100}$ of an inch of rainfall is recorded, and an equal amount in weight of hail or snow.

Registers are made so that they may record several of these meteorological events on the same instrument, and are accordingly styled double, triple, quadruple, etc., thus utilizing one clock movement mechanism, drum, etc., for several records, which is a great advantage in that it eliminates time error corrections. Instruments may be used for simultaneously recording two different anemometers for comparison, or two rain gauges, one anemometer, rain gauge, sunshine recorder and anemoscope, etc. Only a few cells of battery are required, preferably of the closed circuit type, as gravity, depending on the distance of register from instrument, and several circuits may be connected together.

Numerous other instruments exhibited, although not depending on electricity, were very interesting, such as the barograph or recording aneroid barometer, recording the barometric pressure by means of expanding and contracting vacuum shells actuating levers attached to a pen, on drum; the thermograph, graphically recording temperatures by expansion and contraction of a glass tube containing alcohol; psychrometers, polymeters, hygrometers, etc.

Recollections of Werner Von Siemens.[*]

III.—The Stirring Events of 1848.

[Upon the uprising in Schleswig-Holstein against the Danes in 1848 Von Siemens conceived the idea of defending the harbor of Kiel by submarine mines. The Government approved of the idea whenever war should be actually declared.—Ed.]

I employed this waiting-time in making preparations. Large and particularly strong canvas-bags rendered watertight by caoutchouc were got ready, each capable of holding about five hundred-weight of powder. Further, wires insulated in all haste and exploding contrivances were prepared, and the necessary galvanic batteries procured for firing. When the departmental chief in the War Office, General von Reyher, in whose ante-room I daily waited for the decision, at last made the communication, that he had just been appointed Minister and, war having been resolved against Denmark, that he granted me the desired furlough as the first act of hostilities against Denmark, my preparations were almost completed, and on the same evening I left for Kiel.

In Altona, where great excitement prevailed, my brother-in-law Himly already awaited me; a special locomotive took us to Kiel. The news of the declaration of war by Prussia had already become known, but was still considerably doubted. My appearance in Prussian uniform was rightly taken as evidence of the longed-for fact and excited on the whole way to Kiel and in the town itself unbounded joy.

My brother-in-law in Kiel had meanwhile made all the preparations in order to proceed quickly with the laying of the mines, as the appearance of the Danish fleet was daily expected. A ship-load of powder had already arrived from Rendsburg, and a number of large casks stood ready, well calked and pitched, in order to be provisionally used instead of the still unfinished caoutchouc bags. The casks were as quickly as possible filled with powder, provided with fuses, and anchored in the rather narrow channel in front of the bathing establishment in such a way that they were buoyed twenty feet under the surface of the water. The firing-wires were carried to two covered points on the shore, and the course of the current so disposed that a mine must explode if at both points simultaneously contact was made.

At both places of observation upright rods were set up and the instruction given that contact must be made if a hostile ship took up a position in the direct line of the rods and remain made until the ship had again completely removed from the right line. If contact of both right lines were at any moment simultaneously made the ship would be exactly over the mines. By experiments with small mines and boats it was ascertained that this exploding arrangement acted with perfect certainty.

There now began a right cheery life in the fort. My citizen-troops did their duty conscientiously. On organizing the service I found to my surprise among the men members of well-known noble families of Schleswig-Holstein and respected citizens of the town of Kiel. They all however submitted implicitly to the command of a young Prussian artillery officer of their own selection. I had the ramparts cleared, the embrasures repaired, and the old cannons placed on such platforms as remained. The powder magazine was put in order and a stove erected by Kiel artisans for making the balls red hot. I was especially assisted in this work by my man Hemp, (who without orders had followed me from Berlin,) an intelligent, able fellow, who subsequently accompanied me in all my telegraphic undertakings and finally became chief engineer of the Indo-European telegraph line, which position he occupied till last year. With his help the men serving a gun were hastily trained, so that on the third day after the occupation we could essay a first shot, which announced far and wide the military occupation of Friedrichsort.

Arms, ammunition and military insignia I obtained from the ever helpful commander of the town, whose name unfortunately has escaped my memory. My corps of volunteers was recognized by the provisional government, and also received the usual pay. In the military training of the folk my before-mentioned man Hemp, whom I named chief of the artillery, again rendered me signal service. The cannons were certainly old and bad, but a short 24-pounder and a howitzer were still serviceable; the Danish blockade ship, which no longer left the harbor-roads, seemed somewhat to respect the red hot balls, which we always sent her when she came within range.

One morning we were alarmed by the announcement that three large Danish men-of-war were lying in the roads. It seemed indeed as if an attack on the fort were intended, which, considering its bad condition and equipment, would have had the chances in its favor. The weakest point of the fort was the entry gate opening on the inner harbor. The drawbridge was out of repair, the moat was dry and the ravelin protecting the entry only remained in its outlines. As meanwhile my brother-in-law Himly had partially replaced the casks temporarily employed for the mines by the indiarubber bags that had arrived from Berlin, I ordered one of these now superfluous casks to be towed to Friedrichsort, in order to be there used as fougade for the defence of the fort gate. The day before the alarm I had had a deep pit dug in the middle of the old ravelin and the cask lowered therein. As night had come on before this work was finished, the pit remained open and was guarded by a sentry. When next morning the alarm occurred, I commissioned my brother Frederick—who, as subsequently my brothers William and Charles, had followed me to Kiel and Friedrichsort—to prepare the firing communication, to enable the mine to be exploded in case of an attempted storming of the ramparts.

The ships had now really approached within range. My three serviceable cannons were manned and the oven for heating the balls in full activity. I prohibited firing, however, before the ships forced the entrance. The rest of the men I had collected in the fortress yard to distribute them and exhort them to bravery, when suddenly before the fort gate rose a vast fire sheaf. I felt a violent compression succeeded by a violent expansion of the chest; the first sensation was accompanied by the clatter of broken window panes, and the second by the elevation of the tiles of all the roofs to the height of a foot and their subsequent fall with a dreadful din.

Of course it could only be the mine, whose explosion had produced the mischief. I thought at once of my poor brother Fritz. I ran to the gate to look after him, but before I reached it he met me uninjured. He had prepared the mine, set up the battery on the *terre-plein*, connected the one igniting wire with the one pole of the battery and fastened the other to the branch of a tree to have it ready to hand, and was about to announce this when the explosion occurred, and the atmospheric pressure hurled him down from the rampart into the interior of the fort. The rather violent wind had shaken the second firing wire from the tree, causing it to fall just on the other pole of the battery and so producing the explosion.

With the sentry, who was standing on the breastwork of the ravelin when the explosion occurred, it had fared worse. I found him on the other side of the pit lying on the ground apparently dead, beside him his gun buried half barrel length in the earth bayonet forward. The powerful draught, caused by the mine exploding in the open pit, had evidently caught the man up and hurled him over the crater of the mine. Fortunately, however, he had clutched his gun convulsively, and thereby the blow in falling was mitigated. The man came again to his senses after the lapse of an hour; he bled indeed from mouth, nose and ears, and then became blue over the whole body, but was otherwise uninjured and after a few days again fit for service. The Kiel military doctor, who had hurried to Friedrichsort on the announcement of the appearance of the Danish squadron, and was crossing the drawbridge at the moment of the explosion, was more seriously injured. He was thrown with his vehicle into the rampart moat and had received a few contusions. The cook too, who was just carrying up the steps of the ground floor a bowl of soup and was thrown down by the explosion, was severely scalded.

Extremely remarkable were the mechanical effects which the explosion produced in a wide circuit. It must be considered as a shot from an open earth-formed tube with a charge of five hundred-weight of powder. In the entire fort no space of any extent remained closed. Either the atmospheric pressure had pushed in the doors or walls, or where they resisted the ensuing vacuum had burst them asunder. The window-panes even in the villages of Laboe and in Holtenau were broken. The differential pressure must in the interior of the fort have amounted to at least an atmosphere, otherwise it could not have produced such effect at so great a distance.

When I returned to the place where I had left my troop I found it deserted, and feared that the people in their first terror had dispersed and crept away. I soon however saw to my delight that they had all betaken themselves to their assigned places. They had imagined that a Danish bomb had struck and the attack had begun.

The Danish ship had however determined to proceed no further, returned to the outer roads, and soon abandoned these also with the exception of the blockade-ship. In the Copenhagen newspapers it was shortly afterwards reported that one of the submarine mines with which the harbor of Kiel was paved had accidentally exploded and destroyed the fort. Indeed the view from the ships must have been rather astonishing. The red tiles of all the buildings of the fort protruded over the low ramparts, and rendered them particularly conspicuous. Immediately after the explosion however all the tiles had fallen down, and no houses were any longer visible.

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[*] Selected from "Personal Recollections of Werner Von Siemens," recently published in America by D. Appleton & Company, New York, 416 pp., 12mo, uncut edges, wide margin, photogravure portrait.

That the Danes had acquired considerable respect for the mines is proved by the fact that in spite of the notorious weakness of the artillery defence of the Kiel harbor during both Schleswig-Holstein wars no Danish ship ventured into it. Although these first submarine mines never came into action they none the less accordingly played a very important part, I may therefore with justice complain that later military writers have completely ignored this first harbor defence by the help of submarine mines, carried out in view of the whole world and at the time much talked about. Even German military writers have subsequently ascribed the invention to Professor Jacobi in St. Petersburg, although his experiments at Kronstadt were carried out many years later, and he himself never dreamt of disputing my claim to the invention and its first employment in war.

When after conclusion of peace the mines were fished up and lifted, the powder in the caoutchouc bags was found still dry as dust, despite the two years soaking in sea water. It is thus not doubtful that, had occasion offered, the mines would have done their duty.

(To be continued.)

Modern Uses of Electricity—IV.

ELECTRIC LIGHTING.

This was the subject of Prof. Cross's fourth lecture in his course on "Modern Uses of Electricity," in Huntington Hall, Boston, November 13, and the lecturer in entering upon his address said that in a previous lecture he had alluded to a modification that had taken place in the building of dynamos, which modification meant that much more iron was now used in their make than formerly and less copper. The idea of a magnetic circuit with iron in the field had been early wrought out by Hopkinson in England, and was now very general in practice. At the same time it was difficult to lay down any hard and fast rules for making dynamos. It was about nine years ago since the change was first made; now the art has reached the point where it would appear that no further great change was possible.

Michael Faraday was the first to set forth the fact that if you have a current passing through a coil of wire there is an E. M. F. or lines of electric flow. Faraday had an idea also that different substances possess different resistances to the flow of such magnetic lines of force. That is, if we compare air with iron when the magnetic field is in air strongly excited the proportion is about 10,000 to 1.

Reluctance in the magnetic field is equal to the resistance in the electrical field, whereas for a steady current the resistance of a substance is a constant. That, however, is not true of the magnetic flow. If we multiply the magnetic flow by the same number of turns and the flow of current, it will be found that the iron produces saturation. If you double the magnetic lines of force you increase the strength 10 per cent. or 15 per cent. according to the iron or strength of the field.

Certain substances, as for instance brass, do not have any such change in their reluctance when their magnetic force is increased. Bearing that in mind, supposing we had a coil through which a current is flowing. You put a bar through it and the lines of force will flow round from one point to the other. The closer the poles are brought together the less will be the reluctance of magnetism. Increasing the section of a coil reduces the reluctance and increases the magnetic lines of force. This principle is what has led to the changes in the manufacture of dynamos.

The machines thus far discussed are what are called bi-polar machines, and which have no more than two poles. There is no reason why two poles should be the limit, for it is possible to have four or more poles. By using suitable commutators as many as four brushes may be used. The Gramme ring may be considered as two batteries coupled together.

A large number of different types of dynamos were then shown on a screen, the lecturer expatiating at length on their distinctive features as they were exhibited.

Proceeding next to a consideration of the electric arc, Professor Cross said that the arc light was the most brilliant artificial light known. Fifty years ago it was a rarity, to-day it was to be seen in all our streets. In considering its peculiar characteristics, it were well to bear in mind that an arc could not be produced except with a current of 40 volts or more potential, generally it was 60 volts. It was possible to produce an arc of immense candle power—those in general use were rated as of 2,000 C. P., though the term C. P. was really only a nominal term. Under varying conditions the brilliancy of an arc light varied very materially. In an arc light, as would be seen by reference to the spectra of an arc light and of the sun, there was more color than in the latter luminary. The reflection of an arc light was thrown upon a screen, and the varied brilliant phenomena, the crackling noise, the flying particles of incandescent carbon, the difference in form of the opposing ends of the carbon pencils, together with the rich colors in the atmosphere surrounding and in the interior of the arc were shown and fully explained, to the delight of the large and attentive audience.

The Westinghouse Company Wins.

The contract for ninety car equipments for the big Consolidated Road of Cleveland has been awarded as follows: Westinghouse Company, 50; Steel Motor Company, 20; General Electric Company, 20.

This is a decided victory for the Westinghouse Company, this system having been among the oldest customers of the General Electric and Edison Companies.

The fight for the contract was closely contested, Capt. Eugene Griffen looking out for the General Electric interests, and Mr. Lemuel Bannister appearing for the Westinghouse Company.

A Stationary Detective.

Electricity Applied to Thief-Catching.

For some time the firm of Foster, Stevens & Company, Grand Rapids, Mich., has been a loser by persistent robbery. A few days ago a detective arranged a photographer's camera focused on the cash-drawer. An electric connection was fitted to the drawer and the camera so that when the drawer was opened the shutter of the camera would be operated and the same instant a calcium-light would be flashed. The robbers when they pulled out the till were startled by the flashlight, but as no demonstration followed, they finished their work. The suspects were arrested, and when confronted by the photograph taken during the flashlight exposure, they broke down and made a full confession.

An Automatic Time Recorder.

An automatic time recorder for use in horse races, bicycle races, etc., has been invented by Mr. Alfred Bartlett, of New Zealand. The mechanism is enclosed in a cylindrical case, on the top of which is fixed a horizotnal dial, which is divided into 60 seconds, and each second is subdivided into fifths, while a smaller dial registers the minutes. An outer circle has a number of stops, numbered from 1 to 60, and is brought into use in starting for events in which the time system of handicapping is required. In connection with the "clocking" machine is an electric battery with bell attachments, which is fixed at the starting point while the time recorder is placed at the winning post. The mechanism for starting time handicapped events is brought into operation by pressing down the button on the outer rim of the dial, in accordance with the time adjustments fixed for the starters, and, starting from zero, the times at which the other horses handicapped in the race leave the mark are accentuated by a bell, so that no mistake can occur in dispatching the field just as the handicapper had arranged. The seconds hand, which registers the time on the large dial, is carried on a cylinder about 3 inches in diameter and of a similar depth. The outer surface of the cylinder is vertically divided into 12 parts, corresponding with which, on the inner surface of the cavity in which it revolves, are a dozen inked points. The circumference of the cylinder is divided into seconds and fifths, and the aforementioned inked points are electrically connected with the tapes at the winning end of the running tracks. The signal for starting is given by a loud-sounding electric bell at the starting post, and simultaneously the recording machine at the other end is brought into operation. The tapes at the winning end of the tracks are electrically connected with the inked points, and the instant that the connection is broken the inked point registers on the corresponding section of the revolving cylinder the time occupied in covering the ground, as well as the relative positions of each competitor as he breasts the tape.

Good Luck for Mr. McDonald.

The bonds of the New Orleans Traction Company, $6,000,000, in which company Mr. R. T. McDonald was largely interested, have been taken by New Orleans capitalists. The arrangement was consummated by the banking house of Seligman & Co. on the 4th inst.

The system will now be pushed to completion with electrical equipment throughout.

It looks to a man up a tree as if the new railway motor of the Fort Wayne Company might possibly make its debut in actual service in the city of New Orleans, as Mr. McDonald still retains a large interest in the Traction Company.

Storage Batteries for Central Stations.

The report on this subject recently read before the Convention of the American Street Railway Association seems to have been productive of good results, as three concerns have already announced their intention of putting large central station batteries on the market.

Mr. Malloux, the author of the report, says that in one case he was shown the plates in process of manufacture. The information obtained by him since the paper was read seems to show quite conclusively—

1st. That the cost of large central station batteries will not exceed $35.00 per kilowatt hour, set up, in most cases, and for smaller sizes will not exceed $50.00 per kilowatt hour.

2d. That the cost of maintenance will not exceed 10 per cent. of the initial cost.

3d. That the rate factor can be safely based on three hour discharge, or even less, in most cases.

ELECTRICITY

The Popular Electrical Journal.

GEORGE R. METCALFE, - - - EDITOR.
R. H. WILLOUGHBY, - - ASSOCIATE EDITOR.

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NOTICE.—Hereafter cuts will be admitted to the first page of "Electricity," not to exceed one square inch in size.

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The Niagara Power Plant.

Elsewhere will be found in part a paper by Prof. Geo. Forbes, recently read before the English Institution of Electrical Engineers, in which he lays before the public in considerable detail the plans of the Niagara undertaking and explains the reasons which led to the adoption of a number of new departures in the equipment of the plant.

The most noticeable of these is the unusually low frequency of the alternations, and as the figure chosen is too small for ordinary lighting work, it has been the cause of considerable surprise among electricians. From Prof. Forbes's paper it appears that most, if not all, of the current from this plant is expected to be used for running motors, for which purpose the reduction in frequency adds considerably to the efficiency. It is also pointed out that there will be but comparatively little business lost by designing the plant exclusively for the transmission of power, as almost all the arc lighting being run with direct currents a transformation would be needed, and for incandescent lighting the plan would generally be to supply the present stations with motors to replace their steam engines. In this view of the matter theory seems to dictate a very low frequency, but it appears after all that the selection of twenty-five periods per second is to some extent experimental, as we believe no practical trial at this figure has yet been made. The greatest objection to this is probably the increase in the cost of transformers. This is partly counterbalanced, however, by the proportionally large size of the transformers which will be chiefly used in this plant, which largely reduces the cost per horse power, and it is also to be noticed that by reducing the frequency the induction may be increased, so that the size of the transformers actually varies by less than half of the proportion between different frequencies.

The adoption of a multiphase system seems in the present state of the art to be the only solution of the general transmission of power to the distances and for the multifarious purposes contemplated in this project, and the two phase system has been found to involve more expense in construction than the three phase, and is easier to regulate and operate.

This system will also introduce a certain amount of uncertainty, as on this side of the water little has been done in this field. There seems to be but little doubt of the possibility of constructing efficient two phase motors suitable for this current, but we certainly have none at present on the market, as no suitable current supply for them has existed.

Many of the purposes mentioned by Prof. Forbes for which the Niagara power plant will supply current are those in which a direct current will be essential. Among these are street railway power, power for canal boats on the Erie Canal, and current for the electrical reduction of aluminium. In these cases it appears that the methods of transforming remain to be decided upon, as the paper only states in regard to this that "some sort of commutator or motor transformer will be desirable." Commutators of this sort still remain to prove their usefulness, and while motor transformers are entirely practicable for this purpose, the installing of these machines means a pretty heavy expense, and the efficiency of the combination leaves considerable to be desired, as except for the loss in the belt it is about the same as utilizing the two phase current to drive a motor which in turn drives a dynamo to generate the current desired. If a large part of the power is to be applied in this way, the losses in the transformations must amount to considerable.

Another important class of customers mentioned is a class of mills some of which operate continuously day and night throughout the year, and for the latter synchronous motors are well adapted. Where starting and stopping occur even only in the morning and at night some trouble may be expected with this class of machines, especially if this occurs when they are loaded. In fact, in the absence of some device for this purpose not yet known, this trouble would be fatal to the use of synchronous motors in many cases. In a few places where they have been used on a large scale the conditions have permitted the machines to be started without load, and even in these places auxiliary self-starting motors have been necessary for putting the large machines in step with the generators. Where the synchronizing motors are feasible, however, they operate with excellent efficiency.

The electromotive force adopted in the first machines is 2,500 volts, although 20,000 volts is the figure to which the current is to be raised by transformers for distribution. In Prof. Forbes's opinion 20,000 volts is as easily produced at the generator as at the transformer, but as none of the American manufacturers could be persuaded to this view of the case, step-up transformers will be used on the first machines installed, although it appears to be the plan to generate the full pressure at the dynamos eventually. While we have no experience in central station work at anything like this pressure, it certainly must make the running of the station a rather uncomfortable job, and as in this particular case the cost of fuel hardly enters into the calculations the loss in efficiency due to the use of step-up transformers would not be very serious and could be compensated for by the use of a little more water if necessary.

The idea of having a uniform system, that is, having interchangeable dynamos all at the same pressure, will undoubtedly prove an advantage in the end as it is the only way by which the full capacity of the plant may be always utilized, and the management of the station will be thereby much simplified. The use of special dynamos for the different kinds of current required would limit the capacity of the station considerably, as, for example, the machines devoted to arc lighting would be only in use at night and could be turned to very little account during the daytime.

The details of the plant appear to have been studied out with the greatest care, and these remarks are not intended as criticisms, but simply to point out that much of the work will be experimental. Its successful completion, for which we confidently look, will therefore mark an important advance in the science of electrical power transmission.

……

THE Directors of the General Electric Company have officially announced the suspension of dividends on the $4,251,900 of 7 per cent. preferred stock. This is hardly news to the readers of ELECTRICITY, who were told two weeks ago that this action had been decided upon. We understand now that some of the preferred stockholders are going to make trouble, claiming that the preferred stock should come before the debenture bonds in the matter of dividends.

……

MR. E. A. KILBOURNE has been arrested on charges preferred by Mr. B. E. Sunny, charging the former with an attempt at blackmail. We trust that Mr. Sunny may clear himself of the suspicion of fraud; he cannot clear himself of the *fact* of incompetence and stupidity. A million and three quarters of bad paper in the Chicago office for one year is an unanswerable argument.

……

MR. SAMUEL INSULL has not been regarded as a humorist, and we don't know that he is one. But it is certain sure that he offered $20,000 less than shop cost for the big multipolar Edison machine which was in the World's Fair service plant, and that now the white elephant is the property of the Chicago Edison Company. Perhaps Mr. Insull's former office boy is the humorist.

……

ELECTRICITY called attention a few weeks ago to the fact that the Fort Wayne Electric Company had everything to gain and nothing to lose by severing its connection with the General Electric Company. We are pleased therefore to report that the sales of the Fort Wayne Company for November last were a little more than double what they were for the same month of last year.

……

SOME of our readers may have noticed an advertisement in the daily papers offering a large salary to an accountant of peculiar ability for three or four weeks' work. It seems that with all the talent on hand Mr. Coffin is unable to find any one who can prepare a statement showing that the General Electric Company is solvent.

……

WE HAVE not on hand a verbatim copy of the letter from Mr. C. H. Coster which was read before the General Electric directors' meeting three weeks ago, but we would like to have. We feel confident that the many friends and admirers of Mr. B. E. Sunny would count it interesting reading.

……

THE stockholders of the General Electric Company are the most complacent people who have been swindled by wholesale in the history of Wall Street bubbles.

A Slight Exaggeration.

(From the Evening Advertiser.)

A Trust before a court has as little show as a cat before a jury of dogs.

Northwest General Electric Co.

One of Mr. Coffin's Paper Companies which Can be Juggled with no Longer.

In Liquidation, and Nothing Left for Stockholders.

The official announcement that the Northwest General Electric Company is going into liquidation has created consternation in Boston, where the preferred stock was largely sold, but the matter has not received the attention in New York which its importance warrants.

True, the amount of money involved was not large, and a great many of the General Electric stockholders perhaps have never heard of the Northwest General Electric Company.

ELECTRICITY, however, had heard of it, examined it, and reported upon it April 19, 1893, as follows: "Northwest General Electric, T.-H. Electric Light, and T.-H. Motor Company, *no value;* they are simply selling agencies, showing shortages which are made up by the General Electric Company."

The liquidation of the company, from which the stockholders realized nothing, is instructive when viewed in the light which history sheds over all of Mr. Coffin's many schemes.

We present below two statements, prepared about two years ago by Uncle Ellery Garfield, who had a limited number of copies made by his confidential typewriter, and which were distributed to the "chosen few who were permitted to invest in the preferred stock."

It is presumed that the "cash on hand June 1, $4,474,94," gave warning that something must be done, and that for the next six months all hands, especially Mr. Coffin, had in view a statement which would sell stock. Thus the cash had increased from less than enough to pay a month's salaries to $126,579.95 by December 1, when the preferred was offered.

NORTHWEST THOMSON-HOUSTON ELECTRIC CO.

Financial Statements, June 1 and Dec. 1, 1891.

ASSETS.

	June 1.	Dec. 1.
Franchise	$110,000.00	$110,000.00
Machinery, tools, furniture and fixtures	6,390.47	16,262.24
Plants owned and in progress	286,241.69	158,527.09
Merchandise inventory	344,942.88	527,106.55
Stocks in other companies at par	94,000.00	119,500.00
Bonds in other companies at par	120,500.00	144,500.00
Notes receivable	335,850.29	114,142.19
Accounts receivable	487,821.97	797,602.98
Due from Portland branch	113,899.34	......
Due from agents and others	......	68,877.89
Cash on hand	4,474.94	126,579.95
	$1,904,121.58	
Less deduction to bring assets to a valuation below their actual worth	250,450.00	
	$1,653,671.58	$2,183,098.89

LIABILITIES.

	June 1.	Dec. 1.
Capital stock [common]	$750,000.00	$750,000.00
Capital stock [preferred]	......	508,600.00
Notes payable	640,159.06	522,967.52
Accounts payable	162,911.64	
Stock shrinkage	......	58,000.00
Bond shrinkage	......	48,900.00
Contingent expenses	......	114,222.03
Surplus	100,600.88	190,409.34
	$1,653,671.58	$2,183,098.89

NORTHWEST THOMSON-HOUSTON ELECTRIC CO.

STATEMENT.

Profit and Loss Account, June 1 to Dec. 1, 1891.

Gross profit on merchandise account		$89,523.34
Gross profit on construction		38,939.76
Total gross profits June 1 to Dec. 1, 1891		$128,463.10
Less expense accounts		75,357.92
Net profit to St. Paul, June 1 to Dec. 1		$53,105.18
Net profit, Portland		29,423.79
Net profit, Helena		7,279.49
Total net profit, six months, from June 1 to Dec. 1, 1891		$89,808.46
Surplus, Dec. 1, 1891	$190,409.34	
Surplus, June 1, 1891	100,600.88	$89,808.46

Accompanying the above was a circular, which made it plain to all that N. W. T.-H. was a gilt-edged investment. We extract a few samples which are truly Coffinesque:

"The secretary of the Thomson-Houston Company with an expert auditor has lately made a critical examination of the assets, scaling them down to an extremely low and conservative basis. After deducting about $250,000 from the inventory the company has a surplus of over $100,000 worth, besides having paid up to close of 1890 quartely dividends amounting to eight per cent. annually on the outstanding stock from the time of the organization of the company.

"The company has no bonded debt, and none can be created except by the vote of the preferred and common shareholders.

"An annual charge of but $60,000 is required to pay dividends upon the preferred stock.

"This stock is offered with the belief that it is an exceptionally safe and carefully protected security, issued as it is on the basis of less than one-half the capital actually invested, and being surrounded with safeguards that will insure regular and permanent dividends."

The safeguards were manifestly not strong enough.

Captious critics who are interested in the subject might well inquire if these statements were true and correct at the time they were issued, or were they deliberately falsified to hoodwink Boston investors.

This statement showed an increase in surplus in the six months from June 1 to December 1, 1891, of nearly $90,000, and reported assets to cover all liabilities, including $1,258,600 of stock. In twenty-three months' time the surplus is gone and the capital stock is wiped out.

The General Electric Company cannot make as complete and noiseless a collapse as the Northwest General Electric Company, because it owns property, whereas the latter company owned nothing. But the last statement of the General Electric Company was as false as the one printed above, and was falsified for the same purpose—the unloading of worthless securities.

Thus credits throughout the entire range of electrical investments are smirched and thrown under suspicion, and the robbers still ply their trade.

ELECTRICITY is not surprised and will not be when every one of Mr. Coffin's paper houses fall in the same manner.

SOCIETY NEWS.

Meeting of the New York Electrical Society.

A regular meeting of the Society was held on Wednesday evening last at Columbia College, and the lecture room was far too small to accommodate the large audience which assembled to hear the speakers that were announced. It was found before the close of the evening that it would be impossible to complete the programme laid out, as about half the speakers occupied the whole evening, and it was voted to continue the subjects left over at an adjourned meeting.

"Electricity at the World's Fair, and its Lessons," was the subject of the evening, and Mr. Mailloux, who was elected chairman, was the first speaker, describing the exhibits of storage batteries at the Fair. After an interesting resumé of all the batteries exhibited, and the methods of charging, etc., Mr. Mailloux introduced Dr. Emery, who spoke on the subject of steam engines, and illustrated his remarks with a large number of lantern slides. The Corliss, Galloway and Ball compound engines were described, and the Buckeye compound engine was specially noticed for its ability to take from no load to full load with almost perfect regulation. The Edison vertical engine, with two direct connected 800 K. W. dynamos, was shown, but was not tested at the Fair. The Westinghouse 1,000 H. P. and a Siemens & Halske engine were next shown, and the latter was noticeable for its beautiful finish, and smooth, noiseless operation. The

Lake Erie engine, the Willans engine and the steam turbine were also described.

The next speaker was Prof. Crocker, who spoke of the Electrical Congress. He said that there had been but five Electrical Congresses ever held, and of these only two had been official, that is, attended by the official delegates from foreign nations. In every respect, except merely business matters, Prof. Crocker considers the last congress very satisfactory. The results achieved were valuable in three respects particularly. First, the final names and values of the electrical units were established; second, the adoption of the henry is an important acknowledgment of the work of an American by foreigners, by whom the name was proposed and seconded; and third, the important papers which were read and the eminence of their authors.

Prof. Crocker said that while it had been suggested that there could arise no further necessity for another congress in the future, he thought that the subjects of magnetic units, standard of light, and international nomenclature still remained for the discussion of future congresses.

Mr. Nicola Tesla then followed with some remarks on the oscillatory engines which formed the subject of his lecture before the Electrical Congress last summer. In that address, Mr. Tesla said, he had confined his remarks to the purely scientific side of the subject, and from the comments which had since come to his ears he was convinced that he had not been fully understood. In his first experiments in this line he employed a steel spring to regulate the vibrations of the piston and armature, which must be perfectly constant. Next an air spring was tried, and later an air spring connected with the outside air and surrounded with boiling water to keep the temperature rigorously constant.

The reciprocating mechanism has the advantage of making all the wire active as in a transformer, avoids loss by friction and reduces the weight of the machinery. For the latter it is of great importance to use very high pressures.

Mr. Tesla thinks that the development of the principle on which these machines are constructed will furnish a means of producing probably twice as much electricity from coal as at present.

Mr. J. J. Carty spoke very briefly of the Telephone, the most interesting exhibit of which was the New York and Chicago line. There was nothing particularly new in this branch of electricity, Mr. Carty said, and the improvements made recently were in the direction of perfecting the well known inventions. The most important change which has been made in the system is that from series to multiple working, the latter now being general.

Mr. James Hamblet made the closing address of the evening, speaking on electric clocks. He stated that only a few days ago the first decade of electric time had been completed. Over two hundred electric clocks of various kinds had been exhibited at the Fair. The first invention of this kind was in 1851. In the first clocks the hands were propelled directly by electricity, later the mechanism was wound every hour, then a method was invented for correcting the hands every hour by means of a standard clock.

Another class of clocks was the large tower clock in the Manufactures Building at the Fair, to which the current was sent in impulses, one each minute, and the hands moved intermittently. Besides these there are a number of electric clocks built to perform special functions, as chiming clocks, signal transmitting clocks, programme clocks, etc.

The meeting closed with the exhibition of a large number of lantern slides of views of the Fair which were announced by Dr. Emery.

The Electrical Transmission of Power from Niagara Falls.

BY PROF. GEO. FORBES.*

RELATIVE ADVANTAGES OF DIRECT AND ALTERNATING CURRENTS.

A few years ago it would have been considered necessary to devote a considerable amount of space to the discussion of the relative merits of direct and alternating currents. During the last two years, however, opinions have advanced so steadily in the direction of preferring the alternating current for the transfer of power to any considerable distance that it is not necessary to give much time to this question. One of the chief difficulties in connection with using the direct current is that it is necessary, for getting the best results, to connect a number of dynamos in series, and also to put the motors at the receiving end in series with each other. This involves the insulation of each dynamo and motor from the earth—a requirement which can in some cases be attained, but which in a general system of distribution is apt to be attended with difficulty, and perhaps with danger. The best case of the kind which has been put in practice is that of Genoa, and we gave it the most serious attention, but came to the conclusion that, for our purpose, it was undesirable. The facility which the stationary transformers used with the alternating current give for varying the pressure according to the requirements of economy or safety is one great feature in favor of the alternating current. The question was considered in all its bearings with the utmost care, and it was not until the month of May, 1893, that the board of directors passed the resolution to adopt the alternating current, both for their distant transmission and also for the works nearer to the power-house. It was proposed, indeed, by some manufacturers to distribute the current within a radius of a mile or two at 700 or 800 volts, and one firm proposed to do this by means of a direct current. Had this plan been accepted, we should have arrived at the surprising result that by using the continuous current at 700 volts within a mile or two, and high pressure alternating current for more distant places, it would have cost more to produce a horse power per annum at Niagara Falls than at Buffalo.

The argument that seemed to me the most important in favor of using the direct current was that motors for this purpose have been made in much larger quantities than alternators, and that it would be seldom necessary to build special types of machines to act as motors. This advantage seemed of great importance until I realized the value of a low frequency used with the alternating current. So soon as we reduce the frequency low enough, we are able to alter a direct current motor into a synchronizing alternating motor by the simple addition of a couple of rings placed on the commutator and electrically connected with opposite bars of the commutator, and a brush rubbing on each of these collecting rings. I also took into consideration the question of the possibility of storing up energy in storage batteries during the night time, when, of course, the demands on our plant would be least, and giving it off during the day time; but at the present time the cost of the batteries would not repay work in this direction, and it would be cheaper to make another tunnel, with wheel pits, turbines and all the paraphernalia required to generate current, than to go to the expense of putting down the large amount of lead which is required for these batteries. With the alternating current we have the choice of a considerable number of motors of different types. We have the synchronizing motor, the series wound motor with laminated field and commutator, the multiphase motors, which attracted so much attention at the Frankfort Exhibition of 1891, and a host of single phase motors which have been placed on the market because of the high frequency which has been prevalent and with which they were not altogether satisfied. These motors become immediately available if we use a lower frequency. The generation of an alternating current also permits of the use of a commutator, or rectifier, with direct current motors.

NUMBER OF PHASES.

Assuming now that it is generally agreed that the alternating current must be adopted, not only for distant transmission but also for the nearer work, the next point to consider is the number of phases—whether the current should be generated in a single phase, in two phases, or in three phases. The possibility, too, of using even a greater number of phases was also considered, but it did not seem to possess advantages.

As already stated, there are many motors which are suitable for use with a single phase at low frequency and which starts without assistance. In the workshops of nearly all the most able electricians which I have visited in the course of the last year or two, I have found such motors built upon different plans, and nearly all of them seemed to work fairly well, and promise to be very efficient at low frequency.

For all heavy work which is going on, constantly without stopping the machinery, no motor could be more suitable than the synchronizing alternator on a single phase, and its speed is as regular as that of the turbine which is developing the power. It seems, however, that even if single phase motors are going to be adopted, it would be best for the generator to have two phases, because in this way we get a larger output for the same size and price of machine; the circuits may be perfectly independent and supply separate motors. Also, the two phase system makes the rectification or commutation of the current more easy to use it for street railways, electro-metallurgy, etc. Again, multiphase motors have the great advantage that they have been considerably utilized already, and even in small sizes have a fairly good efficiency.

With regard to the relative merits of two and three phases several claims that cannot be supported have been put forward in favor of the latter. First, it is claimed that the saving in the copper on the line is 25 per cent. over a one phase system, and 25 or 18 per cent. over a two phase system, according as four or three wires are used for the purpose. I investigated this matter carefully, and arrived at the conclusion that this was not the case, and that the three phase system had no advantage in this respect over a two phase system with three wires. Second, it is claimed that there is a greater simplicity of wiring with three phases than with two phases; but this advantage disappears when we remember that the two phase system can be used with only three wires, although this is not a plan which I would recommend. Third, it is claimed that any pair of the three wires may be used for a distribution of lighting. This is not the case. A two phase system, where the circuits are completely independent, is much more suitable for the purpose, and maintains the lights at a more constant electric pressure. Fourth, it is claimed that there is a smoother starting and rotating effort with the three phase than with the two phase system. This was originally claimed on theoretical reasons only by Dobrowolski, but everyone who has used the type of two or three phase motors made by the Oerlikon Company, by C. E. L. Brown, and by the Allgemeine Elektricitats Gesellschaft, of Berlin, and others, is convinced that this advantage, which seems probable enough, is purely theoretical; it is not confirmed by actual practice, and, moreover, when the fact is known, the theoretical reason is pretty evident.

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* From a paper read before the Institution of Electrical Engineers, England.

No other claims in favor of the three phase system over the two phase have ever to my knowledge been advanced; and, as shown above, a very full consideration of these claims does not tell in favor of the three phase.

I will now point out what seemed to me great objections against the three phases, due to the fact that the three conductors are all interconnected. First, it introduces trouble in maintaining the efficient working of the line, and in testing it, so that a higher type of electrician would be required to make these tests, and even he would have greater difficulty in finding the faults and correcting them. Secondly, when the three circuits are unequally loaded the electric pressure varies considerably. These difficulties have been thoroughly appreciated by workers in this line. When an interconnected set of circuits such as the three phase system employs is used, it is found that when the circuits are unequally loaded there are great variations in the electric pressure, and the following tests were made at my request to illustrate this. The three circuits are called A, B and C. The average electric pressure of the three branches at the terminals of the secondaries were maintained constant. A resistance tending to reduce the electric pressure at the lamps 5·3 per cent was introduced into each branch. Both the primaries and the secondaries were connected as represented by the form of the letter Y. By varying the connections in different ways, some slight variations were possible; but this general fact remained that when A is loaded and B and C are not loaded, the pressure of A is less than that of C, and that of C is less than that of B, and the difference may be 12 or 13 per cent.; and when A and B are loaded and C is not loaded, the pressure of A is less than that of B, and that of B is less than that of C. The variations here shown in the pressure of two equally loaded circuits is probably due to the armature reactions, and would be found in a two phase system also; but the rest of the variation is due to the interconnection of the three circuits, and is an obvious defect of the three phase system. In order to get over this difficulty, the Oerlikon Company proposed to devote only one circuit to lighting purposes, which shall be maintained at constant pressure, using the other two circuits for power purposes, where constancy of pressure is not so important. In some cases this would be a suitable method of working, but it was not considered satisfactory for the work at Niagara Falls. Having considered these points, the board of directors of the Cataract Construction Company, at their meeting in May, 1893, determined to reject the three phase system, leaving the single phase and the two phase available.

Conditions.	Volts at terminals of lamp mains.				Difference between maximum and minimum volts.
	A.	B.	C.	Average.	
A, B and C loaded (resistance out)........	108.5	108.6	107.9	108.3	0.7
A, B and C loaded (resistance in).........	108.5	103.6	103.2	103.4	0.4
A loaded, B and C off.	102.9	116.0	106.5	108.5	13.1
B loaded, A and C off.	104.5	102.5	114.9	107.3	12.4
C loaded, A and B off.	115.1	105.3	101.3	107.2	13.8
A, B and C loaded (resistance in).........	103.0	103.4	102.5	103.9	0.9
A and B loaded, C off.	98.9	107.8	111.1	105.9	12.2
A and C loaded, B off.	101.2	108.0	98.1	102.4	9.9
B and C loaded, A off.	110.5	98.0	105.8	104.8	12.5
A, B and C loaded (resistance in).........	103.7	103.0	103.0	103.5	0.7

FREQUENCY OF ALTERNATIONS.

I wish now to say some words on a question which has absorbed my most serious attention, especially since I have been acting for the Cataract Construction Company, and this relates to the frequency of the alternating current. In America a frequency has generally been adopted of 133 complete periods per second for lighting purposes. This was done with the object of reducing the cost of transformers, which were supplied to each separate house, and consequently were always of small size, and therefore expensive. The selection was also approved because American engineers working with alternating currents have generally put forward the view that parallel work is not desirable, and the fact that parallel working is more difficult at high frequency, which is one of the principal objections to high frequency, has not been seriously considered in America. In Europe the usual frequencies are from 70 to 100 periods per second, but a notable exception exists in the case of Messrs. Ganz & Company of Budapest, who have adopted 42 periods per second. Some years ago I unwittingly did Messrs. Ganz the injustice to say that I thought it probable that they had adopted this frequency because it suited their particular type of machinery and speed of running. I have it in writing from them, and I am thoroughly convinced of the truth of it, that their reason in adopting the frequency of 42 periods per second was that it is the lowest frequency that is available with arc lights so as not to produce any serious flickering, and their desire was to lower the frequency as far as practicable in order to ensure parallel working. Of course, it is a matter of common knowledge that parallel working is assisted by lowering the frequency.

With the large units which will be employed in connection with the Niagara Falls scheme, the cost of the transformers is very much diminished; and this does not become so important a matter as it does when all the transformers are of small size—under 10 H. P., as is usual in electric lighting in America. Moreover, although with lower frequency the transformers must be increased in size, the increased cost is not in proportion to the lowering in frequency, because we can use a higher induction. Mr. Steinmetz has shown that the loss due to hysteresis varies as the induction raised to the power 1·6, and it is loss which must be kept constant when we vary the frequency. I deduce from this law the fact that in any transformer, if the hysteresis loss is kept constant, its power of doing work varies in proportion to the frequency raised to the power 0·4 (but it is probably unwise to increase the induction so much as to saturate the iron). It follows that when we double the frequency we get out of the same transformer 132 units of work instead of 100. If the frequency were quadrupled, we should get 174 units instead of 100. I have been informed by Mr. William Stanley, Jr., of Pittsfield, Mass., that without the use of theory, but simply working from his experience in manufacturing and testing transformers, he obtains almost identically the same law; and I have got independent practical testimony in the same direction from other manufacturers. It appears, then, that there can be no doubt that in lowering the frequency we are not proportionally increasing the cost; but at the same time it must be realized that the cost of transformers is to a certain extent increased by lowering the frequency. If the frequency be reduced to one-half, the cost is increased about 50 per cent. The lowest price which has been quoted for large transformers is $3.52 per horse-power, at a frequency of 42 periods per second. In halving the frequency the extra cost would therefore only be $1.76 per horse-power. It becomes, then, a matter of enquiry whether the benefits to be derived by lowering the frequency in such a proportion would compensate for the extra expenditure as indicated. I am thoroughly convinced that the gain is far in excess of this amount. I shall have occasion to discuss the superior efficiency of motors at low frequency; and in most types of motors I think it safe to say that in passing from 42 periods to 21 periods, or varying the frequency in that proportion, we have a gain of at least 3 per cent. in the efficiency of the motors. Neglecting altogether the increased value of the motors from this cause, there is 3 per cent. more power at our disposal, which, at only $10 per horse-power per annum, would amount to 30 cents per annum, or, capitalized at 5 per cent., represents an increased value of $6 per horse power of the plant, against which we have the increased cost of transformers—only $1.76. It appears, then, pretty certain that, from a purely economical consideration of the question, a lower frequency than any which has hitherto been adopted is advantageous.

With regard to the lowest limits at which we can work, since our turbines have been designed to revolve at 250 revolutions per minute, a two-poled dynamo—if such could be satisfactorily constructed—would give a frequency of 4⅙ periods per second, and none of the synchronizing or polyphase motors employed at different factories could run at a higher speed than 250 revolutions. I am not sure that it is desirable that any motors should run at a higher speed than this, but in the few cases where this might be desirable the use of belts would be quite natural in order to give the higher speed. With a four-poled machine we would have a choice of speeds at 500 revolutions, 250 revolutions, and any sub-multiple of these speeds; for by increasing the number of poles in the motor the speed of the motor can be reduced as much as we please. With eight poles in the generator, the maximum speed is 1,000 revolutions per minute, which is as high a speed as would generally be desired in connection with the factories supplied from Niagara Falls. This frequency is 16⅔ periods per second, and after considering the three points—namely, cost of transformers, speed of synchronizing motors, and convenience in the design of the generators—I came to the conclusion that, so far as motive power was concerned, this is the frequency which would be most favorable for use at Niagara Falls.

Another indirect advantage of using a low frequency is of a very practical nature, and lies in the fact that the ordinary continuous current dynamos of any size that are made may be used as synchronizing motors by means of rings attached to the commutator bars in the manner which has been above described. This method of altering and working a direct-current motor so as to make it suitable for an alternating current of low frequency has long been known to electricians, but the attention of those who are not experts was forcibly directed to it by the machines shown by Mr. Schuckert and others at the Frankfort Exhibition in 1891. Owing to this fact, it would be possible for any manufacturer connected with our supply station to procure a motor of low frequency of any moderate power he might require at a day's notice, and this is not true of any other alternating motor, nor is it true of a higher frequency.

But the most obvious advantage of low frequency is the improved efficiency of motors. I have arrived at this conclusion from my own observations, but I find it confirmed collaterally. With synchronizing motors, of course, the fact has long been thoroughly established that the performance is very much improved by using low frequencies. Again, those who have used the motors with rotating field of the two phase or three phase types have all been obliged to reduce the frequency of the current to get the best results. In this connection I am pleased to be able to show a diagram giving some tests which were made for me of a three phase motor at 41 complete periods per second, and at 56 periods per second.

It will be noticed that at 56 periods the maximum efficiency is given when the output is 17 H. P. It is then 85 per cent., and the efficiency 7t 41 periods per second at the same output is 8a per cent. But it will be noticed that the efficiency at the latter frequency goes on increasing until the output of the machine is 19½ H. P., when the efficiency rises to nearly 88 per cent. Thus, by lowering the frequency from 56 to 41 periods per second, not only had the output of the motor been increased 15 per cent., but the efficiency had also been increased 3 per cent. It is also found—which is a matter of the utmost importance—that in every self-starting alternating motor, whether multiphase or otherwise, the effort at starting is increased by lowering the frequency.

Again, I find that the ordinary direct current motor with a laminated field works extremely well with low frequency; even without lamination of the field it works, though not well. I have consulted nearly every electrician of experience in this direction whom I have met during the last year or two, either in Europe or America, on this point, and they generally agree with me that the facilities of working motors of whatever kind are very much greater with a low frequency. Last year, being aware that Prof. Anthony had experimented considerably in the direction of series-wound motors with laminated field, I asked him his opinion, and he expressed himself as follows:

"In reply to yours of August 30, I have built two or three continuous-current machines with laminated fields to run with alternating currents, and have succeeded in running motors of about ⅛ H. P. directly from the Westinghouse converter, where the frequency is some 130 per second. Such small machines run very nicely where the alternations do not exceed 25 per second. In fact, so far as I have tested, they seem to give an output fully equal to what they will with continuous current. Of course, with high frequencies the self-induction of the field is against their working, but at eight per second I should say that large motors could be run with perfect success."

I wish to repeat that, from what I have seen in the workshops of all advanced electricians in the last year or two, I am confident that in the near future single phase alternating current motors, self-starting on full load, will be largely used; and there is not the slightest doubt that all of these work far better with low frequencies. In fact, as Mr. Brush once said to me when I was discussing this matter with him, "Really, your best plan would be to lower the frequency so much that you get a direct current."

Whilst speaking of low frequency in relation to motors, I must say that I have much greater hopes of obtaining a good commutating device with a low frequency than with a high one; and I will also state that I have great hopes of important advantages coming to us from the invention of such a commutating appliance which will enable us to furnish street railway companies, electro-metallurgical works and other consumers with the direct current without the use of any heavy revolving machinery at the transforming station.

I am not sure that it ought not to be said that the greatest advantage of low frequency is in connection with the conductors used for transmission, and in the parts of the apparatus that require high insulation. When a high frequency is used there are certain difficulties which are well known. The first of these has been strongly urged by Lord Kelvin—namely, that when using large conductors an alternating current of high frequency tends to confine itself to the outside of the conductor, thus increasing the total resistance. Attention was first generally directed to this subject by the presidential address of Prof. Hughes to this Institution. A second difficulty is that with high frequency the impedance of the line due to the magnetic field formed between the go and return wires may amount to a very sensible quantity. Attention has been drawn to these matters by Mr. A. E. Kennelly, and his paper* on the subject should be carefully studied. Then, again, with high frequency there is a greater tendency to discharge from an electrified conductor into the air. This means that the insulating of a bare conductor is more difficult with a high than with a low frequency. Lodge and others have made this very manifest with exceptionally high frequencies, but the truth of the statement is well known by those who have experimented even with low frequencies. Another trouble is that, whenever it is necessary to use solid insulation, a current of high frequency has a greater tendency to injure the insulation. Mr. Tesla has shown and explained so clearly the rapid deterioration of solid insulation by currents of enormously high frequency, that we cannot fail to see that advantage is gained by using currents of low frequency. Another very important fact is that with low frequency we are less troubled by the capacity of cables, and we have less loss of static charge accompanied by heating of the insulation. Again, the serious troubles which have been encountered at Deptford and elsewhere owing to abnormal rises of electric pressure in the mains above the pressure generated by the dynamos, due to the resonant effect produced by the capacity of the cable and the self-induction of the circuit, may be reduced as much as we please by sufficiently lowering the frequency. All these facts are the explanation of what has been thoroughly established in actual practice, namely, that there are difficulties on the line when using high frequencies which tend to loss of power and to destruction of the insulation, and that these difficulties are largely mitigated, if not entirely obviated, by reduction of the frequency. It must also be remembered that if we reach a frequency as low as 16 periods per second, any induction in neighboring telephone circuits is utterly inappreciable by the ear. Finally, all eddy currents diminish as the square of the frequency. Having now stated as clearly as I can what seemed to me the principal advantages of low frequency, I will place on the other side the disadvantages.

Besides the increased cost of transformers, there is one fact which is apt at first sight to impress one as almost fatal to the employment of very low frequency, but which further consideration shows to be of little moment in the case of Niagara Falls; this is, that a low frequency is not suitable for electric lighting directly. But it must be remembered that it is decidedly preferable to use a direct current for arc lamps, and, in fact, in the present position of the art in America it would be almost a necessity. Hence the natural method of arc lighting would be to use the alternating current by means of a motor to drive the well-known arc lighting machines. In the course of the work at Niagara, the first work in connection with arc lighting which will be set up is the lighting of Buffalo. At present this is done by means of steam engines, developing about 3,000 H. P. and driving arc lighting machines of the Brush, Thomson-Houston and Wood type. There cannot be a doubt that, financially and practically, the best way of converting this station to enable them to use the power from Niagara Falls is to put in alternating motors in the place of the steam engines; and this will be the case in most of the towns which will be supplied with power from Niagara Falls.

(To be continued.)

Boston Notes.

An unusual and unique Thanksgiving present was made on Thanksgiving Day by the directors of the Globe Street Railway Company, Fall River. It consisted of a purse of $450 divided among fourteen employes who were considered to be the most deserving and efficient in the company's employ. The division was made as follows: Two conductors and two motormen received $50 each; two conductors and two motormen got $30 each; two conductors and two motormen got $20 each. One motorman and one conductor got a special prize of $10 each. The gifts were fully appreciated, and such substantial recognition of the services of employes cannot fail to act as an incentive to others, and is a credit to the generosity of the directors. This was such an unusual gift that it deserves to be recorded.

The heating of street cars by electricity will, the present winter, be very general throughout New England, inasmuch as the firm of James F. Shaw & Company, Boston, has sold to no less than sixteen different New England street railway companies electric car heaters of the type made by the American Electric Heating Company under their own patents. Last winter some few cars in this district were heated by electricity, and gave satisfaction, hence the more general adoption.

It is highly creditable to the boys of Lynn who formerly were employes of the General Electric Company that notwithstanding the chronic paralysis from which the Trust is suffering, with every indication of a speedy dissolution, they keep up their spirits, feeding them doubtless on the hope of brighter, better days dawning ere long. Mid all the changes and dismissals and "laying offs," the members of the Thomson-Houston Electric Brass Band keep up their practice and musical engagements, the football club keeps the ball a-rolling, while the Thomson Scientific Club remains, not as lusty as formerly, yet strong enough to furnish some food for the intellectual delectation of its aspiring and and ambitious members.

In the annual report of the West End Railway Company, just issued, it is stated: "At the close of the year about five-sixths of all the mileage, namely, 1,325,000 miles per month, was run by the electric system. It is expected that during the coming year that system will be so extended as to cover most of the important lines. The board of directors have undiminished confidence in the electric system, and the increased riding, wherever it is introduced, proves clearly that the public consider it a great improvement over horse power. This fact and the comparative cheapness of operation, in the opinion of the directors, justify the large expenses involved in the introduction of the system." The West End Company has now 182½ miles fully equipped with electricity and 25½ miles partly equipped. The revenue miles for the year were 18,669,809, number of passengers carried 133,863,618. Of the passenger receipts 80 30 per cent. was from the electric lines and 19.67 from horse lines.

An important meeting of Fire Underwriters, representing the various Eastern Insurance Exchanges, was held at the National Insurance Board Rooms, New York, November 23d and 24th. Those present constituted the Conference Committee appointed to prepare a standard and schedule for electrical light and power stations, electric car sheds and repair shops. Representatives of the Eastern Fire Underwriters' Association were present and did some valuable work. The schedules for the above classes of risks, previously prepared, were gone over section by section, and the results were unanimously adopted by the committee to be recommended to the various boards represented. It is believed that the adoption of the proposed schedules will place these risks on a fairly paying basis, and at the same time will give the assured the benefit of good construction and equipment and such improvements as may be made.

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* "Impedance," by A. E. Kennelly, American Institute of Electrical Engineers, April 18, 1893.

As was to be expected, the incandescent lamp makers of New England felt a good deal interested in the question of the Edison patents, and would have rejoiced to read an authoritative utterance to the effect that said patents died simultaneously with those in England. Such an utterance has not been as yet delivered, and so they anxiously await an expression of judicial opinion on the subject. Meantime the General Electric Company, as if to direct attention from its sure but gradual dissolution, is indulging in a little more of its would-be monopolistic litigation. Incandescent lamps, their inventors and manufacturers, however, are like Banquo's ghost, they "will not down."

Prof. W. L. Puffer of the Massachusetts Institute of Technology is engaged in giving a course of twenty-four lectures on "Practical Electricity" in the Wells Memorial Hall, the course being largely attended. On Friday evening his topic was "Dynamos." Many questions were asked and answered.

By a printer's error there appeared a statement in our last issue announcing the payment of a regular quarterly dividend of 14 per cent. by the New England Street Railway Company. It should have been 1¼ per cent. per quarter or 5 per cent. per annum.

Drexel, Morgan & Company are now represented in the directorate of the West End Railroad Company in the person of Mr. Samuel Spencer, who has been elected director.

Conway is to have an electric street railway—a company with a capital of $50,000 having been organized for that purpose. Power is to be taken from the water in Conway Gorge.

General News.

What is Going on in the Electrical World.

Homer, Mich.—A new electric lighting system is to be established here, it is said, to take the place of that already in use which has failed to give satisfaction.

Harrison, N. J.—The General Electric Company has notified the machinists at its factory here that their wages will be reduced from 30 cents an hour to 22½ cents.

Columbia, S. C.—A cotton mill is nearly completed here which is to get its power from the canal by means of electricity, instead of the old-fashioned belt method.

Martinsville, Ind.—The plant of the Martinsville Electric Light and Power Company, which went into the hands of an assignee last June, has been sold at auction to the Central Thomson-Houston Company of Cincinnati for $7,500.

Pittsfield, Mass.—The Stanley Electric Manufacturing Company held its annual meeting Tuesday of last week. The capital stock has been raised from $100,000 to $200,000, the new stock having all been taken.

Plainfield, N. J.—The consent of a majority of the propertyowners having been secured for the proposed extension of the electric railway to Dunellen, nothing remains to delay the building of the road except to obtain consent of the city council.

Bridgeport, Conn.—The Traction Company will use the trolley as a motive power on its lines. As soon as the company gets permission from the council the generators, poles, etc., will be ordered and the road double tracked. It is estimated that cars ought to be running by summer.

Cincinnati.—City Electrician Cabot the other day discovered a thief wire running from the main lines into a chimney over Kelly's pool rooms in Covington. Another wire, intended as an extra one in case the first one failed, was discovered at another point. The pool room people had been using the stolen current since the latter part of October.

Woonsocket, R. I.—The new plant of the Woonsocket Electric Machine and Power Company is about completed and will be in operation in a few days. Water is the motive power for driving the dynamos, two pairs of 36 in. turbines developing 600 H. P. being used. Three generators, each of 150 H. P., will be installed.

Riverhead, L. I.—Edwin G. Duryea has engaged the services of Electrician Scott of Jamaica to estimate the cost of constructing an electric road between Riverhead and the south side, connecting with Quogue and West Hampton. If the road is built the power is to be obtained from the Riverhead Electric Light Company's plant.

Lebanon, Pa.—A new electric ore separator has been set up at Meily's furnace by Sanders & Thompson, of Philadelphia, for exhibition. The aopacity of the separator is said to be four tons per hour, and is intended to take the place of ore roasters. The ore is ground and by means of a powerful magnet foreign substances are eliminated.

Washington, D. C.—H. N. Allen, Vice Consul General of the United States at Seoul, Korea, has informed the State Department that the king of Korea has recently purchased in America an incandescent electric light plant, which will be used for lighting the king's palace and surrounding grounds.

Ithaca, N. Y.—The Thomson Electric Welding Company, through F. P. Royce, have notified Dr. Thurston of their shipment to Cornell University, for the collection of Sibley College, a selected lot of samples of electrically welded work which has been on exhibition at the Fair at Chicago, with the frames and stands used there in exposing them.

Beatrice, Neb.—Paul Horbach has been removed from the receivership of the Beatrice Rapid Transit and Power Company, and Judge Brush has appointed M. C. Steele in his place. The new receiver will at once resume operation of the plant, and furnish the city with electric lights and electric street railway service.

Carlisle, Pa.—The Cumberland Valley Electric Passenger Railway Company has been reorganized under the name of the Cumberland Valley Traction Company with the following officers: President, S. Ritter Iokes; directors, John R. Lemon, Tyrone, Pa.; William J Iokes, Altoona; John R. Miller, Charles and William Wigton, Altoona, Pa.

New York.—The Rapid Transit Commission has adopted a resolution favoring the West Side Rapid Transit scheme. The resolution stipulates that the structure shall be capable of carrying five-car trains, run at an average speed of thirty-five miles an hour, to be run by electricity or some other power needing no combustion along the line of the road.

Syracuse, N. Y.-Elijah D. Fulford, who has been the superintendent of construction for the American Long Distance Telephone Company during the building of its new line from St. Louis to New York, was arrested here last week on a train while on his way to New York for alleged fraudulent entries in his accounts, involving a loss to the company of a large sum of money.

Salem, Mass.—The 400 horse power generator of the Lynn and Boston Street Railroad Company which has been located in the stations of the Salem Electric Lighting Company has been removed, and now the latter company furnishes all the power for the operation of the cars on the local division of the road from its new station.

Rockford, Ill.—It is understood that the National Thermograph and Electrical Company, which has long been located at Chicago, is to remove its works to this place. The officers of the company are: George H. Sisson, of New York, president; Wm. J. Marks, Chicago, treasurer; H. F. Crow, Chicago, secretary; and A. E. Appleford, general manager.

Lynn, Mass.—In addition to the cut in wages hitherto made at the factories of the General Electric Company another notice was posted in the works a few days ago reducing the wages of all employees paid by the hour whose pay had not heretofore been reduced, and the factory auditor has been given instructions to make reductions in all piece work.

St. Joseph, Mich.—The council has granted a franchise to the St. Joseph and Lake Shore Railway Company and the St. Joseph Electric Light and Power Company to construct an electric railway from the centre of the city to the southern limits, and to furnish electric power and light to St. Joseph. The company is composed of Chicago capitalists, and the railway and light plant are to be in operation by August 1.

New Haven Conn.—The Manufacturers' Street Railway Company have opened subscriptions for an electric road from Grapevine Point to connect with the Consolidated road at Cedar Hill. Whether the company will have its own plant or will take power from the power house now in process of erection for the State street road system is a matter undetermined. The incorporators are George S. Barnum, Frank L. Bigelow, Simson J. Fox and W. W. Kendall.

Rochester, N.Y.—Since the Grand View Beach Railroad Company's power house at Rigney's Bluff was destroyed by fire, several months ago, power from the Rochester Railway Company's lines has been used. Next season, however, the company will generate its own electrical force at a plant in Charlotte.—Frank W. Hawley, vice-president of the Cataract General Electric Company, has been interviewed in regard to State Engineer Schenck's published opinion that electricity as a motive power would be a failure on the canals. Mr. Hawley differs from Mr. Schenck ever so much, and intimates that the latter is no authority on the subject. After disposing of Mr. Schenck's theories, and pointing out the advantages of electricity in canal navigation, Mr. Hawley says: "Opposition is expected. It comes to all things in the way of progress. It helps to develop the best methods."

Baltimore.—The Brush Company has notified the Maryland Electric Company that it is now sufficiently recovered from the recent fire to furnish the 1,030 lights required by the city and will no longer permit the use of its wires and poles by the Maryland Company, which has been supplying current for 229 lights. The Brush Company has the city contract.—The First and Second Branches of the city council have passed an ordinance directing the mayor, comptroller and city register to contract with any existing electric light company to light the streets, lanes, alleys, public squares, public buildings and other places where electric arc lights are now used by the city, or shall be authorized to be used by the general superintendent of lamps. The contract is to be for a term of five years at a price not exceeding 35 cents a lamp each night, and the city is to have the privilege of terminating the contract at the end of any two years by giving the contracting company thirty days' notice. The lights are to be kept burning from sunset until daybreak, the company being subject to a penalty of $1 for every lamp that fails to burn nightly. The company receiving the contract is to be bonded in $20,000 to insure its fulfilment—A trust mortgage for $1,000,000 from the Maryland Electric Company, of Baltimore, to the State Trust Company, of New York, has been recently recorded. It is to secure the issue of 900 bonds of $1,000 each and 200 bonds of $500 each by the electric company. The mortgage is secured by the property, rights and franchises of the electric company.

THE KNAPP ELECTRICAL WORKS.

Notice of Removal.

About Jan. 1 the Knapp Electrical Works, Chicago, are to move from their present quarters to 271 and 273 Franklin street, where their facilities are to be doubled. The new building has a floor space of 40 000 square feet, which is very nearly double that of their present building.

The offices, salesroom and shipping department will be located on the main floor. The two upper floors will be devoted to the manufacture of their many popular specialties. The balance of the building will be filled with a large stock, which will enable them to fill almost any order the same day of its receipt.

They are also building a factory fifty-two miles from Chicago, where they are to manufacture such articles as require a great deal of room.

This company has recently taken up the manufacture of fixtures, combination electric and gas, and are getting up new and original designs, and it is their intention to make a very fine display of this line in their new store.

The growth of this company is something remarkable. They deal only in electrical supplies, and do not enter into competition with manufacturers of lighting apparatus.

Among the valuable agencies which this company controls are that of the Safety Insulated Wire and Cable Company of New York and the Columbia Incandescent Lamp Company of St. Louis.

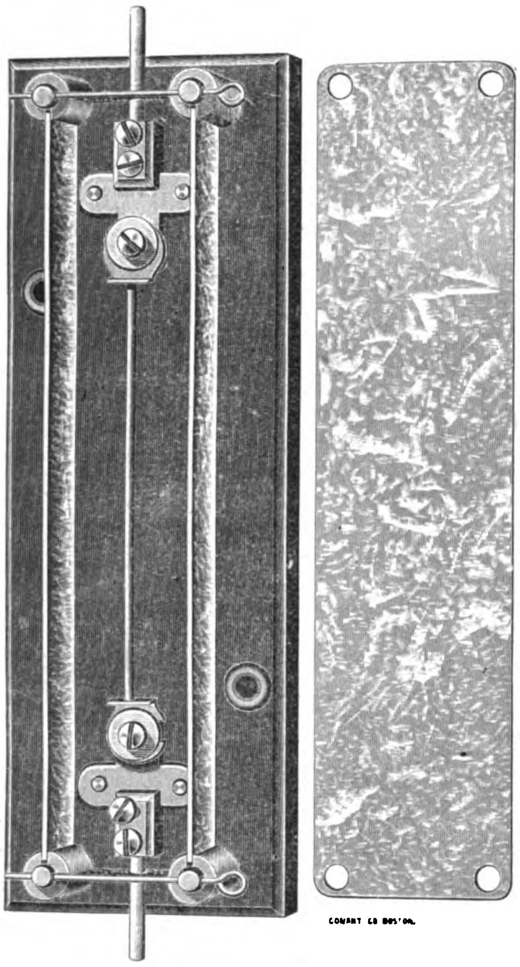
Over five million feet of the safety wire was used at the World's Columbian Exposition, and one hundred and sixty thousand feet of their lead covered cables is used in the South Park Boulevard lighting system.

The Knapp Electrical Works intend fitting up offices in their new store which will be as fine as those of any house in this line of business in this country, and will always be glad to welcome their friends and customers to their new home at 271 and 273 Franklin street, Chicago.

A Covered Fuse Box.

The illustration accompanying is that of a Covered Fuse Box for use on a 500-volt circuit, recently perfected and placed on the market by the W. S. Hill Electric Company, of Boston, Mass. The metal terminal blocks are mounted on a slate base, and the parts are all protected by a box made of mica, the removable cover of which is held in place with two wire pins, so as to be readily removed to permit of replacing a blown fuse.

For some time past there has been a very large demand for a light, compact covered 500-volt Fuse Block, and the above enterprising company in producing this show their ability to keep fully up to the times in this line, as well as in switches and switchboards; hence it is no surprise to hear that they are having to seek a much larger factory, their business being now so extensive that they have quite outgrown their present factory.



A COVERED FUSE BOX.

Royal Arc Lamps.

Mr. J. J. Gates, manager of the Connecticut Royal Arc Company, has close a contract with the Hartford Electric Light Company for 800 Royal Arc equipments, which are to be attached to the arc lamps at present in use on the local company's circuit.

The contract was made after a thorough test of the new lamps by the electric light company.

The Westinghouse Company's New Factory.

The Westinghouse Electric and Manufacturing Company will advertise at once for bids for the erection of new works at Brinton. At that place the company has secured twenty-three acres of land.

The plans for these buildings have been under consideration and elaboration for the last five months, and every detail of manufacture has been most carefully considered, and the buildings finally decided upon are a machine shop 754 feet long and 231 feet wide, a two-story warehouse of the same length, and a suitable power house for the operation of all the machinery. These buildings will give the Electric Company a capacity of $1,000,000 output per month, which under pressure can be greatly increased.

Especial attention has been given to the arranging of the storeroom and warehouse for the carrying of supplies and manufactured material in such a manner that the least possible amount of material will be required with the minimum cost of handling, and the tools have also been arranged with reference to economy in handling the material. The central part of the machine shop will contain most powerful electric cranes, capable of handling the largest pieces of machinery that will probably be needed in the future for electrical apparatus. The buildings in general design are in many respects like those erected by the Air Brake Company at Wilmerding, but are much larger, and include such alterations as have been found necessary for the different classes of work. The buildings will be practically fire-proof.

The advantages to be gained by the Electric Company by moving its manufacturing plant into this establishment, as compared with its present arrangement, will be enormous.

At the present time the Electric Company is employing about 2,000 hands, and has been constantly adding to its force during the past sixty days.

INCORPORATIONS.

The Brooklyn, Queens County and Suburban Railroad Company, Newtown, N. Y.—to construct a street surface road about five and one-quarter miles in length in Queens County, N. Y. Capital stock, $15,000,000. Directors: Frank Bailey, Edward Johnson, George H. Southard, Henry E. Hutchinson, Frederick T. Aldridge and Julian Fairchild, of Brooklyn; Cassius M. Wicker and Francis P. Lowey, of New York City, and Henry T. Bragg, of Yonkers.

The Villisca Electrical Company, Villisca, Iowa—to erect and operate an electric light and power plant at Villisca. Capital stock, $25,000. Promoters: M. N. McNaughton, W. S. Alger, H. C. Stoddard, B. F. Fast, all of Villisca.

Midway Electric Light Company, St. Paul, Minn.—to produce, generate, transmit, furnish and sell electricity for the purpose of supplying light, heat and power and for other purposes. Capital stock, $30,000. Promoters; Geo. B. Lynch, E. A. Forbes, G. F. Downing, St Paul.

The Parsons Electric Light Company, Parsons, W. Va.—to furnish electric light, heat and power to towns, corporations and individuals, etc. Capital stock, $100,000. Promoters: Thos. B. Gould, Jno. P. Harford, J. S. Dougal, Parsons, W. Va.

The Hough Electric Company, San Francisco, Cal.—to manufacture and deal in electrical apparatus and machinery and deal in patents and inventions. Capital stock, $1,000,000. Promoters: Edw. S. Hough, Jos. Hough, Ernest Hough, LeRoy G. Harvey, Jno. M. Beck, Oakland, Cal.; Howard E. Wright, San Francisco; C. L. Wingley, Jr., Oakland, Cal.

The Progressive Manufacturing Company, Camden, N.J.—to manufacture and sell electrical devices slot machines, and other coin control devices, cigar store fixtures and devices, etc. Capital stock, $200,000. Promoters: Samuel Welsh, Chas. M. Keegan, Philadelphia, Pa; John B. Adams, Camden.

The Northwestern Telephone and Electric Company, Milwaukee, Wis.—to deal in telephone and other electrical supplies. Capital stock, $50,000. Incorporators: A. B. Ferdinand, H. C. Dodge and H. H. Spencer.

The La Junta Electric Company, Denver, Col.—to furnish electric plant for the town of La Junta, Otero County, Col. Capital stock, $25,000. Promoters: Chas. F. Lacombe, Geo A. Goddard, Denver; Auen G. Bentley, La Junta, Col.

The Water and Improvement Company of St. Charles, St. Charles, Mo.—to conduct a system of water works and a light, heat and power plant at St. Charles. Capital stock, $100,000. Promoters: H. C. Scott, Thomas Fox, I. H. Lionberger, St. Louis, Mo.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED NOVEMBER 21, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

509,002. Electric Railway. Jonathan H. Vail, New York, N. Y. Filed March 17, 1893.

509,065 Electric-Railway Conduit. Granville T. Woods, New York, N. Y., assignor to the Universal Electric Company of the City of New York. Filed Oct. 14, 1892. Renewed Sept 25, 1893.

509,072. Electric Railway. John H. Dale, New York, N. Y., assignor to the Universal Electric Company of the City of New York, same place. Filed March 1, 1893.

509,123. Trolley Mechanism. James T. Fuller, Calvert, Tex. Filed July 17, 1893.

509,311. Electric Locomotive. John C. Henry, New York, N. Y. Filed Dec. 15, 1891.

509,312. Supply System for Electric Railways. John C. Henry, New York, N. Y. Original application filed Aug. 20, 1889. Divided, and this application filed April 29, 1892.

509,328. Hanger for Trolley-Wires. George H. Ricke, Cincinnati, Ohio, assignor of three fourths to Owen M. Hilland, Michael A. McGuire and Charles C. Agin, same place. Filed Aug. 7, 1893.

ELECTRIC LIGHTS AND APPLIANCES.

508,926. Casing for Electric-Arc Lamps. Peter Federmann, Berlin, Germany. Filed Feb. 23, 1893.

509,014. Electric-Arc Lamp. Henry P. Ball, Brooklyn, assignor to the Edison General Electric Company, New York, N. Y. Filed March 2, 1891.

509,036. Automatic Thermal Cut-Out for Incandescent Electric Lamps. Edward H. Johnson, New York, N.Y., assignor to the Edison Electric Light Company, same place. Filed 3, 1886.

509,167. Electric-Arc Lamp. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company of Connecticut. Filed June 29, 1893.

509,168. Electric-Arc Lamp. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company of Connecticut. Filed June 29, 1893.

509,188. Electric-Arc Lamp. Barton B. Ward, New York, N. Y. Filed Feb. 15, 1893.

509,297. Socket for Electric Lamps. Waldo C. Bryant, Bridgeport, Conn., assignor to the Bryant Electric Company, same place. Filed March 22, 1893.

SIGNALS AND SIGNALING APPARATUS.

508,946. Automatic Railway Electric Signal. Burton A. Karr and Charles H. Bradrick, Omaha, Neb., assignors to the National Railway Signal Company, same place. Filed Dec. 27, 1892.

509,093. Electro-Mechanical Slot Mechanism for Railway-Signals. Thomas H. Patenall, Rahway, N. J. Filed Jan. 6, 1893.

509,171. Electric-Signal Receiver. William H. Kirnan, Bayonne, N. J., assignor to the Gamewell Fire Alarm Telegraph Company, New York, N. Y. Filed April 17, 1893.

509,201. Railway-Train Order and Signaling Device. Leonard T. Crabtree, New London, Wis. Filed June 24, 1893

509,217. Combined Electric Time-Stamp and Signal Device. Thomas F. Gaynor, Louisville, Ky., assignor, by mesne assignments, to the New Gaynor Electric Company, same place. Filed March 7, 1891.

509,218. Electric Signal Device. Thomas F. Gaynor, Louisville, Ky., assignor, by mesne assignments, to the New Gaynor Electric Company, same place. Filed March 16, 1891.

509,244. Electrical Apparatus for Controlling Signal or Other Circuits. Homer A. Parrish, Jackson, Mich., assignor of one-tenth to Eugene J. Weeks, same place, and George A. W. Dodge, New Haven, Conn. Filed Jan. 28, 1893.

MEASURING INSTRUMENTS.

509,095. Electric Meter. John Perry, London, England. Filed March 28, 1893.

509,342. Ampere-Meter or Voltmeter. Carl Wilkens, Frankfort-on-the-Main, assignor to Hartmann & Braun, Bockenheim, Germany. Filed July 19, 1893.

BATTERIES.

509,266, 509,267, 509,268, 509,269, 509,270, 509,271, 509,272. Storage Battery. Edward P. Usher, Grafton, Mass., assignor to the Hopedale Electric Company of West Virginia. Filed Jan 23 1893.

TELEPHONE AND TELEGRAPH APPARATUS.

509,061. Speaking Attachment for Telephones. William Weber and George Weber, Philadelphia, Pa. Filed Sept. 16, 1893.

509,066. Telegraphy. Julien P. Wooten, Bainbridge, Ga. Filed Nov. 18 1892.

509,186. Telephone Exchange Apparatus. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Feb 21, 1893.

509,216. Fire Alarm Telegraph Repeater. Thomas F. Gaynor, Louisville, Ky., assignor, by mesne assignments, to the New Gaynor Electric Company, same place. Filed March 2, 1891.

509,219. Non-Interference Signal Box Mechanism for Fire Alarm Telegraphs. Thomas F. Gaynor, Louisville, Ky., assignor, by mesne assignments, to the New Gaynor Electric Company, same place. Filed March 19, 1891.

509,290 Signal Telegraph. Claudius V. Boughton, Buffalo, N. Y., assignor, by direct and mesne assignments, to the Boughton Telephotos Company, same place. Filed Nov. 26, 1892.

MISCELLANEOUS.

508,914. Device for Singeing Cloth. Rudolph M. Hunter, Philadelphia, Pa. Filed July 16, 1890.

509,050. Electric Bell. William J. Schweiger, New York, N. Y., assignor of one-half to Hermann Apfelbaum, same place. Filed March 15, 1893.

509,075. Base for Stereotype or Electrotype Plates. Herman Fietsch, Jr., Chicago, Ill., assignor to Daniel W. Ryan, same place. Filed Feb. 20, 1893.

509,085. Electric Cigar Lighter. Christian J. Jenne and Charles E. Willey, Louisville, Ky., assignors to William Carter, John W. Dawson and Joseph Meyrick, same place. Filed April 5, 1893

509,091. Magazine Gun and Electrical Devices Therefor. John L. McCullough, Brooklyn, N. Y. Filed Dec. 12, 1892.

509,116. Electrically-Controlled Door. Frank Callagan, Bridgeport, Conn., assignor to Jacob B. Klein, same place. Filed April 8, 1892.

509,124. Process of Preparing Plates for the Purpose of Utility and Ornament. Hannibal Goodwin, Newark, N. J. Filed Jan. 28 1887.

509,279. Regulating Switch for Electric Elevators. Henry A. Allen, Chicago, Ill., assignor to the Eaton & Prince Company, same place. Filed Feb 20, 1892.

509,322 Current Controlling Device. William H. Morgan, Alliance, Ohio, assignor of three-fourths to Thomas R. Morgan, Sr., Thomas R. Morgan, Jr., and John R. Morgan, same place. Original application filed July 22, 1891. Divided and this application filed Sept. 22, 1892

To Inventors and Others.

United States and Foreign Patents Procured.

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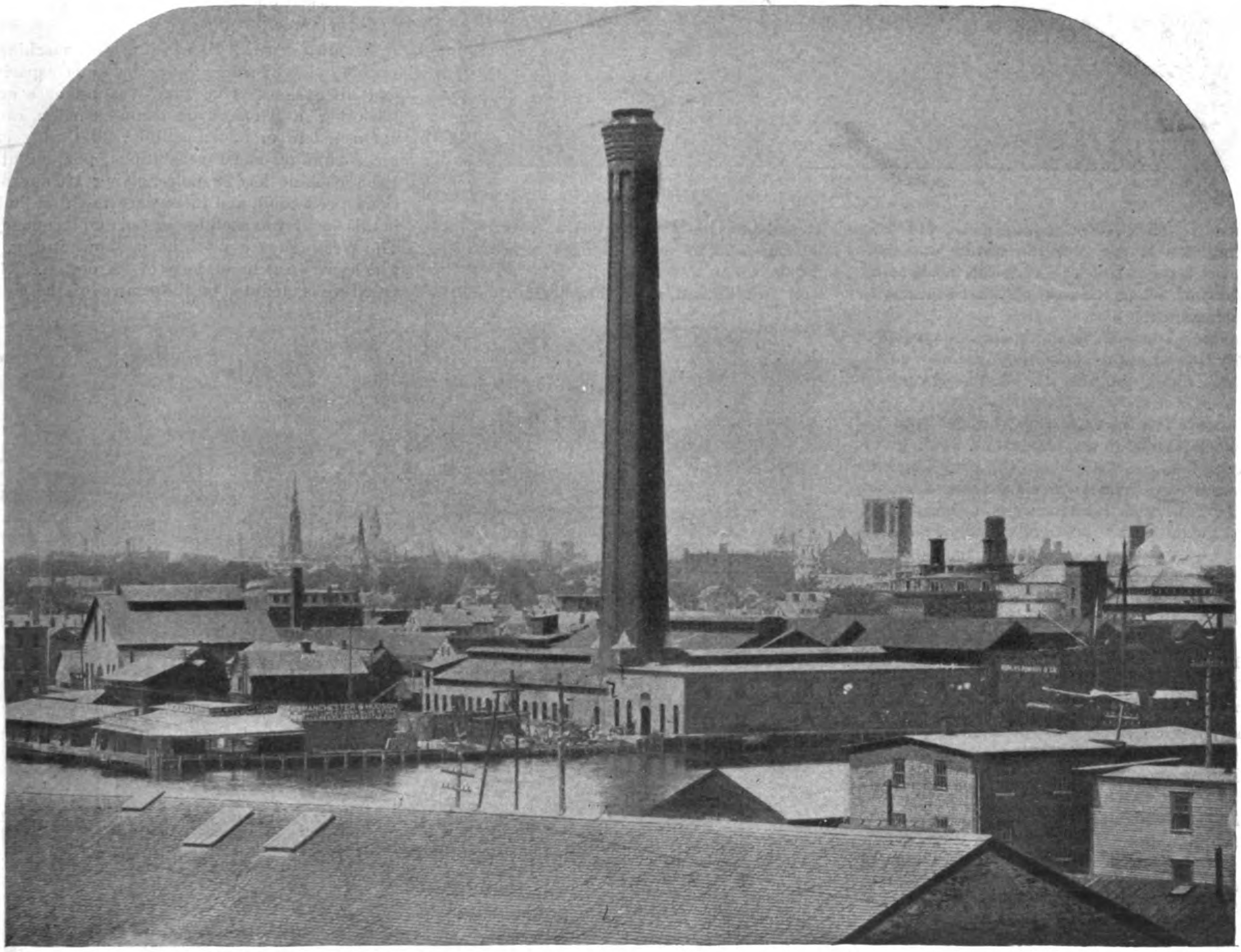
ELECTRICITY.

VOL. V. NEW YORK. DECEMBER 13, 1893. CHICAGO. No. 22



THE NARRAGANSETT STATION, PROVIDENCE, R. I. (SEE PAGE 258.)

The Narragansett Station.

Its Special Machinery and Unique Equipment.

The city of Providence contains an electrical central station which is in many respects distinctly original, both in regard to its general design and the style of machines with which it is equipped. The present arrangement was not contemplated at the time the station was first built, but is the result of extensions made from time to time, which the steady growth of its business demanded.

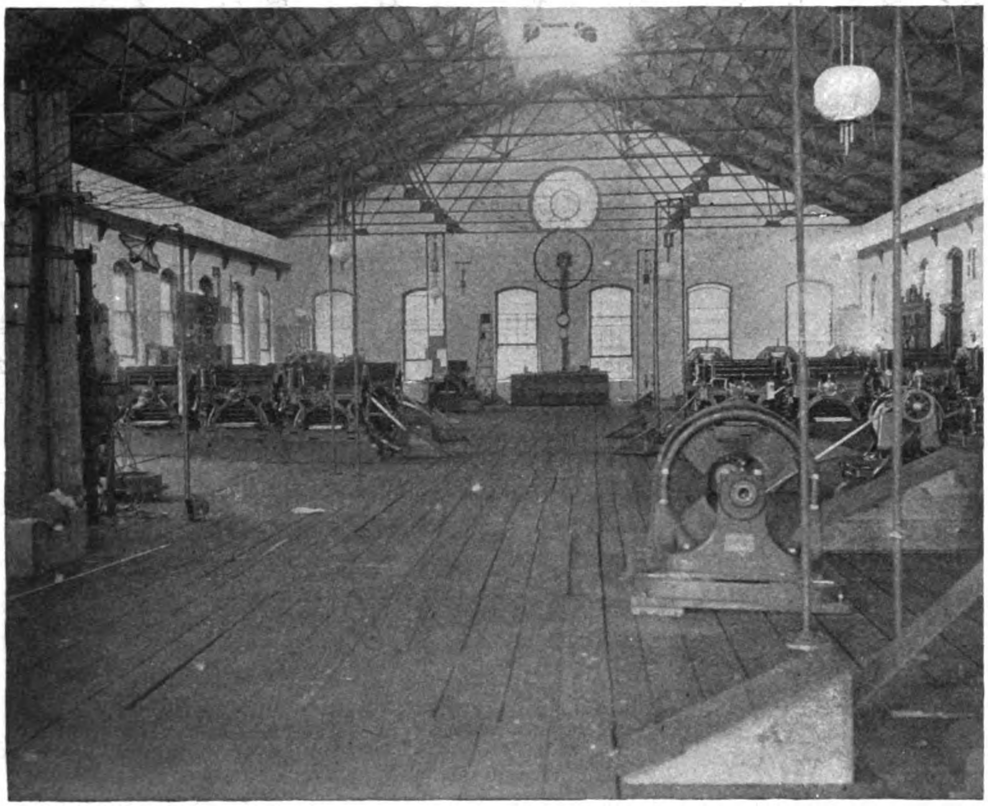


FIG. 1.

The latest additions to the plant are specially worthy of attention, as they include some dynamos which are the first and only ones of their kind in use.

The station, as will be seen from the Frontispiece, is situated on the waterfront, which gives it special facilities for condensing purposes, and is a large, substantial brick structure whose interior is divided into three main rooms, the boiler room, engine room and dynamo room.

The boiler room occupies the end of the building facing the water, and extends across its entire width, the two rows of boilers being parallel to the waterfront. In the rear of this a partition running lengthwise through the building divides it into two long rooms, the one on the right containing the dynamos and the other the engines and the large direct connected machines.

The plant contains eight boilers, four of the Babcock & Wilcox make and four of Moore's National boilers. These are set in batteries of two boilers each, and are run so as to give about 160 lbs. pressure at the engines. Blake and Worthington pumps are used for feeding the boilers and condensers. The aggregate capacity of this steam plant is about 5,000 horse power, an amount which is only exceeded by but few stations in this country.

The dynamo room, a portion of which is shown in Fig. 1, is raised a little above the level of the boiler room floor, and a line of shafting runs below the floor in the middle of the room and along its entire length from which the belts run up to the machines arranged along either side of the room.

There are no less than fifty-five dynamos in this part of the station, whose capacities aggregate more than 3,000 horse power. These include thirty 50 light (2,000 C. P.) Thomson-Houston arc machines, seventeen 50 light (1,200 C. P.) Thomson-Houston arc machines, two 90 K. W. 500 volt and two 60 K. W. 500 volt Thomson-Houston dynamos, two 4,000 light and two 3,000 light Westinghouse alternators.

In addition to the switchboard, described below, a new one 25 feet in length is now being built for use in this room.

The switchboard, which has been installed in place of the one built by the Thomson-Houston Electric Company, is composed of five panels of white Italian marble, and is six feet high, fifteen feet long, having elegant brass mountings and illuminated by incandescent lamps placed on top of the brass caps which surmount the iron tubular columns supporting the panels in their places side by side. This elegant piece of work has connections for fifty circuits and is to control fifty dynamos. The plugs are composed of aluminum bronze, with solid mahogany handles, every hole in the marble board being lined with fine brass bushings. This switchboard was designed throughout by Mr. C. H. Herrick, electrical engineer, Boston, and built by the W. S. Hill Electric Company, Boston. As a piece of apparatus it is entitled to rank as the handsomest and best piece of work of its kind ever made.

The circuit wires enter and leave the station by way of an iron tower specially designed and built by the Berlin Iron Bridge Company of East Berlin, Conn. This tower is twenty feet square and thirty feet high, and no less than 225 different wires are carefully accommodated in it. This tower and all the wiring were put in under the personal superintendence of Mr. Herrick.

The really unique part of the equipment is in the engine room however, where the three large direct-connected dynamos are situated. The smallest of these is a six-pole 500 volt generator of the Thomson-Houston type, driven by an Allis-Corliss engine running at 90 revolutions per minute. This has a capacity of 250 K. W., and is used, together with the 500-volt dynamos mentioned above, for supplying motive power. A number of small manufacturing shops are run from this station, the largest of which consumes 50 horse power.

The two special direct-connected machines, running side by side, are of the same capacity and dimensions. One is a Westinghouse and the other a Thomson-Houston machine, each connected to cross-compound Allis-Corliss engines running at 90 revolutions per minute. Each machine has 80 poles, giving 120 alternations per second, and these were the first built in this country at such low speed and frequency. The Westinghouse machine is shown in Fig. 2, which gives a general idea of its design. The armature is mounted on the centre of the shaft between the two engine cranks, and is 12 feet 3 inches in diameter.

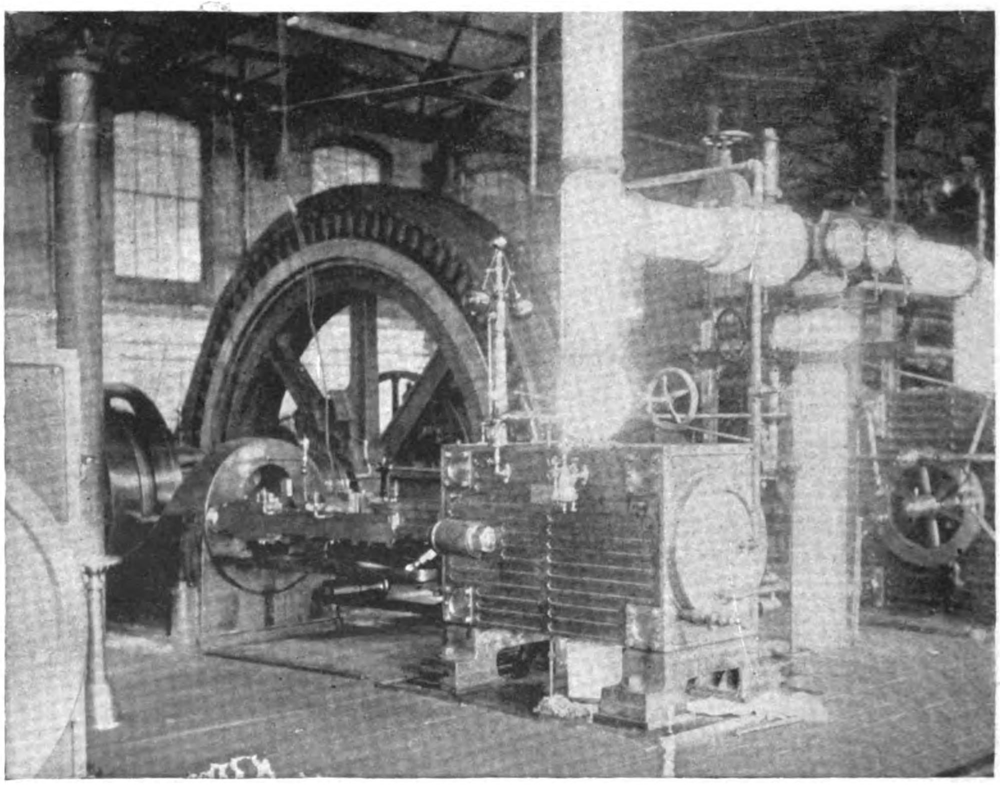


FIG. 2.

The field rests on separate foundations, and is set on tracks parallel to the armature to permit its movement to the position shown in Fig. 3, in order to remove or repair the field or armature coils. The exciter stands at the crank end of the engine, and is belted to a pulley on the armature shaft. No special means of regulation is employed.

The Thomson-Houston generator is very similar to the above in its general outline, and has the same number of poles, diameter of armature and number of revolutions. The method of regulation, however, resembles that known as the Wall controller used with the Thomson-Houston arc machines. It has two exciters, or rather one exciter which itself has an exciter. The dynamo which supplies the field of the large generator is a multiple wound machine, and the field of the latter is a series machine. The result of this arrangement is to bring a change of load very gradually onto the generator, and it therefore gives the engine time to adapt itself to the change without any noticeable variation in speed.

Both of these large machines are so wound that the primary circuit may run at either 1,000 or 2,000 volts. For the former pressure the armature coils are connected all in series, and for the latter the two half series are put in multiple. This change is made by a single switch to which the windings are connected.

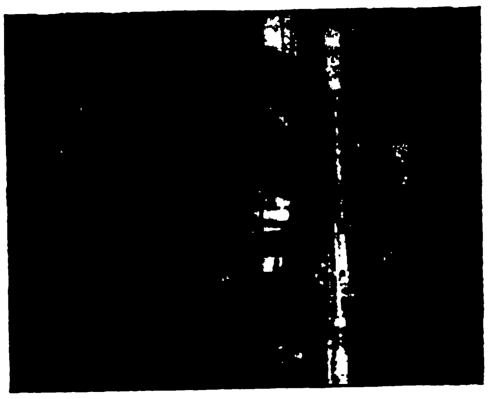


FIG. 3.

Besides the three direct connected engines are three others, all of the same type, which are belted to the shafting under the dynamo room. Two of these are cross-compound of 300 H. P. and 1,200 H. P. respectively, and one 1,500 H. P. triple expansion engine. The latter and the two large direct connected machines run with independent condensers and the others with one large condenser in common.

The total incandescent light service wired for is equivalent to 21,800 lamps of 16 C. P., the maximum output of the station being about 70 per cent. of this amount.

The arc service includes 2,066 lamps in operation, 1,392 of which are contracted for by the city of Providence and the remainder private lighting. This very large service makes the use of such large units possible, and it is expected they will considerably increase the economy of the plant and simplify the operation of the station.

Professor Elihu Thomson in the course of a lecture on lightning and high potentials in Lynn lately received in his body a discharge from a 1,000,000 volt current. Professor Thomson stated that he inclined to the belief that lightning is caused by the action of the sun on the clouds through the ether, arguing that if the sun can produce the aurora borealis in the light thin air, which he produced by electrical apparatus, there is reason to think that in the dense air nearer the earth it can produce a current of high pressure that will strike through with brilliant discharges. He showed a completely safe protection from thunderbolts in the shape of a cage of brass wires, and declared that an umbrella held over the head with brass chains hanging from the ends of the ribs makes a complete protection.

The Electrical Transmission of Power from Niagara Falls.—II.

BY PROF. GEO. FORBES.*

It will be well at this point to say something about the frequency which is required to prevent the arc and incandescent lamps from flickering. I have made a number of experiments on these points, and my conclusions are as follows:—A 16 candle-power 50-volt incandescent lamp shows a flickering almost up to 25 periods per second, at which frequency the flickering ceases when at its normal brightness; but if pushed to an excess of incandescence, the flickering was just perceptible up to 27 or 28 periods. I believe that a 100-volt 16 candle-power lamp shows a perceptible flicker up to 28 periods; but I may mention that this flicker is not nearly so serious or perceptible as that which frequently arises from the employment of certain types of engines, especially single-acting high-speed engines, when sufficient fly-wheel momentum is not provided. As a case in point, I would mention the lighting in the Holland House, one of the best hotels in New York, where, to an experienced eye, the flicker of the lights in the large dining room from this cause is very objectionable. The thinner the filament, the more liability is there to such a flickering. I have lately examined the thick filament lamps to which the name of "Bernstein" lamps has been given, which consume 6 to 10 amperes at low voltage. It takes so long a time for the incandescence to die out when the current is stopped, that I have little doubt about their being able to work without any perceptible flickering at so low a frequency as even 16 periods per second. I have also made some experiments of a similar nature on arc lamps at low frequencies. At 37½ periods per second there was a very bad flickering, and this was most noticeable when looking at a piece of white paper illuminated by the naked light, or when looking at an opal shade put on the lamp. At 40 periods it was still bad. Neither at this speed, nor at the previous one, was there any serious noise, but at 40 periods the noise could be perceived by putting a glass globe over the lamp resting on the metal framework directly. At 41·7 periods there was just enough flickering to be objectionable; at 45 periods it was just possible to notice it on a printed page held close to the lamp, but it was not visible when reading at a distance of 10 feet. At 50 periods the only means of detecting anything of the sort was by looking directly at the arc; nothing was seen when reading a book either with the opal shade on or off. At this frequency the noise became much more perceptible, especially with a long arc about one-eighth of an inch. On reducing the length of the arc to one-sixteenth of an inch the noise was much less. In all these experiments the consumption of energy was at the rate of 26 volts and 14·2 amperes at the lamp terminals. The best cored carbons of Siemens & Halske were used.

An objection has been raised to the use of low frequency owing to the fact that a periodical twisting strain is given to the shaft of the dynamo, but this objection disappears almost entirely when we are dealing with a machine generating two phases.

It follows, therefore, that for arc and incandescent lighting at a very low frequency it becomes necessary to use alternating-current motor-generators, or else to use something of the character of a commutating machine to convert into continuous currents. Such machines as those exhibited by Schückert at Frankfort in 1891 are useful up to a certain extent, but they are expensive, and comparatively inefficient, as their only function is to commutate the current—an operation which ought not to involve any significant loss. At the present moment a good commutator for the alternating current is not upon the market, but the matter is of such prime importance that I feel confident that much will be done in this direction. In fact, I have seen enough with my own eyes to have no fear about our being able to generate continuous current from the two phase alternating current without serious loss, and with very inexpensive machinery. If, however, the object of our work was mainly, or even to a considerable extent, to provide the means of lighting towns by arc and incandescent lamps, I should have hesitated to recommend a reduction in frequency below 42 periods per second, such as is used by Ganz & Company, and which is operated so successfully at Rome and Tivoli, and at a very large number of other places on the Continent. The officers of the company and myself considered this matter most carefully, and, looking at the purposes for which our machinery is being set up, we felt sure that the proportion of electricity which would be used for lighting purposes would not be large, and that we must look upon our whole plant as a power producing and distributing plant, and that our object must be to distribute power in the most efficient and economical manner. This being the case, we agreed that it was desirable to lower the frequency so far as the mechanical conditions of the problem would allow. The lowest frequency which had been offered to us by the manufacturers was a very beautiful design of a machine at a frequency of 20 periods per second. This machine had admirable qualities, but was in some points not exactly adapted to the requirements of the situation, as developed by the selection of a special design for the turbine.

I have myself made several trials of designs at very low frequencies, even as low as eight and one-third periods per second, and for this frequency I prepared drawings of a machine which, though by no means perfect, shows a possibility of being worked into a sound machine of good mechanical construction; but further considerations led me entirely to modify the design of the machine, and eventually I arrived at the conclusion that, both from the point of view of design of the dynamo, and also for suitability of applying the current, 16 periods per second was probably as good as could be obtained. The manufacturers to whom the contract has been given were anxious to use a lower induction in the iron of the machine than that which I would have preferred, and this rendered the machine of 16 periods per second heavier than could be supported by the hydraulic piston which supports the whole weight of the turbine, vertical shaft, and revolving part of the dynamo. Consequently we have made a compromise, and are going to build our first three dynamos with a frequency of 25 periods per second. In concluding my remarks upon low frequency, I must again repeat that, from a purely practical and commercial point of view, one of the great advantages lies in the fact that for any special purpose for which a motor is required any ordinary direct current motor may be altered so as to act as a synchronizing alternating motor at a very small expenditure of time and money.

ELECTROMOTIVE FORCE.

The question of selecting a suitable electric pressure for working to Buffalo, and also for local purposes, is of some importance. Generally speaking, it is desirable to use as high an electric pressure on the line as is consistent with safe and continuous working, as this effects a great saving in the amount of copper used on the line. In the first report, founded on insufficient data, which I wrote more than three years ago for the Cataract Construction Company, I reccommended that 2,000 volts should be used in the neighborhood and that the pressure should be raised by means of transformers for the more distant transmission. But the greater portion of our work in the immediate future will have the character of distant transmission. In most of the tenders which were submitted to us the cost of transformers was almost as much as that of dynamos—in some it was more—so that the use of a step-up transformer for distant transmission meant almost double the cost of generating the current. I hold the view that a pressure of even 20,000 volts can be generated as safely in the dynamo machine itself as in the transformers, and that if we used 20,000 volts for the local work as well as for Buffalo, we should not be incurring the additional expense and losses of a step-up transformer, while we should be saving enormously in the cost of copper. Unfortunately, American manufacturers have never supplied alternating current dynamos at a higher pressure than 2,000 volts, and they are not practically acquainted with the experiences which have been gained in Europe at extra high pressure. Most of the manufacturers declared their inability positively under any conditions to go above 2,500 volts, although some of the engineers were willing to go as far as 5,000 volts. This, however, would have been no material gain to us; and the consequence is that, to meet the views of the manufacturers in our preliminary work—that is to say, in the construction of the first three dynamos for our power house—these will be only of such electrical pressure as they are accustomed to deal with. We shall therefore be using dynamos generating current at 2,000 volts, and employing step-up transformers for the extra high pressure. This may possibly render it desirable in our first work not to use the extra high pressure for local purposes. Besides the actual cost of the conductors, a very serious matter arises when we are dealing with the large currents due to comparatively low electric pressure. I refer to the large quantity of copper which has to be put into the conductors. Working at 2,000 volts, each phase of each of our generators will give nearly 1,000 amperes, without considering the effects of ratardation of phase, which will increase the current by quite a perceptible amount. So that, to put in the most economical section, will require 3 square inches for each conductor, or 12 square inches of copper for each 5,000 H. P. dynamo, or 36 square inches section of copper for the 15,000 H. P., which is now being supplied. When we remember that even with low frequency the question of skin resistance comes into play when the conductors have a large diameter, it is obvious that we are introducing serious troubles, and if a subway were to be made to carry these conductors it would require to be of very great dimensions. For these reasons I am still anxious to see the extra high pressure used even for the factories within a distance of a mile. The uniformity of the system would undoubtedly be of great benefit to us if we could generate the whole current for all purposes at the same extra high electric pressure, but as I have stated, we were obliged to content ourselves with a somewhat less perfect arrangement than would be adopted if we were dealing with the utilization of a waterfall in Europe.

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* From a paper read before the Institution of Electrical Engineers, England.

I wish to lay stress on the importance which I have considered to lie in the fact of having a perfectly uniform system with interchangeable dynamos. Many engineers to whom I have talked have suggested the use of special dynamos at different pressures for special purposes; but if we had a special dynamo for arc lighting, and another for incandescent lighting, a third for street railways, another for electro-deposition and so on, the possibility of interchanging dynamos would disappear, and the whole system would be much more complicated to work.

I wish now to make a few remarks about the insulation which it has been customary to put upon dynamos and transformers which were to be used with high electric pressure. Many persons who have not given sufficient attention to the subject seem to be inclined to believe that there is something mysterious about the tendency of electricity in a dynamo or transformer to break through the insulation, and which prevents them from being subject to the ordinary laws of electricity. Thus, when building a dynamo for 2,000 volts, a thickness of insulation is given which would stand a test of more than 100,000 volts without breaking down, and it has been found from the ordinary methods of using the plant that if something of this sort is not done, the insulation will break down. I wish to point out that the reason for this lies in the fact, not that the insulation breaks down with 2,000 volts, but that in a 2,000-volt system as generally used, electromotive forces are occasionally generated amounting to 100,000 volts or more. These abnormal rises in electric pressure are chiefly due to the resonant effect, which has received so much attention of late years, and may be caused by the sudden breaking of the circuit of the dynamo. If these causes of excess be avoided, the electric pressure will never rise above the working pressure, and the insulation will never break down, even though its thickness be only little more than sufficient to stand a test at the working pressure. Dr. Fleming has shown us how to kill the resonant effect, and such a phenomenon never appears now at Deptford. This trouble may also be avoided by having as little capacity on the line as possible, especially when combined with low frequency. As to the cause of trouble mentioned above, I hold that it is a piece of culpable ignorance, ruinous to the machinery, if anyone should ever, on a large power circuit with alternating current, suddenly break the circuit while current is passing. This practice is quite unnecessary, and has given rise to a large proportion of the breakdowns of alternating current machinery.

PARALLEL WORKING.

Engineers in America have had no experience in actual commercial conditions of parallel working with alternators. This is partly because the machines which have been made in that country do not work so well as some others in parallel. In the case of the transmission from Niagara Falls, my opinion is that parallel working will give the best results. If this arrangement were not adopted, it is obvious that when the dynamos are loaded up as much as possible, they could never be all fully loaded. It is also quite obvious that if our conductors are to be carried through subways, the space required becomes quite excessive, unless we adopt parallel working. The complete success of parallel working between Tivoli and Rome left no doubt as to the feasibility, besides the desirability, of adopting parallel working. The reduction in frequency which we have made assists very considerably in this result, and it says much for the American manufacturer who has received the contract that, although parallel working with multiphase machines has not been adopted in the past, he is ready to guarantee the performance in this respect of the machines which are to be built for us.

The rules which govern the construction of machines which shall work well in parallel are not very clearly understood. The only fact which has been perfectly established in practice is, that the lower the frequency the more efficient and sure is the parallel working. It certainly depends to some extent upon the amount of self-induction and the amount of mechanical momentum in the machines. It is also certain that if the self-induction of the machines is too high, they will not work well in parallel. Of all machines which have been constructed, those which work the best in parallel appear to be those of Ganz & Company, Mordey, and Elwell-Parker, but there are many others which do extremely well. It is, at present, not possible to state exactly the conditions which are necessary, but I may say that, generally, a machine with a stiff magnetic field works better than one where the iron is far below magnetic saturation. In judging whether a machine of a particular type will or will not work in parallel, I think one must be generally guided largely by one's own personal experience in the matter, combined with a knowledge of the effects of self-induction, mechanical momentum, and magnetic saturation as deduced from theoretical considerations. I do not think that anyone who knows anything of the working of the Tivoli-Rome plant, would for a moment hesitate in saying that on a large and important station like that at Niagara Falls, parallel working is essential; and this is the opinion of Prof. Mengarini, who has so ably directed the works at Rome.

MOTORS.

Under this section it may be as well to discuss some of the different purposes for which the electric current will be required. With regard to arc and incandescent lighting, if the frequency be high enough, the current can be used directly for this purpose; although most people would prefer that, in the case of arc lighting, the current should be commutated or converted in some manner so as to give a continuous current. That this is unnecessary, however, is amply proved by the perfect success of the arc lighting by alternating currents in Rome and many other large cities, especially those which have been established by Messrs. Ganz & Company. At the present time one of the largest applications of electricity in the United States is for street railways, which require a continuous current. Another similar purpose which we shall have to consider is the application to canal boats, since it is intended to work the Erie canal by electricity. This canal starts from the Niagara River, and reaches the Hudson River at Albany, 350 miles distant. For these purposes some sort of commutator or motor transformer will be desirable. Some of the first work which will be done is the supply of much direct current at 150 volts for the production of aluminium. This also requires the continuous current, and similar means must be used for obtaining it. Among the large class of mills which will be established at Niagara Falls, one of the most important kind is wood-pulp mills, one of which is already working on our land, and will be the first to receive water-power from our canal. This type of mill uses many thousands of horse-power, and is worked continuously day and night. In this feature it resembles, probably, a large number of the mills which will take advantage of the cheap power at Niagara Falls. Such mills are working continuously day and night, and do not require to be ever stopped or reversed. This is an important class of work in our case, because current can be supplied to such mills by means of synchronizing alternators whose efficiency is extremely high, and this may perhaps be done in some cases without transformers. We require also to consider the case of small motors for use in shops, and for elevators, cranes, and a large number of other purposes. In this type of motor frequent stoppings and reversals are necessary. Hitherto direct current motors have generally been employed for this latter purpose, but the rotating phase induction motors are distinctly suitable, and when these have been fully developed they will probably be largely used for this purpose. The commutated current is a thing which is sure to be in common use before long, and although our arrangements at Niagara are perfectly complete without a machine for this purpose, still its employment has been considered by us, and the probability of its future use has influenced our judgment in some points. There are so many purposes for which the direct current is most convenient, that people would generally accept it for transmission if it were capable of being economically transformed up and down to different pressures. The direct current dynamo is really an alternating dynamo with a commutator placed upon it. If the commutator, instead of being placed there, be placed in the neighborhood of the motor, we obtain most of the advantages both of the continuous and of the alternating current. This is one of the advantages of having two phases generated by the dynamo, because it is much easier to rectify a two-phase current than a single phase current. In addition to the motors above specified, there are a large number of single phase motors which start with a powerful torque which have been invented by different electricians, but which are not yet put upon the market. There are also machines with commutators like a direct current dynamo with laminated field. These all become very efficient and useful when the frequency of alternations is sufficiently diminished.

(To be continued.)

Legal Notes.

Willard M. Taylor has been appointed receiver in supplementary proceedings for Arthur E. Hemmel, electrician, of New York City, in the suit of John Dunnican. Mr. Hemmel is at present manager of the A. E. Hemmel Electric Company.

John G. R. McCorkell, in answer to a suit against him by the Edison Electric Light Company, in Philadelphia, a few days ago, told the Court that his meter was not reliable and that he had been charged for electricity that he had not used, whereupon the company replied that the science was in its infancy, and that the meter was the best they could get, and the Court entered judgment in their favor for want of sufficient defence on the part of Mr. McCorkell.

John H. Wehrle, of Newark, claims that the electric conduit system, as recently put in operation in Washington, D. C., infringes materially upon letters-patent issued to him in 1890. He has secured counsel and proposes to test his rights.

Notice of attachment for $12,000 has been served on the North Attleboro, Mass., Steam and Electric Company and a keeper placed in charge. C. T. Guild is named as plaintiff. The writ is returnable in the Superior Court at Taunton in January.

The Lemaire Decorative and Electrical Manufacturing Company, of New York City, has made an assignment to Jamin S. Morse. It manufactured electric lamps and decorative metal work and equipped buildings with electrical apparatus. The company was incorporated in July, 1892, with a capital stock of $200,000, to push the invention of Paul Lemaire, who had been connected with the Edison General Electric Company. Warren A. Conover is the president and Nicholas H. Stavey treasurer. The liabilities of the company are believed to be less than $20,000.

The Supreme Court of Ohio has affirmed the decision of the Circuit Court of Lucas County in the suit of the Consolidated Street Railway and the Toledo Electric Street Railway Companies which was in favor of the latter. The dispute was about the right to use certain tracks of the Consolidated Company.

Application has been made to the Supreme Court by the Schlicting & Smith Company, manufacturers of electrical apparatus, Brooklyn, N. Y., for voluntary dissolution on the ground of insolvency. Judge Pratt, on the application of Isaac L. Miller, granted an order requiring all interested parties to show cause before Lawyer H. B. Hubbard, at 44 Court street, Brooklyn, on Feburary 26, why the corporation should not be dissolved.

Lamp Litigation.

The Novak Injunction Suit.

The case of the Edison Electric Light Company against the Waring Electric Company, manufacturers of the "Novak" incandescent lamp, was heard before Judge Shipman in the United States Court at Hartford on Saturday last.

Mr. Dyer, for plaintiffs, opened by reminding the court that the case about to be heard was part of the litigation that had been in progress for some time by which it was hoped to secure to the General Electric Company their rights as owners of the Edison patents on incandescent lamps.

Mr. W. E. Simonds, for the Waring Electric Company, addressed the court and said that the admission of plaintiffs' counsel just made, about the delay, proved, he thought, that the Edison Company was not entitled to secure an injunction. What had been said about the Perkins Lamp Company was unwarranted, inasmuch as the Novak lamp had been worked at and finally perfected by its inventor, Mr. John Waring, entirely unknown to the Perkins people.

He was not surprised to hear that the plaintiffs, when testing the lamps they had secured in such a questionable way, found no gas in them, for the very reason that they were not Novak but old Perkins lamps, sold them by an irresponsible party. In the Novak lamp gas was used in unmistakable quantity, and affidavits were in evidence to that effect made by gentlemen who were present when the lamps were being manufactured. They had the testimony of eminent professors proving the value of using bromine gas. He would not, however, go into that phase of the subject, but would argue the merits of the case itself.

Mr. Simonds then quoted from Judges Bradley and Wallace, in this country, who had heard some of the lamp cases that had already been passed upon, and alluded to the discoveries and inventions of Mr. Lane Fox in England, who was an authority on lamps. Judge Lacombe was also freely quoted, and statements were read from the various reports of cases.

Referring to the prior state of the art at the time Edison's patent was granted, it was shown that in a patent issued to Mr. Lane Fox in England there were found the combination of elements, including the carbon filament, an all-glass receiver, and a vacuum, which were included in Edison's patent. As a fact, Edison was not the inventor of the combination, and it had been proved that inventors cannot suppress improvements which are substantially identical. Edison is claimed to have succeeded in securing a stable carbon filament in a vacuum, which it was fair to presume was almost a perfect vacuum, for it was claimed that a slender filament of carbon may be maintained for an indefinite time. Had it been possible for electricians to construct a lamp possessing every element of durability no further improvement would have been needed; yet the impracticability of maintaining a carbon burner under such conditions was of importance. It had been asserted that the carbon was consumed unless there was a perfect vacuum to maintain its resistance. But nothing had been said about accluded gases being utilized for securing stability of the burner. The Edison patent requires that the vacuum shall be nearly perfect, and yet nothing had been said upon that point by the plaintiffs' counsel.

Quoting again from Judge Lacombe's paraphrase on the Edison patent, Mr. Simonds claimed that without doubt it meant an almost perfect vacuum, and such a vacuum cannot be produced by an ordinary mechanical plunger pump, such as was used in making the Novak lamp. The plaintiff contended that the Waring Company used a mercury pump, which was untrue, for they did not require a vacuum, and such statements proved that the plaintiffs knew nothing whatever about the Novak lamp or its manufacture.

Proceeding, Mr. Simonds contended that the Waring Electric Company had made an entirely new invention, altogether different from Edison's patent. The introduction of bromine gas was something entirely new and had never before been accomplished in the field of electrical science. The plaintiffs claim that we have got their invention and something in addition. We claim to have something they have not got.

The affidavits made by Prof. Robb of Trinity College, Prof. Wright of Yale, and Mr. Stone of Boston were then quoted from in support of Mr. Simonds's argument.

Mr. Clarence A. Seward, for the plaintiffs, then proceeded to review the points which had been submitted to the court. He claimed that the testimony that had been submitted by the defendants was that of interested parties in every case. It had further been stated that the defendants sold their lamps at a higher price than any one else. As a fact, his clients had been unable to discover that any Novak lamp had ever been sold beyond those purchased by the Edison Electric Company for the purposes of the present suit.

Mr. Seward supported his suggestion for an early decision, quoted authorities on the point, criticised some of the testimony adduced, dilated upon the technical features or principles involved, and concluded his argument by stating that high authorities showed that the court had the power, and it was its duty, to protect the rights of the parties to the suit.

Judge Shipman reserved his decision.

Obituary.

Mr. Henry Goebel, whose name has been prominently before the electrical fraternity the last twelve months, died of pneumonia at his home, 504 Sixth Ave., New York, on Tuesday last, December 4, after only a week's illness. It will be remembered that when the case of the Edison Electric Company vs. The Beacon Vacuum Pump and Electrical Company, for infringement, was heard before Judge Colt at Boston, last February, testimony, including numerous affidavits and several incandescent lamps, was presented in support of the claim that Mr. Goebel was the original inventor of the incandescent lamp and not Mr. Edison, who secured the patent therefor. Similar testimony was adduced at the subsequent trial of the case against the Columbia Incandescent Lamp Co. which took place in St. Louis. Mr. Goebel was a German by birth, his father being a well-known chocolate dealer at Springer in Germany. The deceased learned the trade of watchmaker and optician, devoting much time to the study of electricity and the making of batteries, dynamos, arc and incandescent lamps. About 1850 he created quite a sensation with his various apparatus, but being a man of retiring disposition, and never appreciating the value of money, he remained in obscurity, earning a comfortable livelihood and satisfied with the personal pleasure his discoveries and inventions afforded him. He had resided in this country since 1848, being the father of fourteen children, seven of whom survive him.

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The Narragansett Station. The equipment of the Narragansett station, described elsewhere, includes two special machines which are the first of their kind in use, and which illustrate the tendency of modern practice towards large units. In the present case the installation of the machines is of too recent date to furnish any data as to their comparative merits, or even their practical efficiency, but the similarity of the two units is so close that it is hardly probable that there will be any considerable difference in their performance. Between these, however, and the smaller machines which compose the old plant, there must be found a great difference, not only in the actual efficiency, but in the simplification of their management and the wear and tear due to the high speed of the latter. On one side we have about 1,500 horse power developed by three machines, forming an integral part of the steam engines, which, on account of their slow speed of 90 revolutions, are largely exempt from the depreciation and repairs which a speed of 1,000 or 1,200 revolutions involves. They are also capable of running with but a trifle of attendance; and the absence of countershafting and belting is an advantage too obvious to call for explanation. If for no other reasons, the saving in space and the absence of noise will be found sufficient grounds for the use of direct-driven machines in many places.

On the other hand, a similar amount of power means the use of twenty or thirty machines whose speed occasions rapid depreciation and the care of which amounts to many times that needed for the former. The oiling, cleaning, adjusting of brushes, etc., and general inspection of the small machines takes half a day where the others need no more than half an hour.

Leaving out the gain in efficiency, therefore, the use of large direct-connected units commends itself strongly if only in respect to repairs and attendance. The series system of arc lighting in general use forbids the use of very large machines, but as the load in this case is practically constant, the advantage to be gained by substituting one or two generators for forty-seven in this case, could not be questioned. In multiple systems where the change is easily possible, there is little doubt that it will soon become the rule, as every consideration points to its advantage.

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AMONG all the books which the Holiday Season calls forth, none can have fewer readers than the one which Mr. W. J. Johnston is about to issue, entitled, we believe, " Additional Arguments Showing that Messrs. Martin, Wetzler, Stump and Colvin are Base Conspirators, and that I am a Much Injured Man; or, Reasons Why the Trade Should Advertise Exclusively in My Pioneer Electrical Journal." The title is a long one, but wait till you see the book. The skeleton of Uriah Heep, done in gold, will illuminate the first cover, and the tail-piece will represent Mr. F. A. La Roche sinking into the bottomless pit—where Brother J. would like to see him.

Electricity in Agriculture. A bill has been introduced in Congress by Senator Peffer, providing for the establishment of an experimental station for testing the use of electric power for farm implements and machinery, to be under the supervision of the Secretary of Agriculture, and an appropriation of $10,000 is named for the first year's expenses in putting the plan into operation.

The value of experiments of this kind is not a matter of question to any one at all familiar with electrical work. As a means of propulsion for moving machinery such as ploughs, mowers, reapers, etc., electricity would hardly be more adaptable than a windmill or a sail. We may assume that a 500 volt current would be necessary, and very few farms are equipped with electric power stations. But even with the necessary current supply, how is it to be adapted to the machines? The trolley is evidently out of the question, as it is hardly feasible to cover a farm with trolley wires close enough for ploughing, and the storage battery is poorly adapted for running over ploughed ground. In view of the fact that steam engines have failed in this work principally on account of the high cost, electricity, even if it could be applied, would be a still more expensive failure.

For running stationary machinery, such as threshers, a motor may be readily used if the current is at hand, although a portable steam engine will probably be found very much cheaper.

The question is perfectly apparent in any particular case, to almost any electrician, and there is no more necessity for Government investigation of this subject than there is for a revision of the multiplication table.

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THE LATEST reports from 44 Broad street are that Mr. Sunny has been brought up short and summarily dismissed, Mr. Garfield taking his place temporarily; and that the resignation of Mr. F. P. Fish is in the hands of the Board.

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MR. HENRY S. HEWITT, who died in this city last week, of pneumonia, was a newspaper man of far more than ordinary ability and of varied experience. He had done much popular dramatic work, and was the author of the lines "It's English, You Know," which made Dixey famous. Latterly, Mr. Hewitt had devoted most of his time to Wall Street matters. His comments on General Electric in the *Daily America* and *Evening Advertiser* have attracted wide attention, and his views have been found correct.

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THE REPAIR shops of the General Electric Company at Atlanta have been closed by order of the executive board of the corporation. This was one of the largest shops in the city and occupied a large five-story building. The entire South was included in the district served by the Atlanta shops. Repair work from every State in the South was sent there, and the shops figure extensively in Atlanta's industrial life. These facts are reported merely to show that the wreck of the General Electric Company is well nigh completed.

We note that the New York and London Electrical Association who sell "Actina" are advertising in the New York papers. We simply call the attention of our daily contemporaries to the fact that these people were branded as frauds and humbugs in these columns some months ago, and that subsequently they were ordered out of the Electricity Building at the Fair, where they had an exhibit.

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It would be interesting to know just how much stock in the Vulcanized Fibre Company, of Wilmington, Del., is held by Mr. F. H. Webster, the purchasing agent of the General Electric Company, and just how and for what considerations Mr. Webster obtained the same. It would also be of interest to know how a man working on a modest salary, as is Mr. Webster, can build a row of houses out of the profits of a few brief years of business.

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We do not wish to be considered as having any enmity whatever towards the Brush Electric Company of Cleveland; we merely record the progress of events, and point the moral that Mr. Coffin has controlled only to wreck. In confirmation of our previous reports on the condition of this company, we are enabled to state positively that the Brush Company's total business for the month of October amounted to less than $50,000.

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No announcement made in these columns has given us more pleasure than it does to state that our old friend, everybody's friend, Mr. A. H. Reece, of Denver and the rest of the world, is the proud and happy father of a ten-pound son. At last accounts Achilles, Jr., was giving six concerts daily. No longer compelled to wear a title which has been a sham and a fraud—hail Papa Reece!

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The stockholders of the Portland General Electric Company would do well to investigate the affairs of their company, and find out whether the dividend recently paid had been earned or was borrowed from the General Electric Company.

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The late Mr. F. L. Ames was an investor to the amount of $300,000 in the preferred stock of the Northwest General Electric Company, recently collapsed. He who runs may read just why the Ames estate has closed out its holdings of General Electric at a sacrifice of more than fifty cents on the dollar of their original cost.

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We are prepared to assure our readers that Mr. Coffin's scheme to interest local capital in Cleveland for the purchase of the Brush Company has been a flat failure. Mr. Coffin is about as well known in Cleveland as he is at the corner of Broad and Wall Streets.

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We have plenty of evidence at our disposal to prove that the opinion of Mr. Coffin held by Messrs. Drexel, Morgan & Company is even lower than that held by Electricity.

It is an encouraging sign of improving conditions that the Stanley Electrical Manufacturing Company of Pittsfield have increased their capital stock to $200,000, the entire increase having been subscribed by local capitalists.

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If Messrs. Coster and Twombly are really anxious to find all the rotten spots in the General Electric Company we beg to suggest the office of the purchasing agent as a good thing to investigate. Electricity can supply a few pointers on which to begin.

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We wonder if Mr. H. M. Byllesby's record as the manager of the Northwest General Electric Company obtained for him the offer of the management of the Chicago office!

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The new list price of the General Electric Company for Edison lamps is 65 cents, with 50 off to consumers in large lots and 60 off to licensees; that is, 32½ and 26 cents respectively.

What is the Scheme?

Is the Gutting of the Edisonian Enterprise to be Made Complete?

(From a Private Letter.)

The frequent and heavy shipments of machinery from the General Electric Company's factories at Lynn to Schenectady look for all the world like "house-flitting." Car after car heavily laden goes from Lynn to Schenectady every week. The suggestion that they are simply castings in the rough that have been made in the new foundry does not so satisfactorily explain the movement as does the more reasonable suggestion that, now the New York section of the Trust has got into control, they are making matters lively for the New England end of the line, and are simply centralizing the business at Schenectady, whither they are fast removing the machinery and some of the men to work it, away from the malarial, pestiferous exhalations that are supposed to rise from the marshes bordering on the Saugus River, Lynn, producing torpid livers and a chronic state of debility alike in workmen, directors and managers.

The remarks of our correspondent were interesting, and caused an immediate investigation.

The shipment of the machinery from Lynn to Schenectady was easily verified. But this machinery was far from being new castings. It was in reality worn out machinery from the Lynn works.

Further than this, we have learned that a considerable portion of the fine machines in the Schenectady works is offered for sale on the Boston market through a firm of brokers, Messrs. Hill, Clarke & Company, who are making sales as rapidly as possible.

The negotiations with Messrs. Hill, Clarke & Company have been conducted by Mr. F. H. Webster, the brilliant financier who holds the position of purchasing agent with the General Electric Company.

We understand that the Schenectady works are to be closed early next year, and the probability is that they will be offered for sale. The purchaser will perhaps find that what he has bought is not the outfit which has made up the finest electrical workshop on this side of the Atlantic.

There is in course of construction in the office of Manager Hawley, of the Hudson River Telephone Company at Albany, a novel map on which will be recorded the position of the house of each subscriber, of whom there are upwards of 1,600. The map has been traced on a scale of 400 feet to the inch, and is about four and one-half by five and three quarters feet in dimensions. The situation of each subscriber is indicated by a pin, and the metallic circuits for long distance instruments by a red silk thread.

The Signal for an Assault.

(From the Evening World.)

Stocks continued strong until the receipt of the following despatch from Boston:

"At a meeting of the General Electric Directors this morning the following resolution was adopted:

"*Whereas*, The net manufacturing profits since the last dividend, ordinarily applicable to payment of dividends, are offset by necessary shrinkage in customers' accounts and other assets.

"*Resolved*, That the cumulative dividends on the preferred stock be not declared at this time."

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This was the signal for an assault upon the entire market.

We do not know why this should have been construed as a signal for an assault on the market. Every broker in the Street should have considered it a signal for an assault on the office of the *Evening World*. We suppose, however, that the most conspicuous line in the above is merely a suggestion of what the preferred stockholders are supposed to have said.

Reorganization an Imperative Necessity.

(From the Boston Commercial Bulletin.)

The New York *Sun* and some other papers say that the latest movement of General Electric stock but adds another page to a mystery which has already deepened to an incomprehensible extent. Nonsense, there are those who could tell the story in its painful entirety, but pity induces silence. This column exposed the condition of the company months ago, and our duty has been performed. There is a point where duty ends, and persecution begins.

There is one man in the General Electric Company who has compelled the sincerest admiration for his grim, bull-dog tenacity in fighting what almost seemed inevitable. More than once have the largest holders had it explained to them that their only hope was in another contribution, as to attempt to unload in such a market meant a ramming of the stock to the ground. The conditions upon which such contributions were made are understood to have been that the stock would be so manipulated and supported as to allow of gradual liquidation, which has largely been accomplished.

We believe the statement to be misleading that the company is doing a business at the present time of $2,000,000 per annum net, and the annual meeting in January will probably prove it. It is needless to say that the combined companies never did a business of $8,000,000 in one year. The meeting in January of the company is likely to have many surprises in store for those who place implicit reliance in all the statements made recently concerning the affairs of the concern. Reorganization will then have become an imperative necessity.

Our contemporary takes a narrow view of the case. The duty of the financial press is not ended. It has scarcely begun. There is at least one important officer of the General Electric Company who knew in the beginning that the common stock was not worth 25 cents on the dollar, who knew that the essence of the whole combination scheme was a swindle and a fraud.

The plain duty of the press is to learn who among the Board of Directors were the swindlers, and who were the swindled, then to give the facts to the public.

The arch swindler, the shrewdest confidence man of the day, is still abroad, and looking for fresh victims.

Lectures on Electricity.

A course of lectures will be given in Philadelphia this winter, under the auspices of the electrical section of the Franklin Institute, as follows: December 19, "Thoughts on Cosmical Electricity," Prof. Elihu Thomson; December 26, "The Theory and Design of the Closed Coil Constant Current Arc Dynamo," Professor H. S. Carhart; February 27, 1894, "Telephony," J. J. Carty; April 24, "Magnetic and Dielectric Viscosity," Professor M. J. Pupin, and on June 26 a lecture on "Electro-Therapeutics," by Dr. William J. Morton, of New York City.

BOOK REVIEWS.

Standard Tables For Electric Wiremen. By Chas. M. Davis. Fourth Edition. Edited by W. D. Weaver. The W. J. Johnston Company. Flexible morocco. 128 pages. Price $1.00.

The third edition of this popular work was exhausted within a few months after its issue, and the fourth edition has been delayed in order that it might contain the latest revisions of the Insurance Rules of the Underwriters' International Electric Association, now almost exclusively used in the United States. In addition to the above rules there has been added to this edition an important section on the calculation of alternating current wiring which, for the first time, brings this subject within the reach of practical men.

A number of the most important tables were prepared expressly for this work, and are not to be found elsewhere.

The method of determining the sizes of conductors for incandescent wiring enables feeders, mains and branches to be proportioned as nearly exact as desired. The wiring formulas for motor circuits, etc., are put in a simple and practical form so as to be easily applied by any one. The formulas for horse power of engines and boilers, as published here for the first time, are based on rational principles, and the results they give are the actual commercial ratings, and not the theoretical horse power.

An Electrical Society at Cornell University.

The students interested in electrical science have lately organized at Cornell University an electrical society for the discussion of scientific problems. The membership is restricted to graduates and seniors, with a few of the oldest students in the other classes. The members of the faculty whose work has to do with electrical questions are honorary members. It is planned to hold meetings once a fortnight to be conducted in the same way as those of the American Institute of Electrical Engineers. The officers are as follows: President, E. B. Clark, '94; first vice president, J. Lyman, '94; second vice president, I. E. Macomber, '94; recording secretary, W. R. Turnbull, R. G.; corresponding secretary, R. W. Quick, '94; treasurer, B. S. Lamphear, '94; executive committee: Messrs. Clark and Turnbull ex officio, S. B. Fortenbaugh, M. A. Gerry and J. Lyman.

Current Items.

When an electric street railway was completed for public use in Bangkok, the capital of Siam, last year by Ohio capitalists, the Rev. J. M. Law, a medical missionary in Japan, thought that a similar enterprise would be profitable and of great public benefit in Tokio, the capital of the Japanese Empire, containing 1,400,000 persons. A few months ago he got Ohio capitalists to subscribe $100,000 to the scheme, with the assurance of additional capital after the plan was further advanced. Dr. Law then went to Japan, and, backed by the influence of American and other ambassadors, obtained one of the most liberal charters ever granted by Emperor Mutso Hita. The intention is to run a line from Tokio to Yokohama, a distance of thirty miles, and build a network of lines in both cities. J. W. Goss and Engineer Riblet have just sailed for Japan to inaugurate the scheme.

Cuero, Texas, was treated lately to an electrical display such as had never been seen or heard in that section. It began with distant thunder, getting closer rapidly, and in less than five minutes there were heavy peals of thunder and lightning flashes, and sparks or balls of fire descending within five feet of the ground and bursting, making a loud report. The people were all frightened, and are not anxious to have the same kind of a treat again.

Steam Piping and Efficiency of Steam Plants.

BY WILLIAM A. PIKE.*

In some recent experience with steam plants, the writer has been impressed with the apparent lack of good judgment and the application of correct principles in the arrangement of the piping between boilers and engines. In many cases, every effort seems to be made to select the best engines and boilers for the particular purpose in hand, but when it comes to the question of connecting them with steam pipes it would appear that it was thought that anything, with a hole through it, would do. Whether the piping is right or not, affects the economy, efficiency, and safety of a steam plant more than most engineers seem to think, and the writer believes that poorly contrived piping is in many cases as detrimental to high efficiency as the use of the wrong type of engine or boiler would be. The following are, perhaps, the points that should be most particularly looked out for in the design of a system of piping:

(1) The piping and accessories should be so arranged that practically dry steam shall always be delivered to the engine.

(2) The steam should reach the engine with very little "drop" in pressure.

(3) The piping should be so planned and valves so placed that water cannot under any circumstances collect anywhere, except in places especially arranged for that purpose.

(4) Wherever practicable, and especially where more than one engine is supplied from one battery of boilers, the piping and valves should be arranged so that in case of accident to any part it can be shut off without shutting down the whole plant.

These requirements are not offered as new or original, but simply as covering points often neglected, and as furnishing texts for this paper. The first requirement given above, viz., that the steam should reach the engine dry, is one often neglected, and the writer has in mind plants of considerable magnitude where absolutely no provision is made for drawing off condensed, or entertained, water, except through the engine itself, and the not uncommon cases of broken cylinder heads and pistons testify as to the effect of such designs. In these days of efficient pipe coverings, of separators, steam loops and traps, there is no excuse, but false economy, for allowing water to reach the engine. In connection with point No. 2, a plan for disposing of water, followed with good success, will be spoken of.

(2) Steam should reach the engine with but little drop in pressure. The effect that an improper arrangement of piping has on the pressure with which the steam reaches the engine, is probably not as well known as it should be, and the principal object of this paper is to bring it to the attention of engineers, and to show how in one case the evil has been remedied.

The conditions of the case used in illustration were as follows:

There were ten single acting engines, 16 x 27 x 16 inches, arranged on two sides of an engine room, and making 250 revolutions per minute. They were supplied by a number of boilers, and the steam from these first passed to a drum, 28 inches in diameter and 45 feet long, at the top of the boiler room and between two rows of boilers. From this drum separate 8-inch pipes ran to each of the five engines on the side nearest the boilers. (At the time referred to the other five were not connected.) The average length of each 8 inch pipe was about 76 feet, and there were five right-angle turns and two valves in each pipe.

On testing these engines it was found that there was a great difference between the boiler pressure and that at the engines.

This difference varied from eight to twenty pounds, depending on the amount of work being done, and averaged fourteen pounds, during usual work.

To find out, if possible, something as to the reason for this drop, an indicator was placed in connection with one of these 8-inch feed-pipes, just outside of the throttle-valve, which was close to the engine. At the same time cards were taken from the engine, and Fig. 1 represents the result.

The narrow diagram at the top is that taken from the pipe, while the lower one is a simultaneous diagram from the high-pressure cylinder.

As will be seen, the steam is at the pressure a at the beginning of the stroke, and at admission falls suddenly to b, then during admission keeps nearly constant until complete cut-off at c, then the pressure rises to d, and gradually settles down to a again at the beginning of a new revolution. From these diagrams it can be seen that, as there is practically no steam-chest to these engines, and as they are single acting and cutting off at about half stroke, there is a sudden and great demand on the 8-inch pipe during admission, a demand so great that the steam cannot keep up its pressure and, more than this, it appears that a vibration of the steam is set up in the pipe, causing the pressure to fluctuate from considerably below to somewhat above boiler pressure. This motion of the steam, of course, requires energy to be used up which is not therefore available for work in the engine.

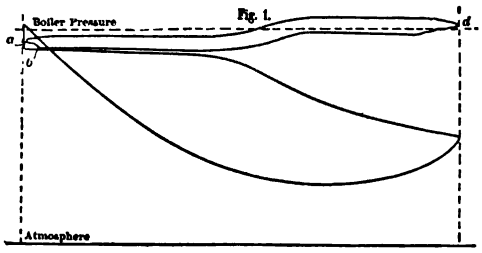

Fig. 1.

In attempting to account for this lost energy, the upper diagram has been treated as an ordinary indicator diagram, representing the work done in an 8-inch cylinder (the size of the pipe), and of a length equal to that of the volume of steam (in an 8-inch cylinder or pipe) required to supply the engine. Then, also, the loss due to friction is taken into account in the same way. The sum of these results is then compared with the extra work the steam would have done if admitted to the engine at boiler pressure. This last is shown in Fig. 2, in which the shaded part AB represents the additional work that would have been done if the steam had been at boiler pressure instead of having the admission line a-b, as was actually the case.

As an example, is taken the case of two diagrams, taken simultaneously on October 21, 1892, at 9:20 A. M.:

The area of the pipe diagram is 0.4 square inch; the length of the pipe diagram is 3.18 square inches; the mean effective pressure is 10.06 lbs.; and the length of an 8-inch cylinder, corresponding to the amount of steam used, is 3.0 feet. Then the work done $= Pe\,LAN =$ $10.06 \times 30 \times 50.26 \times 1 = 1{,}517$ ft.-lbs. The pressure loss, due to friction, is estimated, from the tables in "Steam," to be 2.19 lbs.; therefore the lost work due to friction $= 2.19 \times 50.26 \times 3.0 \times 1 = 330$ ft.-lbs., or a total of lost work = 1,847 ft.-lbs. The area added to the engine diagram, corresponding to AB, Fig. 2. = .28 square inch; the length of the whole diagram = 3.3 inches, and the lost mean effective pressure = 6.79 lbs. This pressure corresponds to 1,819 ft.-lbs. per stroke. Thus we find from the pipe diagram and the estimated friction a loss of 1,847 ft.-lbs., and the corresponding loss as figured by the engine diagram, 1,819 ft.-lbs., or an agreement within $1\frac{6}{10}$ per cent.

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* Presented at the New York meeting of the American Society of Mechanical Engineers, December, 1893.

This analysis is added as an attempt to account for the loss, and whether correct or not, does not affect the fact that in this method of piping there is a serious loss of pressure, causing a corresponding decrease in efficiency.

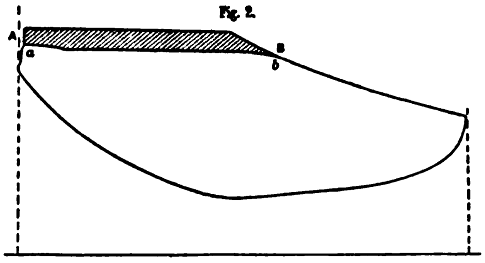


Fig. 2.

As in this case the "drop" was so great, it was considered desirable to endeavor to prevent it.

Two plans were suggested, as follows: First, when the amount of steam used was considered, it was seen that, due to the fact that the engines were single-acting, the demand while it lasted (with a cut-off of $\frac{1}{2}$, say $\frac{1}{4}$ of the time of a revolution) was excessive for an 8-inch pipe, though all the available data would show the pipe amply large for a uniform flow of that amount, and so the first idea was to enlarge the pipe, still piping separately to each engine, with the idea of reducing the effect of breakdowns. But the same reasoning led to the fact that an 8-inch pipe would be amply large if the flow could only be made practically uniform. This led to the second plan—viz., to place a reservoir for the steam close to the engine, and thus enable the flow through the 8-inch pipe to be more nearly uniform. In order to get information as to such a plan, the arrangement shown in Fig. 3 was extemporized.

The 8-inch pipe leading to engine No. 2 was cut, and a drum, 3 feet by 5 feet, put in close to the engine; from this drum a 10 inch pipe led to a 14-inch pipe, about 13 feet long, on the floor, and from this 8-inch pipes led to engines 1, 2, 3. The object was to get the effect, on drop of pressure, of receivers fed by one 8-inch pipe when supplying one, two or three engines. Much to the satisfaction of the experimenters, it was found that when engine No. 2 alone was supplied, through the drum, the drop was but a trifle over 1 lb.; that when two engines were fed the drop was a little over 2 lbs., and when all three were supplied by one 8-inch pipe, through the receivers, the drop was about 5 lbs. These results confirmed the theory that an 8-inch pipe was easily ample for two engines without excessive drop, and that when supplying three engines in this way, the drop was but little more than a third of that when but one engine was fed by a single 8-inch pipe without receivers.

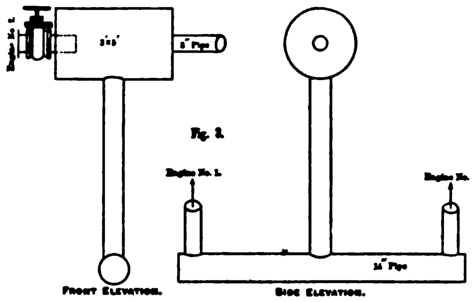


Fig. 3.

With this data as a basis new piping was designed for the plant, as follows: an extra drum was put in the boiler-room, and both drums connected with suitable valves to a loop of 8-inch pipe, running past each of the engines on the side nearest the boiler-room, with a drum, 3 feet x 5 feet, between this pipe and each of the engines. The nipples connecting the drums with the engines project about a foot into the receivers, as shown by the dotted lines in Fig. 3 to *a*, as separators for entrained water. Also each receiver was connected with a "steam loop," to carry this water back to the boilers. On the farther side a similar plan was followed, except that the loop was made of 10-inch pipe on account of the greater distance from the boilers. All pipes and drums were covered with an asbestos air-space covering, and valves were placed between each pair of engines to allow of shutting off any part in case of breakdown, without shutting down the rest of the plant. Tests made of this system show a drop of only 2 lbs. on the farther side of the engine-room, when all five engines were under full load and fed by one loop of 10-inch pipe (making a complete circuit from the drums back to the drums again). The combination of "steam loops" and the separator drums is the plan referred to under the heading with reference to dry steam. This has worked admirably, there being no signs of water in the engines as there had been before.

(3) The danger that may arise from having piping and valves so arranged that water can collect anywhere except in places specially provided, can be best shown by two cases within the knowledge of the writer.

A. A battery of boilers was connected with a header, as follows. From each of two boilers a short pipe was led up to a horizontal pipe branching to the right and left to another pipe leading to the header. Valves were placed close to each boiler, but none at the header. At one time two of these boilers were shut down and the valves at the boilers closed, the remainder of the battery being in service. The first thing noticed was that the calorimeter in the header showed much drier steam than there was any reason to expect, and on investigation it was found that the branch pipe between the two boilers and the header was acting as a condenser and separator, and becoming filled with water. This was fortunately noticed in time, and the water drawn off and a circulation kept up in the pipe, after which the calorimeter showed normal moisture and no harm was done; but if this body of water had been in any way set in motion the effect on the piping, which in this case was of cast iron, can be imagined.

B. In the second case there was a steam main leading from boilers to various pumps, engines, etc., and at a certain point a temporary pipe was led into this main from another boiler with no valve between the pipe and main. Steam was admitted to this pipe for some reason, and then after a few minutes shut off and steam let into the main. Shortly after this steam was again admitted to the temporary pipe, and very shortly a "slug" of water passed from this pipe to the main and acquiring a high velocity flew to a dead end and blew it off, causing the death of an employee. There seems no doubt that a valve placed at the intersection of the main and the temporary pipe, with a suitable "bleeder" in the pipe, would have prevented this accident if handled properly.

(4) The necessity of arranging piping so that in case of accident only a part of the plant need be shut down needs no argument, as the loss and annoyance due to shutting down a large plant, especially one on which the public in any way depends, as in the case of a lighting or street-railway plant, are much greater than the expense involved in making such a thing impossible. The system followed in the case cited under the second head is one that, while expensive, makes it impossible for any large part of the plant to need shutting down. The valves between the boilers and drums in the boiler room, combined with those in the pipes from the drums and those between the engines, making it possible to cut out almost any part without materially affecting the rest.

While, doubtless, much more could be written on this subject, it is hoped that the cases cited above will serve to call attention to the necessity for greater care in designing systems of piping, and will call out a fruitful discussion.

Personal.

Gilbert G. McDuff, who has represented the *Electrical World* and Directory work for the past year and seven months, has resigned and organized The American Electrical Publishing Company, and will publish the new paper, *Electrical and Street Railway Reporter*, with an office, 503 Electrical Exchange Building, New York.

Boston Notes.

There was an interesting meeting of the Lynn City Council, both branches, held last Tuesday evening, to consider an application from the Woodward Underground Electric Light and Cable Company, which is a local concern, for permission to open streets in order to lay, for demonstrating purposes, the conduits manufactured by this company, that the public might have opportunity of satisfying itself as to the merits of this conduit system. The petition was opposed by the Lynn Gas and Electric Company and the New England Telegraph and Telephone Company, whose counsel were present. Several electrical experts were examined as to the truth of the claims set up by the Woodward Company, and Professor Elihu Thomson's written testimony as to the value of the Woodward patents was read. The latter gave it as his opinion that the system possessed little, if any, merit, and the patents were of very slight value. The consensus of opinion was against granting the petition, and a little after midnight the subject was turned over to the city solicitor for his legal opinion thereupon

The Malden Board of Aldermen has at last granted the order giving the West End Street Railway Company permission to use electricity as a motive power for operating their cars in and around Malden. There has been some considerable delay about this matter and many conferences have been held between the company and aldermen. The order carries with it a condition that only a five cent fare shall be charged between any point in Malden and Scollay Square, Boston, and that the cars shall be running by January 1, 1894.

The course of twelve lectures on "Modern Uses of Electricity," given by Professor Charles R. Cross in the Massachusetts Institute of Technology, terminated on Thursday evening with a lecture on Telephony. The interest taken in these lectures had not only been sustained, but it had increased from first to last. They were unusually successful. Professor Puffer is now giving a course of twenty-four lectures at the Wells Memorial Hall on similar topics; these, too, are well attended and evoke much interest.

Judge Colt, of the United States Court, granted an order asked for by the General Electric Company against Captain A. de Khotinsky, restraining him from continuing to manufacture incandescent lamps in his factory at Marlboro, Mass., the same being, so the plaintiff claims, an infringement of the Edison patent now owned by the General Electric Company. The order was issued Friday, and will be operative until such time as an injunction may be applied for or granted.

The decision of Judge Colt in the suit of the General Electric Company vs. the Davis Electric Works, Springfield, Mass., is being looked for with much interest. The Davis Company simply repairs old lamps, and does a very large business of that kind. No new lamps are made, yet the Edison Company claims the Davis people are infringing their patents, hence the interest taken by outsiders.

Mr. H. W. Daggett, Jr., the enterprising and well-known president of the Interstate Electric Street Railway system, which runs through parts of Massachusetts and Rhode Island, has added yet another enterprise to his already long list of interests. He has recently purchased the plant, copyright, good will, etc., of the "Attleboro Daily Sun," a lively sheet published in a lively town. Mr. Daggett has always been successful in the electrical field, and we doubt not that he will make a success of his new journalistic enterprise. He is deservedly popular and full of public spirit.

The spasmodic show of a belligerent spirit that is being made just now by the deceasing General Electric Company in trying to secure a few more injunctions against makers of incandescent lamps, is being accurately appraised at its true worth. Those who have been closely watching the Trust's rapid descent, as well as those who are actually interested as stockholders, regard this new move as "The Song of the Dying Swan." We shall see. Lynn, the City of Shoes, is naturally much interested in the sad fate of the General Electric Company, by reason of the fact that for some time past between 4,000 and 5,000 hands were employed in the factories there, while to-day there are only a few hundred. Hence it is that some prominent Lynnites, holders of Electric stock, express the belief that the Trust will show a bold front when given reasonable time to recover from the effects of the fearful depression in general business affairs. About 200 hands have been discharged from the Lynn works since November 1. Before the consolidation with the Edison Company, the Thomson-Houston Company employed 3,000 hands in Lynn alone, and there the general opinion is that the greatest factor against the Trust is the alleged saddling of an $8,000,000 debt by the Edison Company upon the General Electric Company at the time of the consolidation. They maintain that the New York operators did a good job when the consolidation took place at the expense of the stockholders in the Thomson-Houston Company, which was believed by some to be in splendid condition at the time.

"The Black Crook," a brilliant spectacular piece, is having a long and unprecedentedly successful run at the Boston Theatre. At the close of its run it will be taken through the country at great expense. There are many very beautiful lighting effects and scenes in the piece, which are produced by electricity, and when traveling the company will carry with it the entire electrical output wherewith these weird effects are produced. For this purpose, new and unique apparatus is being manufactured by the W. S. Hill Electric Company, from designs made by Mr. Richard Cartwright, a well known electrical inventor and engineer, of Boston.

General News.

What is Going on in the Electrical World.

Worcester, Mass.—Horse cars no longer run in this city; all the street lines are now run by electricity.

Oil City, Pa.—Electric cars are now running regularly in the principal streets of the south side, the line having been opened on the 1st inst.

Tiffin, Ohio.—The Tiffin and Fostoria, the Tiffin Electric Railway, and the Tiffin Street Railway lines have consolidated; the new capital is $300,000.

Brooklyn, N. Y.—The Broadway Railroad Company has received permission from Mayor Boody to change its motive power from horses to the trolley system.

Augusta, Ga.—The electric exhibits were one of the best features of the local exposition, and the Augusta Electric Supply Company's display was particularly noteworthy.

Berkley, Va.—The *Citizen*, a local paper, is anxious for a little show of life in the town. It says: "Berkley is in need of a bank, electric lights, good streets and an electric car line."

Keokuk, Iowa.—The American Loan and Trust Company, owners of a controlling interest, have stopped the operation of the Keokuk Electric Railway, the receipts being less than the expenses.

New Brunswick, N. J.—The question of changing the motive power on the New Brunswick street car lines from horses to electricity is in the hands of the streets committee of common council with power to act.

Dayton, Ohio.—The City Railway Company is considering the adoption of electric motive power on its several branches, but has yet come to no definite determination. The trolley system, if any, will be the one selected.

Hillsboro, Ohio.—J. M. Hughey, receiver of the Hillsboro Gas and Electric Light Company, has been granted a franchise to maintain an electric plant and furnish arc and incandescent lights to the citizens for six months from the date of his acceptance.

Long Island City, N. Y.—The Steinway Railroad Company of Long Island City expects to have all its lines equipped with the trolley system by the first of next year. The splendid new power house erected on the Astoria shore at Hell Gate is about finished.

Elwood, Ind.—A natural gas explosion on November 29 demolished the plant of the electric light and street car company, and damaged a number of buildings. The accident left the city in darkness and without street car service. The loss is estimated at $15,000.

Kansas City, Mo.—The Interstate Telephone Company, composed of local capitalists, is actively engaged in arranging the necessary details for opening and operating a telephone exchange in this city. The franchise provides that for business houses $60 shall be charged and for residences $36 per annum.

Maumee, Ohio.—The council has extended the franchise once given to T. P. Brown, John Kumler and Coleman Keeler for an electric road within the corporate limits of the place until July 1. J. K. Tillotson is now in possession of the road, and says it is progressing rapidly.

Salt Lake City, Utah.—The Pioneer Electric Power Company, composed of residents of Utah, and with an alleged capital of a million dollars, has been established for the purpose of utilizing water from the Ogden River in the generation of electricity in sufficient force to supply this city with power to run machinery for factories, electric lights, street railroads, domestic heating and cooking, and such other purposes as can be effected by electric agencies.

Cleveland, Ohio.—The Cleveland Electric Railway Company is considering the suggestion to equip some of its cars appropriately for funeral purposes on the line leading by the Newbury Roman Catholic Cemetery. The undertakers favor the scheme as providing a means of reaching the burial place at much more reasonable cost than the usual $5 carriage ride.

Milwaukee, Wis.—The Milwaukee Electric Street Railway line has been sold to the Milwaukee Street Railway Company (Villard syndicate) and the transfer completed. The line was projected in 1886 as a cable line, but owing to the failure of the Rasmussen system was made an electric. From the prominent part taken by John A. Hinsey in securing the franchise for the road it came to be known as the Hinsey line.

McKeesport, Pa.—The trolley car has come into use here as a substitute for a hearse. The wife of a Wilmerding business man died last week, and the mourning husband decided to bury his dead in McKeesport. To get rid of a long, tedious and cold ride in carriages it was decided to use the trolley cars, and a car was fitted up to bear the coffin, accompanied by the pall-bearers. Behind this funeral car were six coaches, coupled together, and filled with the members of the family and their friends.

Montreal, Can.—The cars of the Montreal street railway are to be supplied with a new electric air brake, which is the invention of the electrical engineer of the company, and which is reported on trial to be very successful. The power to operate this brake, it appears, is generated by the motion of the wheels, and the faster the car is going the sooner it can be stopped. At the trial a car supplied with one of these brakes was allowed to attain a speed of twenty miles an hour, and was brought to a stop within a space of about four car lengths by the application of the electric brake.

New York.—The Commercial Cable Company has made a contract with Siemens Bros. & Co., of London, for the manufacture of a new cable, to be laid between Ireland and Nova Scotia. This cable, the third now owned by the company, will be 2,200 miles in length, and is to be made by specification insuring greater carrying capacity than any cable of the same length.—Corporation Counsel Clark has rendered an opinion to the effect that the employees of the Board of Electrical Control are subject to the New York Civil Service Boards.

Omaha, Neb.—For some months past there has been a quiet movement on foot to perfect the organization of a company to put in operation in this city a first-class electric lighting and power plant. The scheme has been to operate under the franchise of the old Northwestern Company which has the remnants of a plant located in the Woodman Building at Seventeenth and Nicholas streets. At the present time the rights under the franchise are being exercised by the New Omaha Thomson-Houston-Electric Light Company which has leased them from the owners.

Eau Claire, Wis.—A new company has been formed to operate the plant of the defunct National Electric Manufacturing Company, which went into the hands of a receiver and whose factory was bought by Peter Truax. The new corporation is called the National Electric Company. A. L. Ide, of Springfield, Ill., is president; Peter Truax, of Eau Claire, vice-president; W. E. Rusk, of Eau Claire, treasurer; Frank P. Ide, of Springfield, secretary. The paid up capital stock is $50,000. The property which passes into the hands of the new company cost the old company nearly $200,000.

Baltimore.—A deed has been recorded conveying from Messrs. Enoch Pratt, F. C. Latrobe and Robert Rennert, trustees, to the Wenstrom Electric Company all the property, rights and franchises of the Wenstrom Consolidated Dynamo and Motor Company in accordance with the plan for the reorganization of the company. The consideration mentioned in the deed is 5,000 shares of the full-paid capital stock of the Wenstrom Electric Company and $5.—The Brush Electric Light Company has decided to rebuild its works and put in a plant superior to that destroyed by fire. It is estimated that the cost of the improvements will be $300,000.

Washington, D. C.—The Lighthouse Board in its annual report gives interesting information respecting telephonic communications between lightships and the shore. The object is to more effectually succor vessels in distress. It is proposed as an experiment to first connect Monomoy Point Lighthouse, Massachusetts, with Pollock Rip Lightship, which are some four miles apart. Having done this the Board proposes next to connect two such stations much farther apart where the conditions of the bottom, current and approaches are different.—Senator Peffer introduced a bill in the Senate a few days ago which authorizes the Commissioners of the District to provide for lighting the public buildings and grounds of the city of Washington, and also for supplying light for citizens, by the establishment of an electric light plant of sufficient magnitude to supply all the light that may be needed by the Government and the people. It is provided that the work of constructing the plant shall be done on a contract let to the lowest bidder. The Commissioners of the District shall have the responsible management of the plant, and shall, on their own application, make the price of light at a uniform rate not to exceed 10 per cent above the actual cost of introduction and distribution. The 10 per cent. profit is to be paid annually into the Treasury of the United States to reimburse the Government for the money expended. The bill appropriates $1,000,000 for the establishment of the plant. It was referred to the Committee on the District of Columbia.

Canadian Notes.

Paris, Ont.—Messrs. Redher & McCosh will shortly let the contract for the erection of their new electro-plating factory.

Charlottetown, P. E. I.—The city council is considering the purchase of an electric light plant.

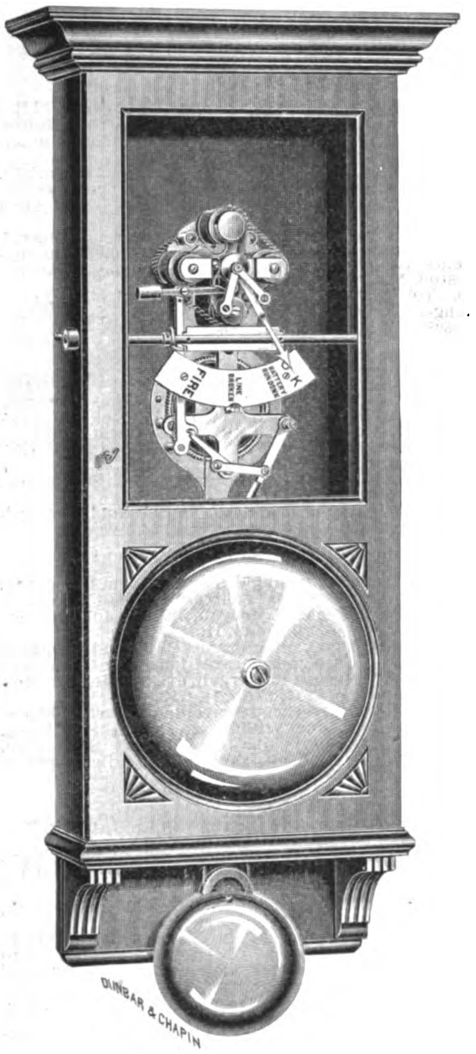
Montreal, Que.—The St. Jean-Baptiste Electric Light Company will erect a new power house adjoining their present works at the corner of Montana and Rachel streets.—The Bell Telephone Company contemplate the erection of an addition to their factory on Aqueduct street at an early date.

Victoria, B. C.—An electric railway to the Alberin mines will be built on China Creek and a smelter erected at the terminus.

Bedford, Que.—This town is considering an electric lighting scheme.

A New Automatic Fire Alarm System.

In the Fire Alarm systems heretofore used, although they appeared well on exhibition tests, serious faults have developed in regular practice, largely due to that class of troubles which appear only after such apparatus has been in use a considerable time. The wiring of such a system must necessarily extend all over a building to be protected, crossing and recrossing it many times, which makes it particularly liable to accident by broken lines and short circuits. The service is also such that the system must be certain to act without a moment's delay, and without any manual assistance whatever, even though it has stood for months without attention.



G. W. Brown's Fire Alarm Annunciator.

In consideration of the above, the following have been laid down as axioms:

First—Any system, to be entirely successful, must be of such a nature that any accident to the battery or wiring that will render the system inoperative will at once notify the attendant at the receiving station without sounding a fire alarm. In short, a system must watch itself and notify whenever it needs attention.

Second—It must be prompt and sure to act, and entirely unaffected by dust, insects, moisture, foul gases or jarring of the building, etc., and require no adjustments.

In the interests of economy such a system should require but very little current to operate it, and be easy and cheap to install.

The first axiom not only makes it necessary that the system shall be closed circuit, but that the entire current required to give the alarm shall flow all the time, otherwise the extra batteries and lines intended to be brought into action by the thermostat may not be operative.

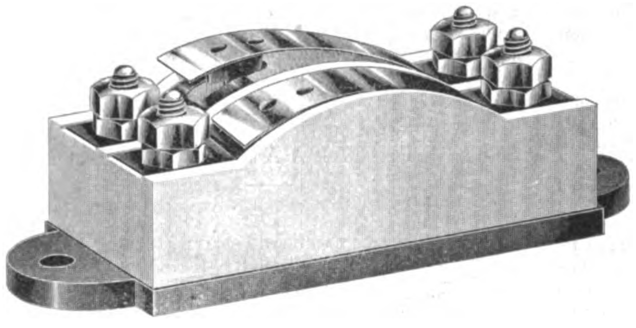
In the system in question, by very simple mechanism, the thermostat in acting reverses the current instead of simply stopping it. Reversing the current is a change which never occurs by accident; hence the receiving instrument will never indicate fire unless a thermostat has acted. The receiving mechanism consists of a very simple and reliable electro-mechanical gong, controlled by a polarized armature of the rotary type, to which is attached a pointer moving over a suitable dial arranged to show just what change has occurred in the line. This dial is marked "O. K." on its right hand end, below which are the words "Battery Run Down," in the middle "Line Broke," and on the left hand end "Fire."

A very important feature of this apparatus is the fact that the battery current can rise much above or fall much below the normal without affecting the working of the system. This system can be arranged with two bells, one of about eight inch in the engine house to ring for fire only, the other of small size to call attention to trouble with the line. A large striker is also provided to strike a factory or other large bell, one blow to indicate trouble with the line, and continuous ringing to indicate fire. This is important in places where firemen are not on duty at all times.

One of the most important features of an Automatic Fire Alarm is the thermostat, upon which to a large degree the efficiency of the system depends. The one here illustrated has been the subject of a great deal of study and experimenting, and is believed to embody more good features than any other ever devised, and no bad ones. Its construction and operation are as follows:

Upon the lower side of a porcelain base are clamped two flat bronze springs, which are held under tension by a fusible solder, the melting point of which can be changed to suit different positions. To the upper side of this base is clamped a plate of vulcanized fibre, through which screws pass into the ceiling to fasten the thermostat in position. In the centre of the porcelain base and covered by the fibre plate is moulded a cavity which contains electro-plated contact points brought into action by releasing the springs. These contact points are punched from sheet brass and riveted to the bronze springs, extending through the porcelain into the cavity referred to, and so arranged as to press against suitable electro-plated copper strips connected in such a way as to reverse the current when the springs are released by melting the solder. The working parts of this thermostat are entirely protected from dust and insects, causes which render a large percentage of those now in use entirely inoperative after they have been in place a year or two. The part sensitive to heat is entirely uncovered and in the best possible position to be affected by direct rays as well as the heated air from a fire, and being thin acts promptly, and will never change its adjustment.

In case the battery should be allowed to run down, the armature would be drawn towards its central position by the weight until the hand pointed to "Battery Run Down," when the striking mechanism would be unlocked and the bell strike. The attendant, on looking at the dial, would see that the bell is striking because the battery is run down, and to silence the bell turns over the handle on the left hand side of the case, which, besides stopping the striker, turns up a card over the dial, marked "Disconnected," which shows that the system is inoperative. Even under these conditions, the system will sound an alarm in case a fire should occur, unless allowed to stand too long. In case of a broken line or short circuit (which in this case is equivalent to a broken line), the same thing takes place, excepting that the pointer indicates "Line Broken." In this case, when the line is repaired, the bell again strikes to notify the attendant that the line has been repaired, and the hand points again to "O. K.," the bell being silenced by turning the lever and card back to the original position. In case of fire the bell rings, and the pointer is carried to the word "Fire," and locked in that position where it remains until released by the attendant.



G. W. Brown's Thermostat.

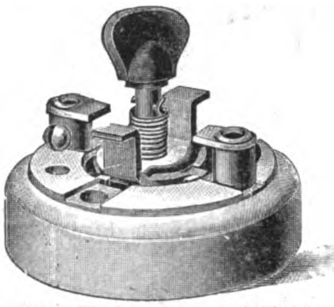
It will be seen that this system is entirely free from relays and local circuits, which in practice have been found to be unreliable. In the arrangement of the annunciator and public alarm bell, with which this system is provided, no element is introduced that can possibly interfere with the action of the engine house gong, bearing in mind that the action of this bell is by far the most important function of the system. With this in view, care has been taken that its action should not depend upon anything delicate or uncertain, or be in any way interfered with by the failure of the other instruments.

It was designed by Mr. Gilman W. Brown, of West Newbury, Mass., who has devoted the last four years to perfecting its details, and is fully protected by patents.

Metropolitan Electric Company.

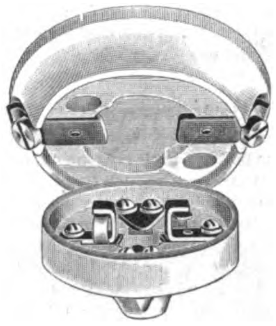
The Metropolitan Electric Company, offices 522-523 Monadnock Building, Chicago, have secured the entire output of H. T. Paiste's factory and hereafter will market exclusively these specialties.

A visit made to the factory enabled us to see these various articles manufactured step by step until completed. First in importance was the making of Eccentric Switches. These switches are the result of years of earnest thought and experience on the part of Mr. Paiste, the pioneer switch maker. An important feature in the switch, as shown in the cut, is that all the brass parts are fixed firmly to the porcelain without the use of screws. In porcelain there is no "cushion," hence screws will sooner or later jar out. The movement is of the eccentric order, thus insuring a positive mechanical action. The electrical contact is made by solder contacts. We witnessed a test made on a five ampere switch. This switch had been run for four days, making thirty breaks and makes, all told about 70,000 half revolutions per minute, more than a switch would be used in fifty years. It was carrying a load of twenty-five amperes at that time, and did it without heating the contact parts. The breaking capacity will easily break 500 volts. These switches are made single and double pole, also three-way.

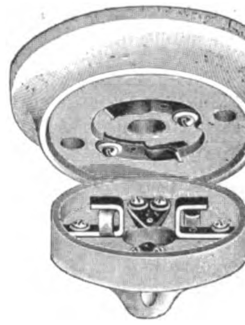


Metropolitan Electric Company's Paiste Switch.

We next visited the Cut-Out department. Here is made in large quantities the Paiste Ceiling Cut-Out (Schaffer style) for open and concealed work. The attached cuts will readily demonstrate the simplicity and beauty of their design. Those of our readers who visited the Electricity Building at the World's Fair will remember the very neat and artistic design made exclusively by these Cut-Outs in Mr. Paiste's exhibit. Main and Branch Cut-Outs of the S. M. and Edison style are also made in large quantities. A new covered branch and main has just been manufactured that will be much appreciated by the electrical trade. A covered Horse-Shoe Cut-Out is in process of manufacture and will be ready to deliver in a short time.

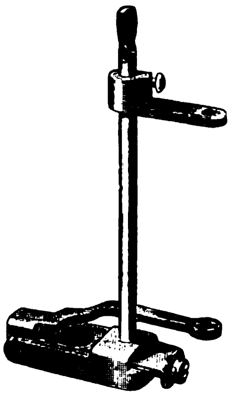


Metropolitan Electric Company's Cut-Out.



Metropolitan Electric Company's Cut-Out.

We next visited the Stamping Department, and there saw them making out of flat sheet metal a clutch for T.-H. arc lamps. The attached cut will illustrate the design and movement. The peculiar feature of this specialty is that it can be adjusted to a carbon rod and therefore is practically indestructible. German silver contacts are used throughout. Here also is made an adjustable lower con-

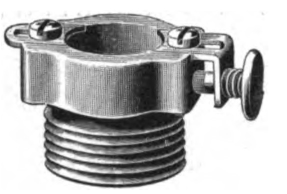


Metropolitan Electric Company's Clutch.

tact bushing for T.-H. arc lamps; the cut will easily illustrate the simplicity of the device.

Numerous screw machines were running, turning out binding posts and various other articles.

Another department just being organized is the making of switchboards, etc. Here men were busy making a complete set of switch and cut-out boards for the Ryerson Library.



Metropolitan Electric Company's Contact Bushing.

The Electric Appliance Company's New Catalogue.

The Electric Appliance Company, of Chicago, have just received from the press their new catalogue of general electrical supplies, which they are sending out to their friends and customers. The catalogue contains 334 pages, and is well printed on heavy book paper. Although concerning nearly the entire field of electrical goods it is very compact and convenient as a reference. Especial attention has been paid to the point of listing only such articles as are reliable and standard. A careful examination of the pages of the Appliance Company's catalogue will be well repaid in time and money saved.

"Acme" Portable Testing Set, "Style B."

Queen & Company, Incorporated, Philadelphia, are now bringing out "Style B" of their "Acme" Engineering Set, which must surely meet with much favor. It is completely self-contained, comprising bridge, rheostat, D'Arsonval galvanometer, battery and keys, all mounted in a highly finished mahogany box, 3¼ x 5¾ x 5 inches, that weighs less than six pounds ready for use. The extreme portability of the apparatus and the fact that rapid measurements can be made under conditions that do not admit of another type of galvanometer being employed, recommend the set to the careful consideration of intending buyers.

Descriptive circular No. 445 will be mailed free upon request to the makers.

COMMERCIAL PARAGRAPHS.

Messrs. Elson & Brewster, New York agents for the W. S. Hill Electric Company of Boston, have removed their offices to No. 141 Liberty street, Central Building.

The Metropolitan Electric Company, of Chicago, are gathering together a very important line of electric railway devices, prominent among which are the Standard Paint Company's P. & B. specialties, the "Anti-Thunderbolt" Oil Paper, Special Oil Glass Insulators, N. I. R. Feed Wire, etc.

The Texas Electric Brokerage Company inform us by circular that they have opened an electrical brokerage business in Dallas and will extend it throughout the State of Texas and adjoining territories. They will sell goods as manufacturers' agents at manufacturers' or wholesale dealers' prices, and will procure orders and place them with the dealer, who may ship direct to the purchaser, he merely notifying the brokerage company whether he fills or refuses to fill the order, and sending a statement of goods sold through their efforts at the end of each month or within ten days thereafter, enclosing a check for amount of commissions due for the month. The Brokerage Company will cheerfully correspond with manufacturers and dealers in regard to such arrangements as they are prepared to enter into. Address: Texas Electric Brokerage Company, North Texas National Bank Building, Dallas, Texas.

The Geo. E. Carter Company has recently been organized, with offices at 1,563 Monadnock Building, Chicago, for the purpose of handling a number of high grade electrical specialties. The company is composed of Mr. Geo. Carter, who has occupied the position of city salesman with the Ansonia Electrical Company, and Geo. S. Thayer, recently connected with the Westinghouse Company. The new concern has been appointed exclusive selling agents of the American Carbon Company's products. They will also handle the Helios arc lamp, the Pumpelly-Sorley storage battery and the Hattery feed water heater. The company expect to add a number of new specialties in the near future.

Goodhue & Lincoln is the title of a new firm which is about to enter the electrical specialty field in Chicago, Mr. Wells Goodhue, formerly with the Ansonia Electric Company and until recently the vice-president of the firm of Taylor, Goodhue & Ames, and Mr. Henry Lincoln, of Boston, are the moving spirits in the new company. Their specialties are high grade electrical material, which includes Wagner Transformers, Motors and Dynamos, and Sunbeam Incandescent Lamps. The new company starts out with good prospects and will undoubtedly be heard from in the near future.

INCORPORATIONS.

Leffler Electro-Magnetic Railway Company, Chicago. Capital stock, $1,000.000. Incorporators: P. W. Leffler, W. T. Pratt and James Brady.

The Canonsburg Electric Light, Heat and Power Company, at Harrisburg, Pa. Capital stock, $12,000.

The Indianapolis and Broad Ripple Suburban Railroad Company, Indianapolis. Capital stock, $50,000. Directors: R. T. McDonald, R. W. Clay, Sterling R. Holt, R. C. Light, Leon Bailey, Thomas Taggart and A. G. Smith.

The Blair Lamp Adjuster Company, Omaha, Neb.—to establish a general electrical supply house, doing a wholesale and retail business; a specialty will be made of the manufacture of electric drop light hangers. Capital stock, $50,000. Promoters: W. J. C. Putnam Cramer, H. F. Roberson and Will Whitmore.

The Carroll Electric Company, Fishkill, N. Y.—to produce electricity for light, heat and power. Capital stock, $100,000. Promoters: Wm. Carroll, New York City; Chas. H. Watson, Fishkill-on-Hudson, N. Y.; Wm. Burtenshaw, Brooklyn, N. Y.

The Standard Thermometer Company, Peabody, Mass.—to manufacture and sell thermometers and electrical and other mechanical appliances. Capital stock, $125,000. Promoters: Henry G. Rice, Samuel C. Lord, Edgar W. Upton, Herbert Torrey, Francis R. Upton.

The Princeton Light and Power Company, Princeton, Ind.—to furnish light by means of electricity, natural or manufactured gas or other means, and to furnish motive power for the purpose of propelling any and all kinds of machinery and conveyances for passengers and freight. Capital stock, $25,000. Promoters: Robt. N. Parrett, Louis Rothschild, Arthur P. Twineham.

The Homestead Street Railway Company, Beaver, Pa.—to construct and operate an electric railway from 30th street, Pittsburg, to Homestead, Allegheny County, Pa. Capital stock, $30,000. Promoters Cyrus A. Danals, Thomas H. Javens, Henry M. Camp.

The Thompson Electric Company, Wheeling, W. Va.—to construct, purchase, sell and operate electrical dynamos, motors, etc. Capital stock, $25,000. Promoters: C. H. Thompson, G. W. Thompson, J. H. Griffith, all of Marins Ferry, Ohio.

The American Standard Battery Company (incorporated in W. Va.), New York City—to purchase, lease and deal in patent rights applicable to primary and other electric batteries, dynamos, etc. Capital stock, $100,000. Promoters: C. T. Griffiths, M. H. Rutty, Jas. W. Garson, all of New York City.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED NOVEMBER 28, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

509,403. Electric Closed-Conduit System for Railways. George W. von Siemens, Berlin, Germany, assignor to Siemens & Halske, same place. Filed April 13, 1892.

509,421. Conduit Electric Railway. Adolph Worner, Buda-Pesth, Austria-Hungary, assignor to Siemens & Halske, Berlin, Germany. Filed Nov. 12, 1891.

509,518. Electric Railway. Thomas A. Edison, Llewellyn Park, N. J. Filed Aug. 14, 1891. Renewed June 2, 1893.

509,603. Coupling for Electric Conduits. Augustus Noll, New York, N. Y., assignor to Sigmund Bergmann, same place. Filed Aug. 5, 1892.

509,616. Clamp-Ear for Trolley-Wires. Edwin B. Gates, Decatur, Ill., assignor of one-half to Don Carlos Shaw, same place. Filed April 5, 1893.

509,622. Conduit Electric Railway. Edward H. Johnson, New York, N. Y. Filed May 16, 1892.

509,650. Trolley-Track. William H. Brodie, Brooklyn, N. Y. Filed Sept. 2, 1893.

509,651. Closed-Conduit System for Electric Railways. Emile Chabeault, Marseilles, France. Filed Oct. 13, 1892.

ELECTRIC LIGHTS AND APPLIANCES.

509,443. Electric-Lighting System. James B. McGiffert, Elizabeth, N. J. Filed March 24, 1893.

509,842. Electric-Arc Lamp. Ernest P. Clark, New York, N. Y., assignor to the Clark Electric Company of New York. Filed Jan. 28, 1893.

DYNAMOS, MOTORS, ETC.

509,445. Combined Electric Motor and Induction-Coil. John S. Nowotny, Cincinnati, Ohio. Filed April 5, 1890.

509,475. Compounding Dynamo-Electric Machines. Walter H. Knight, Lynn., assignor to the General Electric Company, Boston, Mass. Filed Feb. 6, 1893.

509,486. Compounding Dynamo-Electric Machines. Horace F. Parshall, Lynn, assignor to the General Electric Company, Boston, Mass. Filed May 11, 1893.

509,499. Regulator for Dynamo-Electric Machines. Elihu Thomson, Swampscott, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed April 11, 1892.

509,505. Switching Apparatus for Electric Motors. Parvin Wright and Joseph W. Kinsey, Denver, Colo. Filed Nov. 15, 1892.

509,517. System of Electrical Distribution. Thomas A. Edison, Menlo Park, N. J. Filed Dec. 12, 1883.

509,620. Shaft-Mount for Armatures. Samuel E. Hitt, Rockford, assignor, by mesne assignments, of one-half to W. Irving Hitt, Chicago, Ill. Filed March 20, 1893.

509,662. Dynamo-Electric Machine. Carl Hoffman, Berlin, Germany, assignor to Siemens & Halske, same place. Filed Feb. 28, 1893.

509,705. Electro-Magnetic Reciprocating Motor. Richard Threfall, Sydney, New South Wales. Filed Feb. 24, 1892.

BATTERIES.

509,881. Battery-Box and Case. Linwood F. Jordan, Somerville, Mass., assignor of one-half to Henry B. Bennett, Portland, Me. Filed Oct. 3, 1892.

TELEPHONE AND TELEGRAPH APPARATUS.

509,480. Printing-Telegraph. Robert A. Fowden, Philadelphia, Pa., assignor to the International Printing Telegraph Company, Camden, N. J. Filed Jan. 31, 1893.

509,477. Trunk-Line Signal. Edmund S. C. May, Chicago, Ill., assignor, by mesne assignments, to the American Bell Telephone Company, Boston, Mass. Filed April 17, 1893.

509,484. Signal Apparatus for Telephone Systems. Joseph J. O'Connell, Chicago, Ill., assignor, by mesne assignments, to the American Bell Telephone Company, Boston, Mass. Filed April 17, 1893.

509,530. Telephonic Apparatus. William S. Harrison, Hong-Kong, China. Filed Dec. 13, 1892. Renewed Oct. 5, 1893.

ALARM AND SIGNALING APPARATUS.

509,367. Switchboard Circuit and Signaling Apparatus. Francis W. Dunbar and Edmund S. C. May, Newark, N. J., assignors to the American Telephone and Telegraph Company of New York. Filed March 7, 1892.

509,524. Police and Fire Alarm System. James B. Gill, San Francisco, Cal. Filed Dec. 9, 1892.

509,545. Signal Apparatus. George McIntosh, Stonington, Conn. Filed Feb. 1, 1893.

509,680. Electro Magnetic Alarm. Parnell Rabbidge, Sydney, New South Wales. Filed Feb. 28, 1893.

ELECTRICALLY OPERATED TRAVELLING CRANES.

509,756. Overhead Travelling Crane. William H. Morgan, Alliance, Ohio, assignor of three-fourths to Thomas R. Morgan, Sr., Thomas R. Morgan, Jr., and John R. Morgan, same place. Filed Jan. 11, 1893.

509,757. Overhead Travelling Crane. William H. Morgan, Alliance, Ohio, assignor of three-fourths to Thomas R. Morgan, Sr., Thomas R. Morgan, Jr., and John R. Morgan, same place. Filed Jan. 14, 1893.

509,758. Trolley for Overhead Travelling Cranes. Thomas R. Morgan, Sr., and William H. Morgan, Alliance, Ohio, assignors of one-half to Thomas R. Morgan, Jr., and John R. Morgan, same place. Filed April 8, 1893.

MISCELLANEOUS.

509,363. Electric Current Regulator. John H. Clark, Boston, Mass. Filed Dec. 30, 1891.

509,373. Electrically Operated Jumper Drill. Carl Hoffmann, Berlin, Germany, assignor to Siemens & Halske, same place. Filed Oct. 12, 1891.

509,397. Electric Elevator. Charles R. Pratt, New York, N. Y. Filed Feb. 5, 1892.

509,500. Electric Double Pole Fixture Cut-Out. Henry E. Werline, Lancaster, Pa., assignor of three-fourths to Frank S. Barr, same place, and Edwin L. Reinhold and Henry B. Cassel, Marietta, Pa. Filed Feb. 15, 1893.

509,501. Electric Pendant Cut-Out. Henry E. Werline, Lancaster, Pa., assignor of three-fourths to Edwin L. Reinhold and Henry Burd Cassel, Marietta, and Frank S. Barr, Lancaster, Pa. Filed April 17, 1893.

509,539. Electric Switch. Charles J. Klein, New York, N. Y. Filed Dec. 2, 1892.

509,556. Electric Plow. Charles H. Roberts, Eau Claire, Wis. Filed April 30, 1892.

509,578. Potential Indicator. George A. Lintner, Minneapolis, Minn. Filed March 16, 1893.

509,614. Strain Insulator. Charles H. Dey, Boston, Mass., assignor to Albert & J. M. Anderson, same place. Filed June 5, 1893.

509,634. Process of Refining Slimes from the Electrolytic Refining of Copper. David K. Tuttle, Philadelphia, Pa., and Cabell Whitehead, Washington, D. C. Original application filed Feb. 20, 1892. Divided and this application filed Sept. 19, 1893.

509,713. Cut-Out. Nathaniel F. Adams, Boston, assignor of one-half to John G. Robinson, Melrose, and Hayes Lougee, Newton, Mass. Filed Feb. 18, 1893.

509,750. Electric Current Meter. William T. M. Mottram, Dallas, Tex. Filed May 23, 1891.

509,770. Laminated Converter Core. Charles F. Scott, Pittsburg, Pa. Filed Nov. 25. 1892.

509.776. Electrical Controller. Elmer A. Sperry, Cleveland, Ohio. Filed Aug. 21, 1893.

509,783. Lightning Arrester. Alexander Wurts, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, same place. Filed May 16, 1893.

509,784. Universal Non-Arcing Lightning Arrester. Alexander Wurts, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, same place. Filed May 16, 1893.

509,821. Electric Elevator. Francis B. Perkins, Boston, Mass. Filed March 16, 1889.

To Inventors and Others.

United States and Foreign Patents Procured.

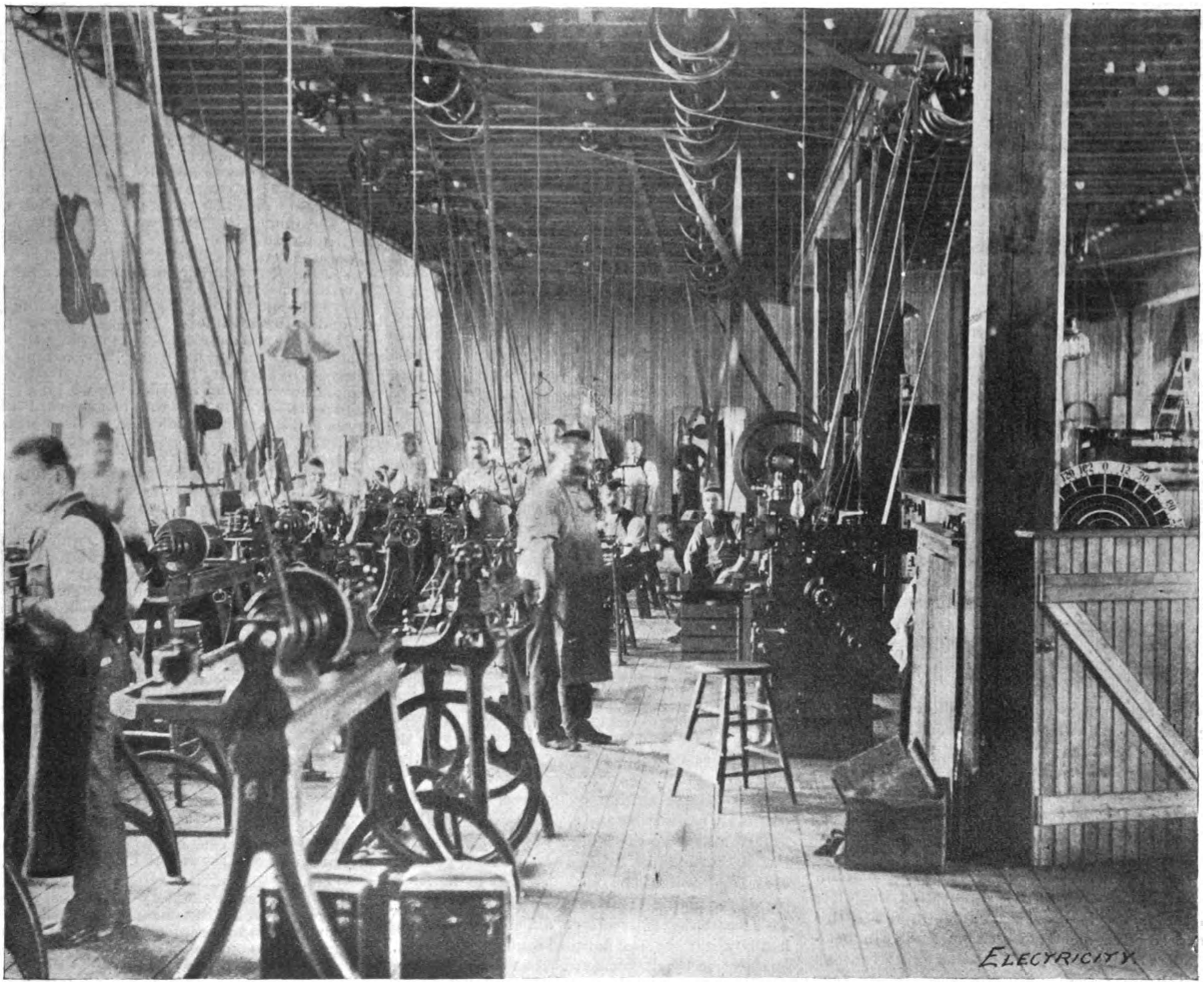
A PATENT DEPARTMENT has been established in connection with the publication office of ELECTRICITY, for the transaction of all business connected with the procuring of patents on inventions and devices of all classes. The object is to furnish inventors and others, at moderate cost, with a reliable, well-equipped and accommodating bureau through which they may be aided in procuring United States and foreign patents and obtain all information necessary to a successful prosecution of their claims.

Immediate attention will be given to inquiries and orders by addressing

T. F. BOURNE,
Manager Patent Department ELECTRICITY,
6 Park Place, New York City.

ELECTRICITY.

VOL. V. NEW YORK. DECEMBER 20, 1893. CHICAGO. No. 23



MACHINE SHOP, J. C. VETTER & COMPANY, NEW YORK. (SEE PAGE 277.)

Recollections of Werner Von Siemens.*

IV.—Telegraph Work in 1848.

In the meantime great changes had taken place there (in Berlin). The military commission for the introduction of electric telegraphs had been formally dissolved and telegraphy placed under the newly created Ministry of Commerce. As head of this department Assessor Nottebohm had been appointed, who had already occupied an administrative post in the telegraph commission. The resolution was taken to follow the course adopted by the late commission, and first to construct in all haste a subterranean line from Berlin to Frankfort-on-the-Main, where the German National Assembly was holding its sittings. In consequence of this, an inquiry was addressed to me whether I was disposed to direct the construction of this line according to the proposals made by me to the commission. In the event of my acceptance my command from the War-Office would be transferred to the Ministry of Commerce. Although a position under Assessor Nottebohm was not particularly agreeable to me, I nevertheless accepted the call, since it set me free from the present monotonous military life in the little fort, and gave me an opportunity of bringing my proposals into practical execution on a large scale.

In Berlin I found Halske already busily engaged in work for the line about to be constructed. It had been determined to lay the line altogether underground, as it was feared that above-ground wires would be destroyed in that time of great political excitement. The wires, insulated by a coating of gutta-percha, were to be laid without external protection in a trench a foot and a half deep in the railway embankment. My proposed protection of the communications by means of envelopes of iron wires, iron tubes, or clay channels was not approved on account of the great expense. A contract had already been signed with the Berlin indiarubber factory of Fonrobert & Pruckner for the further construction of subterranean wires. This was the same factory to which I had transferred my model for the covering of copper wires with gutta-percha, and which had already manufactured the experimental line from Berlin to Grossbeeren with a press made according to that model. I had to confine myself to providing for the best possible insulation of the wires. Considerable difficulties stood in the way however, inasmuch as, owing to the sudden great demand for gutta-percha, the best insulation sort was soon out of the market.

To cope with this impediment to the rapid progress required of the work it was resolved to make use of the recent English invention of vulcanizing the gutta-percha, i. e., intimately mixing it with sulphur, whereby even with inferior kinds of gutta-percha the insulation of the conductors as well as their power of resisting external injuries was increased. Unfortunately the vulcanization turned out afterwards a mistake, as the sulphur combined with the copper of the conductor and thereby also the adjacent layers of gutta-percha became gradually copper and capable of conduction. To this circumstance it was mainly ascribable that the wires, though perfectly insulated at the time of their being laid down, had after a few months already lost a part of their insulation.

Particular care was taken in testing the wires in the factory. Halske manufactured for this purpose galvanometers which far excelled in sensitiveness all known up to that time. In testings with these sensitive galvanometers I observed for the first time in the year 1847 the surprising phenomenon that, even in a perfectly insulated wire lying in water, on interposing a battery a short current occurred, which was succeeded on removal of the battery by an equally strong current in the opposite direction. This was the first observation of the electrostatic charge by galvanic chains. I was at first inclined to see in this a phenomenon of polarization, since at that time the galvanometer was not considered capable of indicating the passage of static electricity. The phenomena on longer well insulated lines soon however rendered it quite indubitable to me that it was a case of electrostatic charge and not of polarization.

The first difficulty, the finding defective insulating points in a long piece of the conducting wire, I was able to overcome in the following manner. The dry wire coated with gutta-percha was drawn through a vessel filled with water and insulated in respect to the earth, whilst the second coil of thin covered wire, which surrounded the electromagnet of a Neef hammer, was interposed between the insulated copper wire and the earth. If now a workman standing in communication with the earth dipped a finger into the water of the insulated vessel, he felt electrical shocks at the moment at which a defective piece of the wire enveloped by gutta-percha was immersed. In this way I succeeded in detecting all the small defects of insulation discoverable in no other way, and in obtaining after their removal conductors with extremely good insulation.

With regard to the modification just described of the Neef hammer the following observation may here find a place. I had already made this modification in the year 1844 and given it the name of the voltaic inductor. It even then afforded me the opportunity of observing the therapeutic effect of the variable current induced in the second coil of such a voltaic inductor. My brother Frederick at that time was suffering a good deal of rheumatic toothache, which had affected his otherwise perfectly sound teeth and refused to yield to any prescribed remedy. The experiments with my new voltaic inductor led me to hit upon the idea of trying whether the variable currents produced by it could not remove the intolerable pain, or at least diminish it, if conducted through the roots of the teeth. This was actually the case with a particularly painful front tooth. The pain was at the first moment intense, but then suddenly quite ceased.

With the great force of will which at all times characterized my brother Frederick he at once proceeded to send alternating currents through all roots, and thereby obtained entire exemption from pain, which he had not experienced for weeks. Unfortunately however on the second day the pains returned. By repeated application of electricity their cessation was again effected, but the ensuing painless period became shorter, and at last the remedial agency altogether failed. This first attempt within my knowledge to employ galvanism for therapeutic purposes inspired me with a certain distrust of this particular application of the electric current. It appeared as if its action were only temporarily, not permanently, curative.

The ensuing autumn of 1848 was to me an exceedingly interesting and exciting one. The line to Frankfort-on-the-Main, where the German Parliament held its sittings and the vicar-general of the empire had his residence, was to be completed for political reasons as quickly as possible. This was however rendered difficult on the one hand by the disturbed political condition of affairs, on the other by altogether unexpected phenomena which manifested themselves in the underground conductors. My friend Halske, to whom had been consigned the fitting of the finished parts of the line with signalling apparatus, was the first to encounter these phenomena whilst I was engaged upon the line between Eisenach and Frankfort, which it had been resolved to carry above-ground, as the railway was still in course of construction—the land even having been only in part acquired.

Halske found first of all that with shorter lines our self-interrupting indicator telegraphs acted with much greater speed than corresponded to the resistance of the line. When communication between Berlin and Cöthen had been established a distance of about 95 English miles, the giving apparatus ran with double velocity whilst the receiving apparatus stopped altogether. This at the time inexplicable phenomenon occurred the earlier the better the lines were insulated, which induced Halske purposely to impair the insulation of the line by the addition of artificial watery by-passes.

The above-ground construction likewise encountered unexpected difficulties. Where the land for the future railroad had not yet been purchased, the owners would not permit the erection of the posts. This opposition was encountered especially in the non-Prussian parts, Hesse-Cassel and Hesse-Darmstadt, where the antagonism between the government of Prussia and the administration of the empire after the restoration of order in Berlin had become considerably acuter in consequence of the entrance of the army returning from Schleswig-Holstein. I only succeeded in executing my task by obtaining an open order from the vicar-general of the empire, Archduke John. Technical difficulties also made their appearance. The line was constructed of copper wire, as suitable iron wires were not then to be had in Germany, and moreover were still regarded with a certain mistrust. The unfortunate experiences which we had had the foregoing year in the case of the Berlin-Potsdam line, which despite the application of all sorts of insulating media proved so badly insulated in rainy weather that the proper service of the apparatus was constantly disturbed, had led me to make use of bell-shaped insulators of porcelain. These possessed the great advantage that the inner surface of the bell always remained dry even in rainy weather, whereby the insulation was secured under all circumstances. In fact I succeeded in this way in producing an almost perfect insulation. Unfortunately I did not then think it necessary to solder the copper wire, close coiling seeming to me sufficient. This afterwards turned out to be an error. In calm weather the apparatus acted very well, but with a strong wind the resistance of the conductor was so remarkably variable that the apparatus refused to work. Only subsequent soldering of all the joints put an end to this trouble.

The atmospheric electricity proved also very disturbing. In passing from level to high land currents of varying direction often traversed the communications and impeded the working of the apparatus. A late autumn storm caused widespread destruction, which led me to construct lightning-conductors for the protection of the lines and apparatus. In order to ascertain the most efficient form of lightning-conductors I set up between two paralled wire spikes, balls, and plates at equal intervals from one another, and observed the sparks, caused by the discharge of a large battery of Leyden jars, which passed between these three adjacent lightning-conductors. It appeared that very weak discharges took their course solely through the spikes, whilst stronger ones passed mainly between the balls, and very strong ones were carried off in a large number of sparks almost entirely through the plates. For actual lightning therefore roughened metallic plates placed nearly opposite one another proved particularly effective. The influence of the Northen Lights also made itself frequently perceptible, and at times in a very disturbing degree, especially in the underground line running mainly from east to west. Thus during the great aurora in the autumn of 1848 communication was interrupted for days between Berlin and Cöthen on account of violent rapidly changing currents. This was the first observation of the connection between earth currents, magnetic disturbance, and the aurora borealis.

When the underground line had been extended to Erfurt, Halske's watery by-passes were no longer sufficient. But meanwhile I had become convinced that the peculiar behavior of the underground wires could only be ascribed to the electrostatic charge already observed at the testings in the factory, the wires namely forming the inner, the damp soil the outer coating of a Leyden jar. Conclusive was the circumstance, that the quantity of electricity contained in a perfectly insulated conductor, measured by the deflection of a freely oscillating magnetic needle, was define itely related both to the electromotive force of the interposed galvanic battery and to the length of the wire; further that the electric tension of the charge in a closed conductor corresponded to the electric tension occurring at every point of the circuit according to the law of Ohm. Having perceived this, the impediments to signalling on long underground lines, could, if not be removed entirely, yet be rendered innocuous for practical purposes by suitable contrivances. These were the application of by-passes in the form of metallic resistances without self-induction, and automatic translation by which several closed pieces of line were united into a single large line.

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* Selected from "Personal Recollections of Werner Von Siemens," recently published in America by D. Appleton & Company, New York, 416 pp., 12mo, uncut edges, wide margin, photogravure portrait.

My theory of the electrostatic charge of closed as well as of open circuits found however even in scientific circles at first but little acceptance, since it was opposed to the ideas prevailing at the time. Although it is not easy at the present day, when one can hardly conceive how a civilized man can live without railroads and telegraphs, to carry oneself back in imagination to that time, with the view of understanding the difficulties which we then encountered in things now regarded as a matter of course. Conceptions and helps, which are to-day familiar to every schoolboy, could at that time often only be obtained by effort and hard work.

I had the satisfaction of seeing this first long telegraph line—not merely of Germany but of Europe—already at work in the winter of 1849, so that the election of an Emperor, which took place in Frankfort, was by its help known the same hour in Berlin. This favorable result led to the determination of the Prussian Government to construct at once a line from Berlin to Cologne and the Prussian frontier at Verviers, and after that others to Hamburg and Breslau.

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The final decision of the question what turn I should give to my future life had now to be made. I decided for the last. To return to the military garrison service, after the exciting and successfully active life which I had behind me, I should have found altogether impossible. The civil service did not at all content me. There was wanting in it the feeling of comradeship which mitigates and renders endurable the oppressive differences of rank and power, there was wanting in it also the plain-spoken candor which reconciles one even with the bluntness which is traditional in the army. My brief experience of the civil service gave me sufficient grounds for the formation of this opinion. As long as my superiors understood nothing of telegraphy, they let me work entirely unchecked, and limited their intervention and instructions to questions of financial importance. That soon changed in the degree in which my immediate superior in office, Assessor, afterwards Counsellor Nottebohm, acquired knowledge of the subject during the progress of the work. People were assigned to me of whom I could make no use, technical arrangements ordered which I knew to be bad—in short, frictions and differences occurred, which marred the pleasure in my work.

To the acceptance of my request for dismissal was attached a remark of reprehension on a formal error in my petition. The political reaction had then become so strong that the German sentiments shown by me in the Danish war had become a reproach in governing circles.

In spite of the small final result of my military service I look back with a certain satisfaction to my military period. My most agreeable youthful recollections are connected with it, it paved my way through life, and gave me through the success I had achieved self-confidence for aiming at higher goals.

(To be continued.)

American Institute of Electrical Engineers.

The Eighty-second Meeting of the Institute will be held at headquarters, 12 West Thirty-first street, New York City, on Wednesday, December 20, at 8 o'clock P. M. A paper will be presented by Albert Stetson, Esq., on "The Practicability of Electric Conduit Railways." The paper will be illustrated by lantern slides. The December number of the Transactions will not be issued until after this meeting.

Ex-Surrogate David A. Pell, of Bergen County, N. J., has been appointed receiver of the Fort Lee, Leonia and Hackensack Electric Railway Company by Chancellor McGill. The railroad company laid about a mile of tracks, but lack of funds caused a halt. It is said the company owes about $9,000.

The Electrical Transmission of Power from Niagara Falls.—III.

BY PROF. GEO. FORBES.*

LINE CONSTRUCTION.

A great deal of attention has been given to the different methods by which current can be conveyed to the points of consumption, whether on our own property or at Buffalo, or even farther. Naturally the pole line was first dealt with, in which the poles might be constructed of either wood or iron. This is the cheapest type of construction, and has some advantages, but we must consider the climatic conditions in the neighborhood of Niagara Falls. We are subject there to severe thunderstorms, and troubles from lightning have already been serious in several parts of the United States in connection with electrical machinery. Snow and frost are very severe, and sleet forming upon the wires and insulators may cause a great amount of trouble. There are also at times very violent gales sweeping from over Lake Erie. All these difficulties can be counteracted to some extent, but it is nearly certain that with overhead construction occasions would arise when the continuity of operations would be interrupted, and this would be a very serious matter. The next system to be considered in order of cost would be underground cables, but I am strongly opposed to the adoption of these for any considerable length. It is true we are able to deal with their capacity so as to reduce its injurious effects, but surely the best plan of all is to abolish the capacity itself as far as possible. The most satisfactory method of proceeding is to build a subway of sufficient size to enable a person to walk along it and to carry bare copper conductors in it, but this is a matter of considerable expense. I am glad, however, to be able to inform you that the officers of the company resolved last summer that a subway such as I have described should be constructed from the power-house up to the Pittsburg Reduction Company's works, where aluminium is to be produced, a distance of 2,500 ft. In accordance with their instructions I prepared plans, which are now exhibited, and which give space enough to carry the conductors at 20,000 volts for all the power that will be developed by the present tunnel, parallel working being adopted. The subway is built of concrete having a minimum thickness of 10 in. The height inside is 5 ft. 6 in. Wooden beams are embedded in the concrete on both sides every 30 ft. When the concrete is set these beams are removed, and iron castings for supporting the brackets that hold the insulators are put in their place, and these are then grouted in. Iron brackets, as shown in the drawings, are bolted to these castings, and the oil insulators placed upon them. Copper wires are shown as being supported on these insulators, but we shall probably adopt copper strip. The bottom of the subway is always on an incline, and is of curved shape to drain off any water of condensation, but it is also proposed to force air through the subway so as to keep it dry. The 2,500 ft. now being completed is all drained at the power-house end by a boring into a water-bearing stratum. At the bottom of the subway the concrete is formed in two steps, the lower one of which supports sleepers for a very light tramway upon which a truck can run to carry supplies, and also to carry the inspector. At first this can be moved by hand lever, but arrangements are made for eventually driving it by electricity, the conductor being carried on the floor, between the stringers (placed on the ties or sleepers,) which form a platform running along the length of the subway. On the stringers outside the rails is placed a screen separating, mechanically and electrically, the part of the subway where the conductors are from the part where the inspectors walk. This screen is formed in 10 ft. lengths of wood supporting expanded metal, covered over with plaster up to a height of within one foot of the top, the upper part being left open in the form of a network, through which the inspector can look at the conductors and their supports. These screens are held by iron supports fixed by expanding bolts into the concrete, and can easily be removed. The top of the arch is 3 ft. below the surface of the ground, so that it will not be affected by frost. According to the last report, it appears that on October 21, 1,590 ft. of this subway had been completed; the total length being put down at present is 2,500 ft. Each of the iron castings has a wire attached to it which passes through the concrete, and is soldered to a copper wire running outside the subway along its whole length, and connected to a plate sunk in the water at any suitable points. At every 400 ft. cross streets will be made, and at these points there is a manhole. Also at these points, on each side of the subway, four drain pipes, 3 in. in diameter, are let in, closed at their outer ends. When the subway is to be tapped for use on the side streets, or for intermediate points, wires can be laid through these pipes. Between Niagara Falls and Buffalo there is very little rock, but the part where the subway has now passed through has been chiefly in rock. This involved blasting out a channel larger than was required. In this case the part of the trench outside of the subway has been built up of stone. In the construction of this subway American Portland cement has been used, and a very suitable sand from the neighborhood, which contains its own gravel. The whole of this work has been done by Mr. Humbert, and up to the date of my last inspection every part was thoroughly and satisfactorily done. This work is of great importance as conveying to the minds of those who intend to use our power some idea of the desire to ensure continuous working.

With regard to the electric pressure that is to be used for distant transmission, this will undoubtedly advance with experience. Some manufacturers in Europe who tendered for the work proposed to adopt 25,000 volts; but we have considered that at present 20,000 volts is not likely to be exceeded by us, and we may work at a low pressure at the commencement. When it is remembered that the Deptford machines have one terminal connected with the earth, and are working satisfactorily at 10,000 volts, and when it is noticed that, in consequence, our work would be under exactly the same conditions as regards insulation when working at 20,000 volts, it is easy to see that we are not risking anything experimental in our first work.

With regard to the size of conductors, I worked out the economical size at different current densities for the whole distance. In doing this I took the following data:—I took the cost of copper at 12½ cents per lb., and the annual charge on this cost at 5 per cent. I then computed the power loss in the line, and the amount of power which was left available for delivery. I took the value of this power at the distant end of the line as being $15 per horse-power. This is something more than what it costs us to produce it, but when the power available from our tunnel is nearly all consumed this quantity will have to be increased. It must also be remembered that I have not allowed for the increased size of the conductors required by the retardation of phase, which is an unknown quantity. Still, it will be seen that from these considerations we may be able to work economically at a slightly higher current density than is obtained from this investigation. From this work it appears that the most economical density to work at is 350 amperes per square inch. If this density is used, the fall in volts between Niagara Falls and the northern boundary of Buffalo is only 3½ per cent. — a matter which makes regulations extremely easy.

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* From a paper read before the Institution of Electrical Engineers, England.

With regard to the efficiency of the system, it is remarkable how high the efficiency of the dynamos comes out when we are dealing with the large units of 5,000 H. P. There can be little doubt that the efficiency, electrical and mechanical, of our dynamos may reach at least 98 per cent. Taking off 3½ per cent. for losses on the line, we would have 94½ per cent. delivered electrically at Buffalo if no transformers were required to raise the electric pressure to the full 20,000 volts. In cases at Buffalo, where the power consumed is very large, the motor can be constructed on the same principles as the dynamo; and if in this case it be ever possible to work at the full pressure without a transformer, it is obvious that the total efficiency of the system—that is, the power delivered by the motor to the shaft of the machinery, divided by the power delivered by the shaft of the turbines to the dynamo—will be certainly over 90 per cent. As a matter of fact if we were to use a higher density of current, and were to use step-up transformers at Niagara Falls and step-down transformers at the northern boundary of Buffalo, and other step-down transformers in the town of Buffalo itself, and were to use motors of small power and consequently less efficiency, in this case the total efficiency of the plant might be reduced to 80 per cent., or even lower.

I have given these figures, not as indicating precisely the lines on which we have determined to work at Buffalo, but because the present Paper is intended to embrace the subject of the general distribution of power, and I thought it desirable to lay before you certain facts in this connection in a definite form.

DESCRIPTION OF MACHINERY TO BE USED.

Under this heading I shall deal chiefly with the type of dynamo which has been finally decided upon. It will suffice to say of the turbines that they are each of 5,000 H. P., that they revolve at 250 revolutions per minute, and were designed by Messrs. Faesch and Piccard, of Geneva. All the principal parts of this machinery were constructed by the I. P. Morris Company, of Philadelphia, but the governors of the turbines are of Swiss manufacture. and part of the steel fittings were constructed in France.

With regard to the dynamo, the Cataract Construction Company at first invited many different manufacturers in Europe and America to submit plans. The number of these that were submitted altogether amounts to 24, some of the manufacturers having taken a great deal of trouble to submit a series of designs, in order to be able to meet different requirements. Many of these designs were extremely good; but it was determined, after estimating the increased cost of using the European designs, owing to the high tariff in America, and owing to transport, to have the machines manufactured in America. Among the designs from American manufacturers there were none which fulfilled all the requirements of the case, and eventually the Cataract Construction Company decided to get out their own designs, and to submit them to the American manufacturers for tender. I had been for some time previously engaged in working out a design which I am confident none of the manufacturers who had sent in designs could say was in any way borrowed from their ideas. We had received suggestions of an external amature with internal revolving fields, and also of external fixed fields and internal revolving armature. We naturally had a preference for a dynamo with a fixed armature, because the coils can be more securely wound, and are not subject to the mechanical stresses induced by centrifugal force. But all the designs with revolving fields which had been submitted to us contained a weak feature: the field coils were held in by pole faces secured by bolts or keys to the poles, and this seemed an element of weakness when we considered the enormous centrifugal forces to which the machinery would be subjected. At the same time the turbine makers had insisted upon having a certain momentum, or fly-wheel effect, which was not given by the revolving parts of any of the dynamos submitted to us, and it was found that if anyone of these had been accepted it would have been necessary to add to the design a fly-wheel of large dimensions. Centrifugal force was one of the most important matters to be considered, because at 250 revolutions per minute this force assumes considerable magnitude in the large masses with which we had to deal. Moreover, in all the designs which had been submitted, the magnetic pull between the poles and the iron of the armature assisted the centrifugal force. The principal feature of the design upon which I was working consisted in having the armature fixed, and inside the machines, with the fields revolving outside; the fields being formed of a ring of iron with the poles projecting radially inwards. One advantage is that we are able to get the full fly-wheel effect that was required by the turbine makers. This requirement was that in the revolving part the sum of the weight in pounds of each part, multiplied by the square of its velocity in feet per second should equal 1,100,000,000. The design also gives an extremely good mechanical construction for the revolving parts. The iron ring which forms the yoke of the fields serves as a support to hold in the pole-pieces and the exciting coils, and no part is held in against centrifugal force by bolts or keys. Moreover, the magnetic pull between the fields and the armature acts in opposition to, and does not assist, the centrifugal force. The armature is fixed, and a large space is available inside of it for the workmen to attend to the bearings, and to reach any part of the armature. It is obviously possible to insulate the armature coils for any electric pressure. With a large machine of this kind, the space occupied by insulation has not the same importance in reducing the output of the machine as is the case with machines constructed in the past. In fact, the armature coils can be wound with the same insulating properties as a transformer, and hence the necessity for using a step-up transformer can be avoided.

Starting with this general principle, I first got out designs of a machine at 33 periods per second, in order that I might compare the general appearance of such a machine with those of other types. The next point was to design a machine of as low frequency as was possible under the limiting conditions as to weight. The revolving parts of the turbine and dynamo, and the shaft connecting them, are supported by a hydraulic piston, and it was the desire of the Cataract Construction Company not to use a thrust bearing of any kind to support the weight, although there is a thrust bearing at the top of the shaft, which simply acts to retain the apparatus in a fixed position in a vertical direction. Owing to this decision. it was necessary to limit the weight of the revolving parts of the dynamo to 80,000 lbs. In getting out the design for this machine it was desirable to select such a form of winding as past experience led me to believe would be most efficient for parallel working, and I judge from past experience that this is best attained by having the number of coils per pole very small. The 33-period machine which is shown in the drawings has only been sketched out with a view of getting at the general dimensions of the machine. It is not suitable for our special purpose, because it is essential that, without taking the dynamo altogether to pieces, we should be able to lift up through the centre of the dynamo any parts of the turbine shaft which may require repair.

It will be seen that from the necessities of the case at Niagara Falls the dynamo which was required differed in some respects from what would be necessary in many other cases, but it is equally obvious that in any case of so large a transmission of power the conditions must be thoroughly considered beforehand, and the dynamo specially designed for the purpose. At the meeting of the Board of Directors of the company, in May, 1893, I was instructed. with Dr. Sellers, to get out plans for an alternator of the type which I have described.

I am not able to lay before you now plans of the machine as it has been finally adjusted by conference between ourselves and the manufacturers. In the plan which we prepared, the frequency was 16⅔ periods per second, there being eight poles. The armature coils were so wound that they might be connected to give either 2,500, 5,000, 10,000, or 20,000 volts. and the coils were limited in number so as to give the best assurance of good parallel working. For various reasons we decided eventually to raise the frequency to 25, and to lower the volts to 2,000, without the means of connecting the coils to give a higher pressure; and instead of winding the armature on the conductors in a limited number of coils, to adopt the methods more commonly used in some of the large types of generators, But since in any future work which is done the dynamo will be required to be modified for the special purpose, a description of the machine —of which I am able to show you the drawings* —is sufficiently representative of the type of machine for our purpose.

(To be Continued.

Modern Uses of Electricity—V.

DISTRIBUTION OF ELECTRICITY FOR COMMERCIAL PURPOSES.

This was the topic on which Professor Cross spoke on Monday evening, November 20, at the Massachusetts Institute of Technology, and in entering upon its consideration he said that the temperature of the electric arc was so enormously high that it affords a means of fusing refractory substances, which was a very great advantage not only in the laboratory but in actual practice. With a simple apparatus, almost the same in principle in construction as an arc lamp, a piece of zinc was instantly fused when the current was turned on. In volatilizing other substances an electric furnace could be used, the same being invented by Siemens some twenty years ago. It consisted of a plumbago crucible into which passes a carbon rod, this being the pole while the crucible formed the negative. The substance to be treated was placed in the crucible, and the carbon being brought into contact with it an arc was formed, the crucible became heated and the substance fused. This principle had been utilized by the Cowles Brothers for smelting aluminium from an ore containing from 75 to 80 per cent. of pure aluminium. In this process, copper, carbon and ore were mixed together and aluminium bronze was the product. Common clay was being treated for the same purpose, but containing only something like 12 per cent. of aluminium it did not pay to extract it. There are the Cowles and the Hall processes of electrically reducing ores in operation.

Passing on to the subject of electric heating, it was stated that for many purposes, such as cooking in a great variety of ways, heating soldering irons and similar purposes, electricity was very available. It had not yet been thus utilized on an extensive scale, but this new department was deserving of consideration. It was not yet possible to utilize the electric current for heating very large spaces, such as buildings, thus superseding the use of furnaces, but this process was practicable for raising the temperature of a room beyond the point to which it had been raised, say by a furnace or other system of heating.

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* Diagrams were shown at the meeting, but none of them have been received by us for publication.—Ed. E.

Illustrative of what was now being done in the department of electric heating, the lecturer then showed a variety of cooking and other utensils manufactured and loaned to him by the New England Electric Heating Company, describing their construction and uses and informing his audience that at the present time cooking was being regularly done by electricity at the American House, one of the principal hotels in Boston.

Passing on to electric lighting by incandescence, he remarked that the history of this department was particularly interesting, because it brought them some idea of the many attempts that had been made ere success was attained.

In 1845 a Mr. King, of Cincinnati, used carbon in the manufacture of incandescent lamps, but it was never recorded what progress he made, though it was reported that he operated successfully ten or twelve lights in Manchester, England, at a private exhibition when Michael Faraday was present.

Other early experiments were made by Mr. Moses G. Farmer, in 1869, in lighting a house near Salem, Mass. This, however, is said to have been done by using a platinum ribbon.

The incandescent lamp has been evolved out of the persistent labors of many different workers, of whom the best known was Mr. Thomas A. Edison. The modern type of incandescent lamp consisted of a small thin thread of carbon through which an electric current passes after the carbon has been placed in a vacuum to prevent combustion.

Lane Fox in England and Edison in America were among the earliest successful workers in this field. The latter began by making a lamp having a filament of platinum of very high resistance. The great objection to a lamp made of platinum was that the limit between the point of incandescence and melting was so narrow that the lamp was liable to break down at any time.

It was the platinum lamp in 1878 that so suddenly brought down the price of gas stocks on its introduction and not the carbon lamp as now used. Edison was able to improve the platinum lamp when he found that the breaking down was generally due to the cracking of the wire caused by the ebullition of gases that had been occluded and which were liberated when the current was increased. Abandoning one particular line of work he started out on another and finally succeeded in bringing out the lamp which bears his name to-day.

One of the first things of importance in the making of incandescent lamp filaments was to select a substance that could be easily carbonized. Edison first used paper, but abandoned it for bamboo, certain fibres in which just met his requirements. His company has hitherto proceeded on the assumption that it was best to carbonize the filaments before using them. Silk thread has also been used extensively. Flashing filaments by submerging them in petroleum and passing a current through them is very general; it makes them strong and even in tension. Of course it was necessary to attach the filament to the leading-in wires. These have usually been made of platinum, because it can easily be sealed in the glass bulb, the coefficient of heat of glass and platinum being very nearly the same.

The vacuum in an Edison lamp is equal to 1-80,000th of an atmosphere; with the use of a Sprague pump a vacuum of 1-1,000,000th of an atmosphere is possible. The necessity for a vacuum is because if there was any oxygen present in a lamp, of ever so small a quantity, the carbon filament would be instantly burnt up. This is not the only reason for placing the filament in a vacuous chamber. There was the additional reason that what was known as "air-wash" was very destructive of the filament, this being the action of some molecules of air on the filament. No one has yet been able to ascertain what is the least number of molecules of air that would render a lamp useless.

Within a recent period what are called "stopper" lamps have been placed on the market. All lamps that have been held to infringe the Edison lamps contain the carbon filament placed within a chamber having a vacuum in it to prevent "air-washing," with platinum leading-in-wires.

The lecturer then minutely described at great length the making of various types of incandescent lamps, showing a number of the "New Beacon" lamps which had been placed at his disposal for that purpose.

Showing a Westinghouse lamp of 50 volts, Prof. Cross attached it to a 110 volt circuit to illustrate how it could be so used by means of a resistance box. By increasing the pressure of a current to secure greater brilliancy, the life of a lamp was shortened. It was an open question what should be termed the life of a lamp—the period the filament lasts, or the time that elapses before a lamp blackens so that it cannot be used any longer.

In using lamps, the higher the pressure of the current the more expensive, and vice versa. Lamps generally give out by the breaking down of the filament, which is weak. After speaking of the hundreds of measurements that have been made to ascertain the C. P. of lamps, and the efforts of inventors to get a good light on a horizontal plane, the lecturer called his audience's attention to the spectra of the arc light, incandescent light and gas light. He pointed out that there were more red rays in the arc light than in the incandescent, and less in the gas light, and stated that the higher the incandescence the better the light. What inventors to-day were after was the discovery of a filament that could be heated with a small current and yet give a better light.

Next, discussing the loss of light and heat by radiation in all kinds of artificial light, the lecturer showed that there was an immense waste going on; what the amount of loss was, and how to correct or obviate it, was a subject engaging the closest attention of the most prominent scientists, and with the aid of delicate instruments already in use, there was a not very remote possibility of this problem being solved.

ELECTRICAL TRANSMISSION OF ENERGY.

This was the topic on which Professor Cross spoke at Huntington Hall, Boston, a few evenings ago, the address being one in the series of lectures he was giving on "Modern Uses of Electricity." In entering upon the lecture, the speaker said that a motor, when running, sets up a reverse electromotive force which increases from zero when the motor is not running to its maximum when the motor is doing the heaviest work possible for it to do. This fact was illustrated by passing an electric current through a small motor and lamp. Under this arrangement if the motor was prevented from turning or running, then the lamp would glow quite brightly. If, however, the motor was allowed to start up and increase its velocity, then the lamp would glow gradually dimmer and dimmer. It was shown that when the speed of the motor was such that the inverse electromotive force was half of the current passing, the mechanical work done was greatest.

The efficiency of a motor was the ratio between the electromotive force of the current furnished to the motor and the inverse electromotive force of the motor. On this depended the commercial success of the electric transmission of energy.

Passing on to the subject of lighting, Prof. Cross said that electric lamps are run in either "series" or in "parallel." Arc lamps are usually run in series, thus requiring a constant current in the circuit. This constant current was secured by means of a current regulator. Incandescent lamps were usually installed in parallel or multiple arc, which requires a constant difference of potential between the terminals of the dynamos. Shunt machines, as they were called, were usually used for this purpose, but do not regulate themselves very well under great variations of load. Compound wound dynamos were now being used very generally for incandescent lighting. These machines had a combination of shunt and series winding, and could regulate themselves under great variations of load. The electrical mains, like water mains, must be made so large that the diminution in voltage along their length is very small. Various systems of distribution were used in case of central stations. The series system used very small current, with but small loss. It required, however, a high electromotive force, and was thus dangerous to handle. The parallel system uses a low electromotive force, and was therefore harmless but required large conductors, which made it costly. The series parallel system combined the first two, but was used only in running incandescent lamps on arc circuits.

The converter system was one in which the current generated at the station was used to produce local currents at the places where they were to be used. There were several forms of this system, but the transformer system was the most important and the one most generally used. Its greatest advantage was where the current had to be carried long distances. The objections to it were inferior regulation and danger from the current, especially in case of inferior insulation in the transformer. Two important additions had been made to the parallel system during the last few years. These were the system of "feeders," and the "three-wire" system, both of which greatly reduced the cost of wiring.

The lecture was interspersed with views of various types of generators, isolated and central station plants at home and abroad, together with maps of the underground system of electrical distribution as it is in existence and operation in Boston at the present time.

He Sawed the Conduit.

How Supt. O'Neill, of Rochester, Mended a Water Main.

A few nights ago the continued ringing of gongs in the fire and police patrol service at Rochester gave warning that something was wrong. City Electrician Barnes, with the superintendent of construction of the Telephone Company, soon discovered that a large portion of the city was absolutely cut off from all connection either by telephone, fire alarm or police patrol service. An investigation disclosed the fact that the Superintendent of Public Works, Mr. O'Neill, finding that the electric conduit retarded his progress somewhat in the repair of a water main, had deliberately sawed the conduit in two places and removed a piece about a foot in length. The conduit contained seven cables.

Mr. O'Neill is still unable to perceive that there was anything unusual in this. A Rochester reporter says: "The superintendent appeared to be completely exhausted from the effects of his night's work, and it was only by repeating each question several times that an answer could be obtained."

ELECTRICITY.

The Popular Electrical Journal.

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SEPARATION IS THE PLAN.

From all the information at hand as we go to press, it is believed the present plan of reorganization for the General Electric Company is to effect a separation of the Edison and Thomson-Houston interests.

The scheme is believed to be well under way, the details being settled as far as the Directors are concerned.

Legal obstacles may arise, but there is little doubt that it is intended to sell the Thomson-Houston stock, now held as a treasury asset by the General Electric Company, to a syndicate of Boston capitalists, headed by Mr. Coffin. The Thomson-Houston Company will, it is believed, go into business at the old stand, of necessity confining its attention chiefly to railway work.

The General Electric Company would be in reality the Edison Company, and the name of Edison would doubtless be speedily taken on again.

We leave speculation on the foregoing to our readers, and the settlement of bondholders' and mercantile creditors' claims to the courts, a receivership being no doubt necessary as the preliminary step.

It is common talk in Boston that the labels "G. E. Co." on all working machinery in the Lynn works have been planed off, and the old-time labels, "T. H. E. Co.," substituted therefor.

It has been generally supposed that a separation could not be carried out. That is a question, perhaps, which the courts will have to decide, but there does not seem to be any inherent impossibility in its solution. The Thomson-Houston Electric Company is still in existence legally; its stock is owned by the General Electric Company, and the latter company is authorized by charter to buy and sell stocks of other companies. Certainly the Thomson-Houston people cannot *withdraw*, but if the General Electric Company wishes to sell its Thomson-Houston stock to a syndicate, we believe it can do so.

Indeed a careful review of the situation from the day Mr. Coffin was placed in the saddle lends some color to the view that this is a plan which he always had in mind. First, there was the extermination of the name of Edison from all the company's literature; then the sale of nearly all the stocks of Edison licensee companies—valuable assets and becoming more valuable every year; later comes the reported gutting of the Schenectady works; and throughout the whole the studied and successful effort to break up and scatter the selling machinery of the old Edison Company.

The Edison people cannot fail to see now, what they evidently did not see two years ago, that they gave up the ghost just at the time when the long-fought for success was within their reach. A slight additional investment of capital and another year of good management would have placed them in an impregnable position. Further than this, the Thomson-Houston Company would have been soon declared bankrupt. It is just possible that the Edison interest believes it could start now where it left off two years ago.

$50,000 Reward.

The offer of the Metropolitan Traction Company of the above sum to the inventor of a practical method of street car propulsion is printed in another column, and as the implied preference is for an electric system which shall avoid the use of overhead wires but be as economical to operate as the trolley system, the electric conduit is probably the method which most nearly complies with the requirements. There are no doubt a number of inventors who will lay claim to this prize at once on the strength of the various conduit systems which have been designed and experimented with, and the feeling among electrical engineers is pretty general that there is no inherent difficulty in the way of a conduit trolley system except the high first cost of building such a line. As this is practically the same as an overhead trolley system except in the location of the trolley, the operating expenses of the conduit road would be likely to prove about the same as the trolley system in general use, and it would further have the advantage of being less liable to depreciation and repairs if substantially built at first. The trouble arising from the use of a grounded return can also be avoided, as it is about as easy to run a double as a single circuit in the conduit.

The only place where this has been tried on an extensive and practical scale is at Budapest, where about twenty-five miles of conduit road has been in operation for some time and from which very satisfactory results have been obtained. Aside from the cost of this system, the objections which have been raised against it for use in American cities are entirely without foundation, and relate merely to minor details which could readily be modified to suit the conditions in our streets.

The width of the slot is the trouble most frequently heard of but is in reality of no importance. The slot used in the Budapest road would certainly be impossible to use in New York, but it is a perfectly simple matter to design a trolley which will run in a slot even narrower than those in use on either of our present cable roads.

The drainage of the conduit is another point which is held up as a chief objection to the conduit, and is of course an essential quality in such a system, as the insulation of the trolley wires depends upon this. The wires to be kept entirely beyond the reach of water must be placed in a conduit sufficiently large to act as a drain for all the water that can ever run into it, and connections to the sewers must be frequent enough to prevent the water from rising above a definite height in the conduit. This, however, offers no engineering difficulty, and is merely a question of the first expense of the construction.

The climatic conditions here have also been used as an argument against the conduit system, but when we consider that the Budapest road is operating in a climate subject to the same variations and extremes as our own, this objection is without weight, and it seems impossible to avoid the conclusion that a conduit system of the class mentioned, viz., one employing bare conductors supported near the top of the conduit, is not only feasible, but has been demonstrated a practical success.

The cost of installing such a system would vary from $50,000 to $100,000 a mile according to the local conditions and topography of the road. The drainage of the conduit is the essential requirement, and in most of the experiments tried in this field this requirement has not been fully met. Where the traffic is sufficient, however, to warrant the expense of a conduit large enough to supply the necessary drainage, electrical engineers are in a position to-day to equip and guarantee an underground trolley system.

Another plan which offers a considerable advantage over the bare trolley wire, but which has not yet passed the test of a practical commercial application, is the conduit with insulated trolley wires, from which no current can pass except at the point directly beneath the car. A system of this description has been installed on an experimental scale at Coney Island and was described in detail in ELECTRICITY of July 5, 1893.

The special merit of this plan is the fact that the pressure of water in the conduit will not give rise to any leakage of current between the trolley wires except at the point where a car is standing, and experiments with a conduit filled with mud and water showed the leakage with one car to be hardly noticeable on the station indicators.

Whatever system may be chosen, there can scarcely be any doubt that numerous plans will be forthcoming when it is generally understood that a company such as that offering the reward can be secured as customers.

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No Deal in Cleveland. There has been talk for the past three months of a new combination, embracing the Brush and Fort Wayne Companies. We do not know anything of the Fort Wayne end of this plan, and doubt if it ever was received seriously there. But it is a fact that Mr. Coffin some time ago, when threatened with immediate retirement from his present position, made the effort of his life to induce Cleveland capitalists to purchase from the General Electric Company the stock of the Brush Company, thus giving him, as he at that time supposed, one more chance to juggle with stocks and deals.

The effort proved a complete failure.

The scheme was doubtless conceived months ago, when several prominent capitalists in Cleveland were elected officers at handsome salaries in the Cleveland General Electric Company, a company whose stock is all held by the parent company. After a few months the services of these men, headed by Mr. M. H. Herrick, were all enlisted by Mr. Coffin in the endeavor to raise a little matter of four millions. The local pride for which Cleveland men are noted was worked upon to the full extent, but the banks did not take kindly to the scheme, and there are those who say that Mr. Coffin's friends played him double; while working industriously for him at interviews where he was present, they called again after he had left town, to explain their correct position. And in addition, the Brush-Thomson-Houston deal has not passed so far into history but that it is vividly remembered by several Cleveland capitalists. Mr. Coffin is a plausible man, but it was really asking too much of Clevelandites to allow themselves to be done up twice within five years. Another circumstance which doubtless operated against Mr. Coffin's brilliant efforts was the condition of the carbon company. Mr. Coffin's connection with this deal would make a long story, but it is sufficient to say that some of the officers of the company are indebted to him for their present prominence. Like many others, they have learned that his favors were purchased at a high price, and it is said in Cleveland that the money which was in the treasury of the company was borrowed by Mr. Coffin, has not been repaid, and that consequently work on the new factory has been discontinued for some time.

If the Brush enterprise is again to stand alone, which is next to impossible, it will not be backed by Cleveland money.

……o……

A Question Easily Answered. A representative of this paper was recently told by an advertiser that he had tried all the papers except ELECTRICITY; that they had all treated him unfairly except the *Electrical World*, and that he had no reason to suppose we would be unlike the others. Pressed for an explanation, he replied that all the other papers had worried him in regard to payments; that he now owed the *Electrical World* for three years' advertising, and that they had not troubled him for the account.

This case is of some interest at this time, as it goes a long way towards answering the question our contemporary has asked of every advertiser in the trade as to why its advertising patronage had not decreased in the same proportion as that of its competitors.

We have reason to believe there are a score of practically similar advertisements in our contemporary—advertisements of dead-head concerns, who sell cheap goods at cut-throat prices, and who are enabled to continue their course as trade-disturbers because their advertisements are virtually carried free. Reputable concerns who pay their bills have an interest in this matter deeper than that of the journals whose business is perhaps temporarily injured by this ill-judged policy of a dishonest contemporary.

The law of business is the survival of the fittest, and legitimate concerns should not be subjected to the competition of irresponsible ones by the aid of the paper which the good money of the former has built up.

……o……

THE collapse of the Northwest General Electric Company leaves a practically clear field for the rejuvenated National Electric Company at Eau Claire, which starts off under extremely favorable conditions. It has a plant which originally cost $200,000, and which it has acquired for $12,000. The paid up capital of the new company is $50,000, thus leaving $38,000 on which to begin business, with no debts. Messrs. A. L. and F. P. Ide, of the Ide Engine Company, are respectively president and secretary of the National Electric Company. Their names will inspire confidence throughout the trade.

ATTRACTED, doubtless, by the fabulous amount of money made by the electrical papers this year, two new enterprises are about to be launched. One of these is a monthly magazine, which, if properly conducted and backed by $100,000 of cash capital, ought to make a go of it. For the other the prospects are not so bright. It has long since been decided that financial reports have no place in a periodical which depends for its support upon the advertising patronage of the concerns reported upon. Many such publications have been started; none has proved successful. Every one has, sooner or later, degenerated into a blackmailing sheet, or the next thing to it, withholding unfavorable reports for an advertising consideration. The promoters of the new enterprise at present have the respect of the trade, but we warn them thus early that their plan is impracticable. Human nature will have to change before any such scheme can be successful.

……o……

IF THE details of Mr. C. A. Coffin's many schemes to get the money of banks invested in his various enterprises are ever told in court, many things will be made plain which are now enveloped in mystery. The distinction between a confidence man and a financier would be clearly shown. Just now a few side lights are being shed on this subject in the trial of Mr. H. G. Allis, the Little Rock banker, who has fully recovered from the hypnotic spell after his bank and all his other enterprises are ruined.

……o……

ABOUT a year ago, when General Electric shares were at 115, we called the attention of the officers of that company to the fabled hen of old who tried to lay a goose egg; it will be remembered that this hen ruined herself and broke the egg. Compelled to sell lamps at 26 cents, and with every other branch of its business in even worse condition, we submit that the egg is broken and the hen is permanently disabled.

……o……

MR. C. A. COFFIN'S star has set. He has failed where a less able but more honorable man might have succeeded.

……o……

THE importance of the victory won by the Columbia Lamp Company at St. Louis is becoming more apparent every day. The fight the company made was thought to be bad judgment by nearly every one in the trade, the general opinion being that new lamps could alone be looked to to break the monopoly of the General Company. Mr. Rhotehamel's judgment, however, proved correct, and he deserves the success which his company is enjoying.

……o……

MR. W. J. HAMMER, whose connection with the General Electric Company, so we were told, ended some time ago, was almost the first purchaser in this city of the new Packard lamps. He bought a full assortment. These lamps, strange to say, were found later in the testing room of the General Electric Company. Mr. Hammer is a very clever gentleman, and is now publishing *The Buyer's Directory*, for which, we believe, advertisements are solicited from independent concerns, including the lamp men in whose business and product Mr. Hammer has shown such brotherly interest.

……

THE advertisements in any first-class publication are worth reading. In them may always be found poetry, philosophy, even religion, and truths tersely told. No editor in the sanctum of the *Sun* could say more in few words than is contained in the following from a late clothing advertisement: "If we were you, we'd rather have an ulster than a life insurance policy. The epitaph on many a grave might appropriately read: 'He ought to have worn an ulster.'"

What Coffin is This?

(From the Evening Post.)

Acting upon the report of Bank Examiner Clement Dowd, State Treasurer Tate instructed the sheriffs of Cumberland and Robeson Counties to close the branch banks of the Banking Association of the Carolinas at Fayetteville and Lumberton, N. C. The president of the bank, John P. Coffin, is notified to appear before Superior Court Judge Whitaker at the next term of Northampton Court to show cause why a receiver should not be appointed and the affairs of the banks wound up.

These "banks," it appears, were very shaky concerns. The "stock" was $22,400. Two thousand and four hundred dollars of this amount was subscribed by citizens of Lumberton, while the other $20,000 was supposed to have been subscribed by Coffin and his wife, who live at Florence, S. C. The bank was chartered one year ago. When the bank examiner investigated the "branch banks" a few days ago, he found in the one at Fayetteville $161, and in the one at Lumberton $83. It was also discovered that President Coffin had borrowed all the money the banks were supposed to possess, with the exception of the above-mentioned $244. He asks for time to repay the money.

Although somewhat familiar with Coffin genealogy we have not learned whether or not John P. is a brother or cousin of Charles A.

Thomson-Houston Financiering.

How F. L. Ames Was Robbed of $300,000.

(From the United States Investor.)

One of the most melancholy consequences so far noted of the misfortune that has overtaken the General Electric Company is the announcement that the Northwest Thomson-Houston Company is in process of liquidation. The money invested in this enterprise is large, and it is to be feared that the loss to the stockholders will be well-nigh total. The company was one of the *proteges* of the old Thomson-Houston Company, which owned a control of the common stock. The Thomson-Houston people recommended the Northwest Company to their friends as a very promising field for investment. The preferred stock was issued to Thomson-Houston stockholders at par, and sales were later made at 115. Of the $750,000 preferred stock about $300,000 was owned by the late Frederick L. Ames, who paid a high price for his holdings, and who was a strong believer in the enterprise.

The Northwest Thomson-Houston Company was always represented by the Thomson-Houston people as being highly prosperous. This was particularly the case about two years ago, when efforts were being made to market a block of the preferred stock.

The experience of the Northwest Company can hardly help adding to the uncertainty now felt by the security holders of the General Electric Company regarding their property. The complete collapse of the Northwest Company reveals the exceedingly insecure basis on which the electrical business has been conducted. The company was regarded by most persons as strong, and those who knew most about it were the most urgent that their friends should buy its securities. How great then must be the distrust which the downfall of the Northwest Company will engender in all minds regarding other electrical enterprises, and especially regarding the General Electric Company.

Continued Prosperity.

The Brooklyn Edison Company has declared the regular quarterly dividend of 1½ per cent.

More Lawsuits.

The Edison Lamp Patent in Philadelphia.

Suits have been begun in Philadelphia against the Manufacturers' Club, the Philadelphia Trust, Safe Deposit and Insurance Company, owners of the Colonnade Hotel, and George J. Crump and Henry J. Crump, lessees, and the Spreckels Sugar Refining Company, to restrain the defendants from continuing the purchase and use of incandescent lamps alleged to infringe the Edison patents.

Also a Feeder Patent Suit.

The General Electric Company has secured a temporary injunction against the E. G. Bernard Company, contractors, alleging intended infringement of the Edison feeder patent in the equipment of the plant at the Watervliet Arsenal at Troy, the contract for which was secured by the Bernard Company in competition with the General Electric Company. The hearing is set down for January 2.

Legal Notes.

City Attorney Carothers, of Newport, Ky., has filed the answer and cross petition of the city in the suit brought by the Electric Illuminating, Heating and Power Company for the recovery from the city of the sum of $26,486.86, due on its electric lighting contract. The answer goes fully into the history of the case and makes the square and direct issue of fraud and collusion in the granting of the franchise between the officers and agents of the Electric Company and the Mayor and council. The city attorney prays the court for judgment decreeing a cancellation of the contract and that it be set aside and held for naught.

In order to have the highest judicial test of the right of rural electric railways to be on earth within the confines of the State of Pennsylvania, equity proceedings have been begun in Montgomery County, in that State, the result of which will establish a precedent for like contentions in other parts of the State. Two questions are at issue. One is, Are country highways or roads "streets" within the meaning of the law under which electric passenger railway franchises are granted? Question two is, Have township supervisors the authority to grant railway companies the use of country roads? In the equity suit instituted by the Pennsylvania Railroad Company against the Montgomery County Passenger Railway Company, Judge Weand has refused the injunction asked by the plaintiff to restrain the defendant corporation from constructing its roadbed on the highways or roads of the country districts. He holds that the words roads, highways and streets are identical and are interchangeably used in the law, and, furthermore, that supervisors are the proper officials to grant the use of roads in townships. To this decision the plaintiff excepted, and Charles Hunsicker was appointed master to take testimony for the purpose of an early hearing and adjudication by the Supreme Court.

In the case of the Westchester Telephone Company against the Long Island Electrical Construction and Supply Company, an action brought to restrain the Long Island Company from operating a system of electric-light and power wires on the same side of the street and near the telephone wires on Main street and Throgg's Neck Road in the town of Westchester, on the ground that the wires of the electric company would be charged with heavy current necessary for arc lighting, and would after a short exposure to the weather become dangerous, etc., Judge Bartlett announced that he would continue the injunction already granted in as far as it prevented the construction of the arc line within eighteen inches of any telephone wire and the placing of the wires above those of the telephone company. The rules of the State Board of Underwriters require electric light wires to be placed above the telephone wires, and the decision is in direct opposition to this rule.

CORRESPONDENCE.

"Electricity" Is Appreciated.

To the Editor of ELECTRICITY.

DEAR SIR: I am unluckily a stockholder in the General Electric Company, and for some time past have been a careful reader of ELECTRICITY. From what I have learned through your columns of the fraudulent character of the Electric Trust and the utter unscrupulousness of its officers, I am no longer surprised that my holdings have decreased in value until they are to-day scarcely worth the paper which represents them.

Business relations which I have had from time to time with its New York office convince me however that, in addition to being handicapped by a dishonest management, the General Electric Company's prosperity is being retarded by incompetents in its executive offices and in some of its departments. The pompous puppet who rattles round under the title of "Assistant Manager," and whose prototype is to be met with in many of the other offices, has been an expensive luxury to the stockholders; and the consequential anthropoids and cranks who are walking about on their hind legs in the mismanaged railway department have undoubtedly contributed not a little to the ruin of a magnificent business.

Until the General Electric Company throws off its incubus of jejune managers and dudes, it cannot expect to recover its lost prestige with business men. Very truly yours,

JUNIUS.

Plainfield, N. J., Dec. 7, 1893.

(From a Private Letter.)

I wish to assure you of the kind feeling I have towards ELECTRICITY, and especially toward yourself personally, and my appreciation of the work you have done. Few realized a year ago the danger that the electrical interests were in, and few appreciate now their narrow escape. I believe you have done more than any other single agency in averting what might have been a serious calamity to the whole electrical interests. In future I may be able to show my appreciation in a more substantial form than I can at the present time.

Another Lamp Decision.

Repairing Lamps Held to Be an Infringement.

An injunction has been granted by Judge Colt, of the United States Circuit Court, at Boston, against the Davis Electrical Works of Springfield, enjoining them from repairing Edison incandescent lamps or lamps which infringe the Edison patent.

It was held that the Edison lamp being an organic whole, opening the glass bulb and reinserting a new filament really constituted the making of a new lamp, and consequently infringed the Edison master patent.

In this decision Judge Colt says in part:

> It is apparent that the defendants by substituting a new filament in the glass receiver and exhausting the air from such receiver produce a lamp in which all the elements but one (the leading-in wires) of the patented combination are used either in a new or reconstructed form.
>
> The lamp there produced is substantially a new lamp, and its voltage may be higher or lower than the old one. From the very nature of the Edison invention, I do not see how the glass bulb can be opened and a new filament inserted without making essentially a new lamp.

Trade Notice.

Owing to changes which have taken place in the corporation of Taylor, Goodhue & Ames within the past year the style of the firm is now changed to Taylor, Dee & Mack. On account of distrust with which corporations with limited capital are looked upon in certain quarters, Taylor, Dee & Mack will do business as a partnership and will assume all liabilities of the corporation of Taylor, Goodhue & Ames.

Electro - Medical Instruments.

A Resume of What Has Been Accomplished.

How Some Late Forms Came to be Adopted.

At the last meeting of the Electro-Therapeutic Association, which was held in Chicago during the past summer, it was a noticeable fact that a considerable portion of the business transacted consisted of the reading of reports of committees which had been formed to inquire into the merits and demerits of the electro-medical apparatus offered for sale by the various dealers. The Association listened to reports on standard coils, standard meters, electrodes, etc., and in fact on nearly all branches touching the mechanical end of electro-therapeutics.

The significance of this cannot be overestimated. The dependence of the physician on his instruments is a large factor in the cure of disease, and the fact that he has at last come to a realizing sense of the importance of selecting the very best that can be had is one which the manufacturer will do well to record.

It was not until comparatively recent years that electro-therapeutics has held the important position before the medical profession that it now occupies. The whole business was looked upon as quite outside the domain of the respectable practitioner, and its advocates labored under drawbacks and disadvantages to which they themselves contributed indirectly. It is to-day, however, a recognized branch of the profession and cannot be ignored.

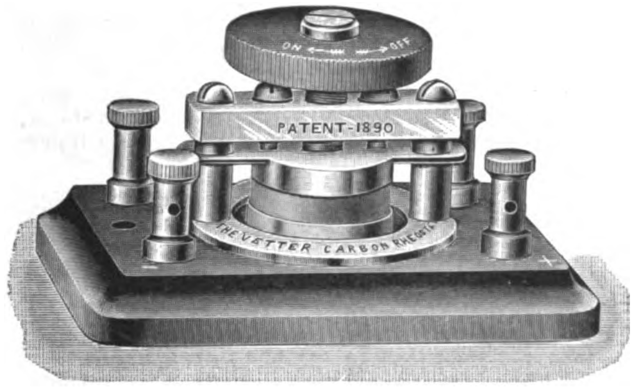


FIG. 1.

Much of this advancement has been made possible principally by the increasing excellence of the various kinds of electro-medical instruments; and while this is largely due to the physicians themselves, it owes its degree of perfection more particularly to the various dealers who, catering to the needs of the therapeutist, have made a special study of the mechanical part of the science.

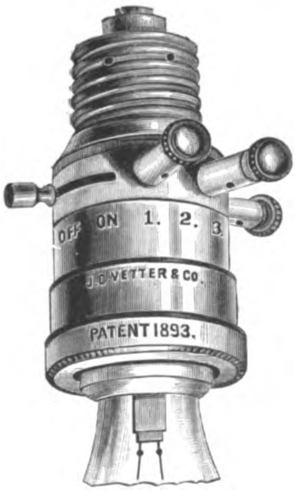


FIG. 2.

But in manufacturing for the medical profession the electrician must take cognizance of the fact that he has often to deal with forces quite outside the domain of ordinary electrics; if he does not, he may meet with hindrances which he may least expect to encounter.

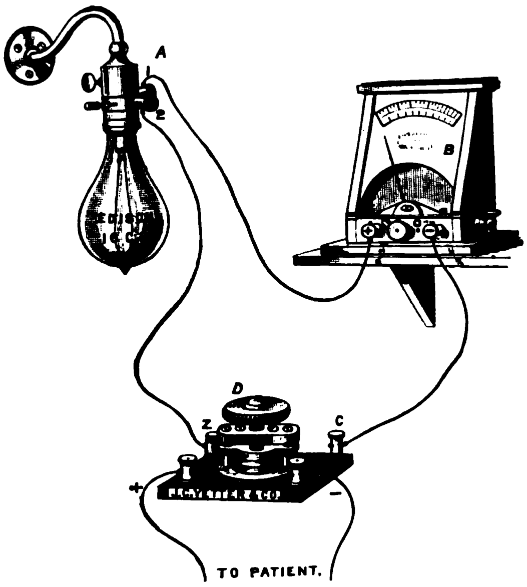


FIG. 3.

Hindrances such as these are among the least of the drawbacks to be expected by the instrument dealer, and the fact that he has risen superior to every one is good evidence of the amount of brains he has used and the ingenuity he has called forth in the pursuance of his calling.

But the greatest evidence of his brains and ingenuity is to be had from a view of the instruments themselves. In designing them the maker must remember one cardinal point. The average practising physician is seldom a practical electrician, even in the barest application of the word, nor will he be until some far-seeing philanthropist shall endow a "chair of electrical science" in our medical colleges. Hence the always to be desired feature is simplicity of construction.

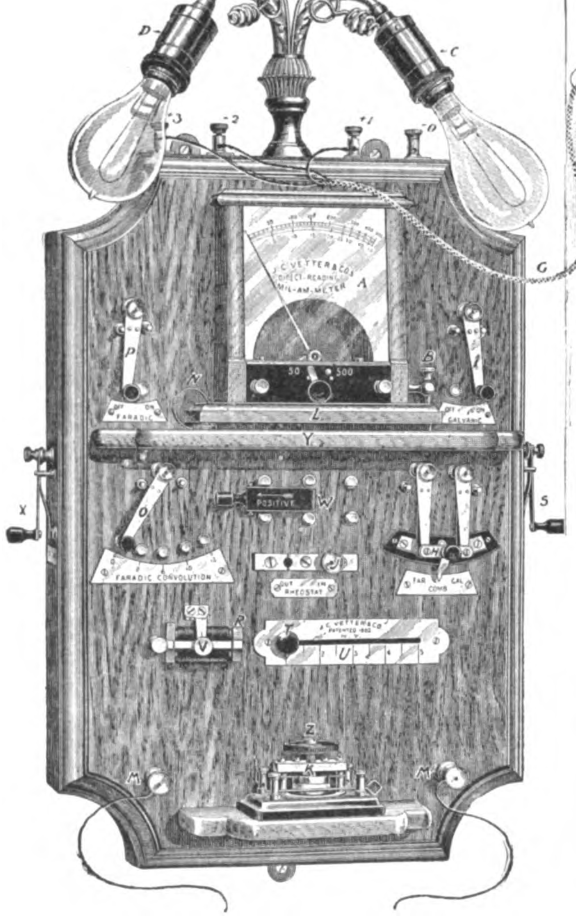
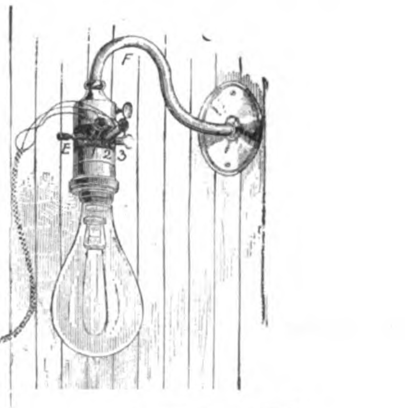


FIG. 5.



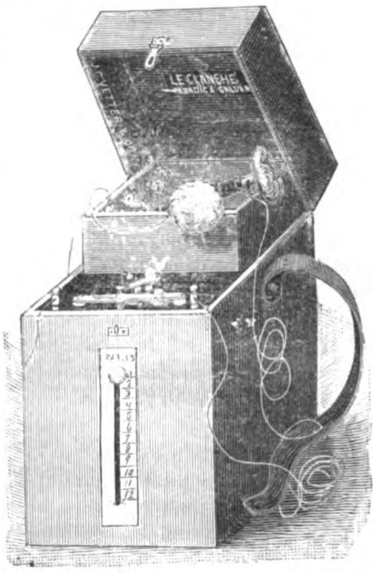


FIG. 4.

Some years ago, when the Electro-Therapeutic Association was in its infancy, an exhibition of apparatus was held at one of the meetings of the society. Most of the dealers were represented by some article or other, and a heterogeneous collection it was. The lesson evolved was, that the electrical-medical instruments of that period were decidedly complicated affairs. A wide-awake manufacturer of New York City, yet young in the field, and, be it said, with just as complicated instruments as his competitors, took advantage of the lesson there learned, and instituted a series of improvements which has resulted in as complete a line of goods as has yet been offered for sale.

The goods made by this firm have for their recommendation the simple plea of simplicity of design and application. The plan on which they were constructed is merely a result of proper appreciation of what the physician needs for the simple electrical treatment of disease.

Leaving out electrodes, which are elective adjuncts anyway to the general outfit, the electro-medical practitioner need take cognizance of but three propositions in considering the galvanic current. These are: the simplest way to generate it, the simplest way to control it, and the simplest way to measure it.

The simplest way to generate the current is by means of the cell, and the best cell for him to use inasmuch as it will cause a minimum amount of trouble, is one of some dry variety. The simplest way to control the current is to connect all the cells up in series and then regulate the total current by some form of rheostat. The simplest and only way to measure the current for medical use is with a direct reading milliampere meter.

A combination of these three points makes an ideal battery for medical use, and one which ought to appeal to the scientific spirit of the electro-medical man. In it are the dry cells enclosed in a portable case, and a controller which will allow of the current being used in any degree of intensity desired.

This controller (Fig. 1) is a unique instrument in itself. The fundamental principle adopted in its construction is the effect of variation in resistance which takes place in a quantity of carbon subjected to a change of pressure. A quantity of carbon in a finely divided state is placed in a small rubber cylinder which is between two metal plates forming opposing ends of a circuit. The lower plate is affixed to the instrument, and the other, traveling in upright guides, can be depressed by means of a screw with a fine thread so as to compress the carbon in the rubber cylinder. The broad claim on which the instrument was patented is, confining the carbon powder in a rubber pouch. The function of the latter is to hold the contained powder in the position necessary to keep up the contact between the poles, and to aid by its pliability the manipulation of the powder as the will of the operator causes the resistance to be diminished or increased.

The meter used in the first illustration is a vertical and direct reading one and possesses great advantages over horizontal indirect reading meters ; it does not depend upon terrestrial magnetism, which varies in different localities, but instead the pointer is controlled solely by the current passing through either of two coils, and the reading can be taken immediately the circuit is closed; no time is required for adjusting.

The best recommendation that this meter possesses is that at the last test of milliamperemeters conducted by the Electro-Therapeutic Association the instrument above was the only one out of six different styles that corresponded with the Weston standard.

If the practising physician lives in a town far enough advanced in civilization to possess an incandescent lighting plant, he need not bother with a battery. The latest method in these *fin de siecle* times is to take current from the street.

The adapter or incandescent current tap, shown in Fig. 2, enables him to do this without any trouble. It resembles an ordinary incandescent lamp socket. The instrument is a combination of binding posts and a switch. To use it, it is only necessary to detach a sixteen candle power lamp from its socket, put the adapter in its place, and afterwards screw the lamp into the adapter. Here is a battery indeed, and a source of unlimited supply of current, which never falls from grace by getting out of order, never spoils carpets with ruinous acids, and which cannot be borrowed "just for a couple of hours, you know," by a brother physician with predilections in this direction.

How the street current is coupled up, controlled and measured for medical work, is best shown in Fig. 3, which explains itself. The instrument is a *multum in parvo* of various electrical uses diversified to the greatest extent. It can be used to operate electric motors, charge storage batteries, extend a drop light, operate electric bells, miniature lamps, etc., and so on down a list too voluminous to detail.

In these days of scientific administration of the electric current—when medical men haggle over the therapeutic difference which may or may not exist between the administration of five or ten milliamperes of constant current, or as to whether the faradic coil should be made of coarse, medium, or fine wire, or combinations of all three, and other finely drawn distinctions of a like nature--the young physician is often at a loss to know just where he will enter the medico-electric arena. His hesitation generally ends by his entering through the door of Faradism armed with a battery whose vibrations are as irregular and uneven as the quakings of his own soul. He will find right here that his troubles have but just begun. Hence it is well if he select the very best weapon he can find. In the matter of faradic batteries there is much or little to say, depending on which text book he shall have studied, and how much he shall have been impressed thereby. We confess to thinking that the least there is said the soonest mended and many and various high sounding conclusions may not have to be recanted.

Meantime many good and definite results may be obtained from the use of Fig. 4, which will do everything the physician may desire in ordinary practice and is a valuable adjunct to clinical work.

The ideal outfit of all, however, is formed from a grand combination of all the foregoing. It is shown in Fig. 5. The whole affair is mounted on a handsomely polished base and combines a milliampere meter, a current controller faradic coil, DeWatteville switch for combining the galvanic and faradic current, pole changer and current tap. Switches for controlling these devices give the board a finished look and the incandescent lamps in the bracket above set off the affair in a brilliant manner.

The firm of J. C. Vetter & Company, who manufacture these goods and a picture of whose workshop is shown in our Frontispiece, are very well known in the medical electrical world, where they are acknowledged to have reached the top notch in the competition which has been going on for several years. They are now looking for new worlds to conquer and propose to enter the field of general electricity with their current tap as an opening wedge. They claim wonders for its future performance, and say it must ultimately be adopted wherever the incandescent current is known. They are established at 104 East Twenty-third street, New York City.

$50,000 May be Won.

Prize for a System of Street Car Traction.

It is Worth Working For, and the Time Limit should be Extended.

A prize of $50,000 has been offered by the Metropolitan Traction Company of New York City for a system of street car propulsion which will be superior or equal to the overhead trolley, without possessing the objectionable features of the trolley for crowded thoroughfares. The president of the company, Mr. John D. Crimmins, says that the general idea is to encourage some sort of underground trolley system.

The proposition was embodied in a letter sent to the State Board of Railroad Commissioners, and reads as follows :

> On streets where the lines are straight and the business is heavy the cable system is the most economical yet invented. For general use in a city, winding about through the streets following the routes of travel which the public wish to pursue, it is impracticable. You require straight routes for cable roads. We have in addition to the lines upon which the cable will be laid over eighty miles of street railroads now operated with horses all below Central Park. It is to these lines in particular that we now desire to direct your attention.
>
> Up to the present time the only system whose practicability has been demonstrated is the overhead trolley. We are well aware, however, that its application in the streets of New York would not meet with the approval of the community. What we most desire now is to hasten the development and perfection of a better system. We therefore submit the following proposition :
>
> First—We will set aside the sum of $50,000 to be awarded as a prize to any person who shall, before March 1, 1894, submit to your honorable board an actual working system of motive power for street railway cars demonstrated to be superior or equal to the overhead trolley.
>
> Second--The qualities necessary to meet this requirement shall be left to your decision; but with the present state of art, a system to win the award must necessarily approximate the trolley as a standard of economy in operation, but should be without the features objectionable to the public that are in it.
>
> Third—We shall exact no rights in the invention in return for the $50,000, and shall have nothing whatever to do with the making of the award further than to pay any expenses which your honorable board may deem it necessary or wise to incur, either in the employment of experts, the giving of hearings, or the conduct of experiments—this in order that no effort may be spared to achieve the desired result.

The proposition is made in perfect good faith, and inventors should attack the problem with renewed vigor.

Fifty thousand dollars is in reality a small part of the prize which awaits the inventor of the successful plan.

General News.

What is Going on in the Electrical World.

Washington, D. C.—$200,000 is to be expended in supplying an electric light plant for the Capitol and the new Congressional Library Building.

Griffin, Ga.—This city has voted to issue bonds to the amount of $16,000 to be expended on an electric light plant to be owned and controlled by the city.

Washington, Pa.—The electric street railroad, which has been in the hands of a receiver, has suspended operations, and will be sold by order of court.

Gainesville, Tex.—The city council has made a contract with a new company for a system of electric lights. The plant is to be completed within six months.

Green Island, N. Y.—A settlement has been effected in the matter of the electric light works, and it is probable that New York men will purchase the plant and operate it.

Natick, Mass.--The Natick and Cochituate Electric Railway Company has been granted a charter to run their tracks through Wellesley and Wellesley Hills to Newton Lower Falls. The company will lay the tracks in the spring.

Prairie du Chien, Wis.—The council has granted a ten-year franchise to an electric light company whose present offiers are : Will Thompson, president; Ira D. Hurlbut, vice-president; A. I. Heiman, treasurer; H. Bisbee, secretary.

Chicago. — The National Thermograph and Electrical Company, of Chicago, whose capital is $500,000, manufacturers of a thermograph used in refrigerator cars to register the temperature each hour in the day, have decided to remove their plant to Rockford.

Hartford, Conn.—Both branches of the common council have adopted the report of the rapid transit committee, giving the Hartford Street Railway Company permission to equip with the trolley the Parkville, Lafayette street, Farmington avenue and Asylum avenue lines.

Canton, Ohio.—The city council has under consideration the building of an electric light plant, to be owned and managed as a branch of the city government. The gasoline, gas and electric light companies, which secure about $20,000 a year out of the city, will contest the project.

Richmond, Va.—At a meeting of council last week, Mr. Turpin offered a resolution instructing the committee on streets to confer with the street railway authorities as to having the cars on the Broad street line propelled by electricity. The resolutions were referred to the committee on streets.

New York.—The Gas Commission met in the Mayor's office on the 15th, and awarded most of the contracts for lighting the city with gas and electricity to the same companies and at the same price as that of last year. Some of the electric companies wanted an increase, and their bids were laid over for consideration.

Toledo, Ohio.—The wood carving room at the Manual Training School is now illuminated by electric lights. The dynamo furnishing the current is entirely the work of the students, who also strung the wires and arranged the whole lighting system under the direction of Superintendent Waite.

Whitestone, N. Y.—The trustees of this Long Island village have granted a franchise to the College Point and Whitestone Street Railway Company, recently incorporated, to operate an electric road on the streets of the village. A similar application will be made to the College Point trustees to lay the tracks on some of the principal streets of that village.

Paterson, N. J. — Twenty machinists employed at the Edison Electric Works have struck because the company refused to grant them their request for an advance of 25 cents a day. A month ago the men were receiving $2.75 a day, and claim they were reduced to $1.75. After working a week or two at these wages they concluded to ask for an advance to $2.00.

Freeport, Ill. — The Freeport City Street Railway has been purchased by Percy Thompson & Company, bankers, of New York City, and their associates. A new company has been formed with a capital stock of $150,000, and will at once change the present motive power to electricity. The new company will immediately construct and operate eight miles of electric road.

Topeka, Kan.—D. E. Kimball, of this city, has returned from Chicago, where he has been interesting capitalists in his new electric underground conduit system, which is intended to do away with the overhead trolley system of electric railways. A company has been formed in Chicago to manufacture the conduits, and they expect to begin work about the 1st of March.

Springfield, Mass.—The Springfield Street Railway Company has given notice to the United Electric Light Company that the present contract under which the latter furnishes power for running the street railway cars would be terminated December 1, 1894. The railway company will erect a power house at an early date and put in a plant as perfect as possible in every appointment.

New Orleans.—According to the *Picayune*, Mrs. F. W. Tilton, of Canal street and University place, has the proud gratification of knowing that she has the first electrical piano received in the South. It was delivered to her two weeks ago. -The St. Charles Street Railroad Company have applied to the city council for permission to change the motive power of their road to electricity.

Indianapolis, Ind.— A dispute has arisen between the street car company and the Indianapolis Light and Power Company as to the contract for furnishing electric power. The street car company insists that the contract calls for six hundred horse power at the generator, while the power company claims that the strength of six hundred horse power is to be furnished at the engine.

Rochester, N. Y.—Dr. Charles Forbes has been engaged to deliver a course of ten University Extension lectures on "Electricity" at the Free Academy Hall here, beginning with the first Tuesday in January. The lectures are to be illustrated by experiments, and the aim will be to present and illustrate the elementary principles very clearly, so that the great modern applications of electricity may be understood.

Liberty, N. Y.—It is understood here that S. P. Kellogg and J. C. Clirehugh, of Elizabeth, N. J., backed by competent capitalists, purpose, under certain conditions, building a trolley road from Liberty via Stevensville, to White Lake, and also a road from Stevensville, by the way of White Sulphur Springs and Youngsville, to Jeffersonville. The principal power station would be at Stevensville. It is said the entire twenty miles can be in running order by July 1.

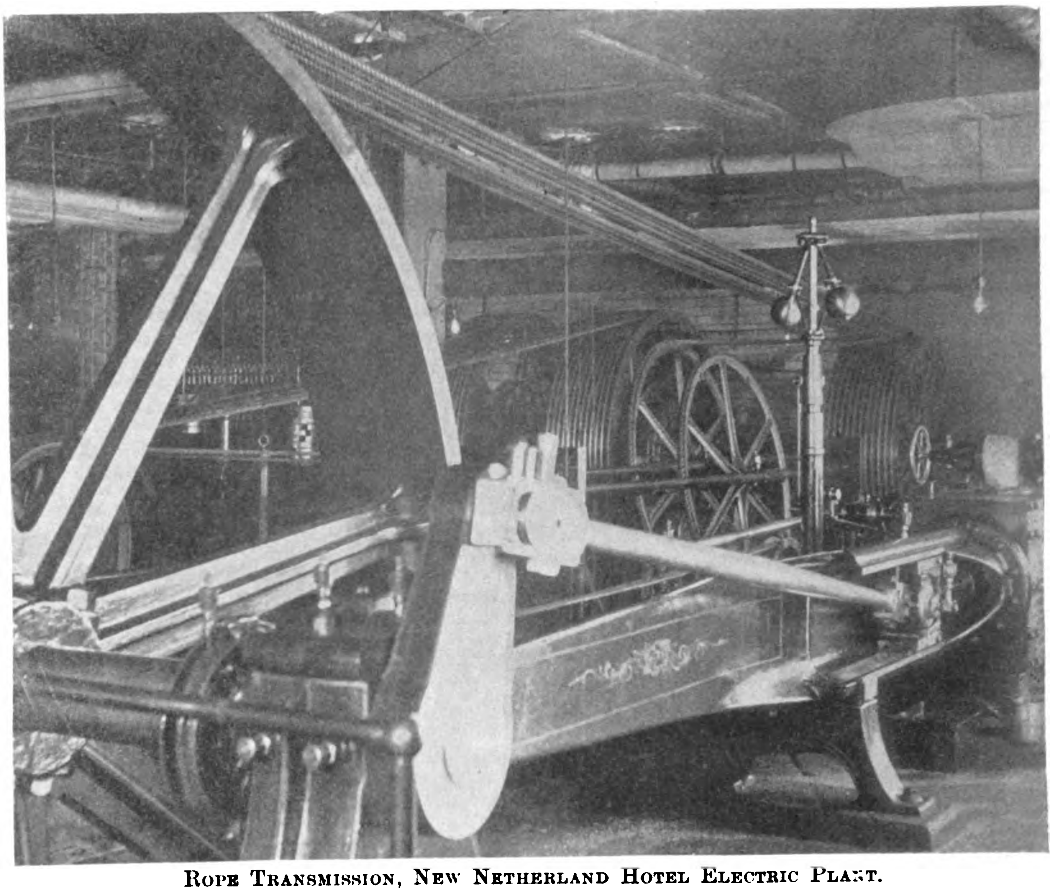
Kingston, N. Y.—The *Freeman* says that a contract has been closed with New York parties for the construction of a trolley line from this city to Lake Katrine. The road will be operated by a stock company to be known as the Lake Katrine Electric Railroad Company, and steps have been taken to have it incorporated. The majority of the stock will be held by the Lake Katrine Hotel Corporation, the rest having already been sold to New York parties.

New Haven, Conn.—The incorporators of the West Shore Electric Railroad have made arrangements to build the line at an early day. The capital stock is $50,000, and the charter allows the company to build from the termination of the Winchester Avenue Road at Savin Rock to Merwin's Point, a distance of about 3½ miles. The incorporators are James D. Dewell, Henry Sutton, Israel A. Kelsey, C. K. Bush and W. Wallace Ward.

Nashville, Tenn.—At the annual meeting of the stockholders of the United Electric Railway Company on the 12th inst. the following officers were elected: T. W. Wrenne, president; M. M. Gardner, vice president; E. G. Connette, general manager; G. W. Cunningham, secretary and treasurer. The directors are: Thos. W. Wrenne, H. H. Buckner, R. W. Turner, M. M. Gardner, James P. Byrne, Andrew Marshall, J. H. Bruce, J. P. Williams, James Simmons, W. C. Dibrell, T. O. Morris and J. C. Bradford.

Battle Creek, Mich.—The Chicago *Inter-Ocean* publishes the following dispatch from Battle Creek: "Seth M. Carter, of Auburn, Me., one of the bondholders of the electric street railway here, is in the city looking after his interests. He says that the purchasers of the bonds were swindled. It was represented that the road was paying a dividend when it had never paid expenses. The bondholders, cannot, he says, operate the road until the United States Court gives them possession and the council has started proceedings to take back the charter."

Pittsburg, Pa.—The largest dynamo ever made was finished on the 12th inst. at the Allegheny shops of the Westinghouse Electric and Manufacturing Company, and subsequently satisfactorily tested. It is one of four built for the Louisville, Ky., Gas Company, and has a capacity of 10,000 incandescent lamps. It weighs fifty tons and has an armature 20 feet in diameter. This is four feet greater than the armature on the big dynamo at the World's Fair. It will make ninety revolutions per minute. The dynamo will give the same power as the World's Fair machinery, but will take up less floor-space. It will be operated by a one thousand horse power engine. The shaft of the engine will connect with the dynamo, no belting being required.



Rope Transmission, New Netherland Hotel Electric Plant.

Bridgeton, N. J.—Two companies have just been formed here to build new trolley railways to be operated in connection with those already in use. One company is the Bridgeton, Cedarville and Port Norris Railway Company, which proposes to establish a line from South Bridgeton for a distance of about nine miles, passing through Fairton and Cedarville and eventually connecting Port Norris, the heart of the oyster growing region. The other company is the West Side Railway Company, which proposes to build a road in the Third Ward of Bridgeton, lying west of the Cohansey River.

Baltimore, Md.—The Thomson-Houston Company has practically completed the motors and generating machinery for running trains through the Belt tunnel by electricity. The electric company is to put overhead wires in the tunnel, as the trolley system is to be used. The rails of the roadbed will be connected with wire to make a return current of electricity and so to complete the circuit from which the electric engine will obtain its power. The Baltimore and Ohio Company is to select a site and build the power house for the electric plant with which the experiment is to be made.

Niagara Falls, N. Y.—Major George B. B. Burbank, chief engineer of the Cataract Construction Company, said to a reporter last week: "Our power house for the 5,000 horse power dynamos is nearly completed. The immense steel electric crane has been placed in position within the building and the heavy stone walls are up. The foundations for the great turbines will be completed this week. These wheels are ready for shipment at Philadelphia and will probably be ordered next week. The big penstocks are already here. The other works of the Cataract Construction Company, such as the new village, the railroad, the water works, electric companies and others, are progressing fast towards completion. Niagara Falls is fast preparing to furnish the world with electricity."

A New Style of Rope Transmission.

The New Netherland Hotel of this city contains an electric plant in which a somewhat unique system of transmission is employed. The equipment consists of two Corliss engines of 325 and 250 horse power respectively, one of which is placed at either end of the room, and is connected to a line shaft extending along the length of the room in front of the engines, and four dynamos, three of 100 K. W. capacity and one of 60 K. W. The novelty of the plant lies in the system of rope belting used.

The driving wheel of the largest engine is grooved for twelve strands of rope and that of the smaller engine for ten strands. Both of these pulleys have two separate rope belts of six and four continuous strands respectively, by which the line shaft is run. As the dynamos are driven by means of rope it enables them to be placed quite close up to the line shaft, which would be impracticable with belts, thus saving valuable space. Careful tests have failed to detect any slippage whatever, and there is an absence of all noise and vibration. There is not a foot of belt used for transmitting power in the plant.

Another point to be noticed is the tension device. One strand of each multiple rope passes over a wheel on a traveling carriage, which keeps the strain on the ropes constant for any power regardless of the variations in length of rope due to moisture or stretch caused by use. It takes up any slack caused by a sudden increase of load, or gives back slack when the load is reduced. There are two of these tension carriages to each machine, as shown in the accompanying engraving. There is also a high speed engine connected to a 100 K. W. dynamo in the same manner, and the whole plant is contained in a remarkably small space, due to the short distance between centres which may be used with this system.

The apparatus was manufactured and put up by the Link Belt Company of New York and Philadelphia, and has given excellent satisfaction.

Adams Electric Company.

Mr. A. D. Adams resigned his position as electrician and manager of the Commercial Electric Company, December 1, and has formed, with others, the Adams Electric Company, for the manufacture of his improved dynamos and motors at Worcester, Mass.

Mr. Adams's new machines will be of the same general type as his former ones, will embody the well-known forged iron field magnet construction, and several important improvements.

Realizing that most armature burn-outs are due to the destructive action of heat on the cloth and paper usually employed to insulate armature cores from their windings, Mr. Adams will use a fire-proof material for the insulation of all armature cores in his new machines.

The line of motors and dynamos at present manufactured will cover the usual sizes, from 1 to 25 K. W.

A large, well-lighted shop is being fitted up at 100 Beacon Street, Worcester, for the manufacture of the above machines, and shipment of any of the sizes named can be made during January next.

The encouraging fact is reported that orders for several machines have already been received.

THE NATIONAL ELECTRIC COMPANY.

Special Announcement.

The National Electric Company of Eau Claire makes the following announcement of its plans and purposes:

"Having purchased the entire plant and stock formerly operated and owned by the National Electric Manufacturing Co. we take pleasure in announcing to our friends and to those interested in electric lighting that we are prepared to furnish alternating and direct current apparatus, multipolar power generators and motors, transformers of any capacity and voltage, as well as other electrical apparatus and appliances, promptly upon receipt of your orders.

"To the former patrons of the National Electric Manufacturing Company we extend a cordial greeting, and solicit a continuance of your patronage.

"To others we extend a similar greeting, and will take pleasure in quoting prices and furnishing other information desired relative to our apparatus promptly upon application. Sincerely yours,

"NATIONAL ELECTRIC COMPANY.

"Eau Claire, Wis., Dec. 8, 1893."

Removal Notice.

The Phosphor-Bronze Smelting Company, Limited, of Philadelphia, have removed their offices to No. 2,200 Washington avenue, where they have largely increased facilities for the manufacture of their famous Elephant brand phosphor-bronze ingots, castings, wire sheet, rods, etc.

Commercial Note.

The Metropolitan Electric Company, Chicago, have added another very important name to their list of specialties—a new incandescent lamp. This is to be known as the "Metropolitan" and embodies the latest improvements in incandescent lamp manufacture. By the utilization of new and improved methods, this lamp offers very high efficiency, and will maintain its full candle power throughout its entire life, two elements of value in incandescent lamps that cannot be over-estimated. The lamp has been patented, and the Metropolitan Company will guarantee that it is non-infringing in every respect. It is now ready for the market, and orders can be filled promptly.

INCORPORATIONS.

The Milford Electric Light Company, Milford, N. H.—to generate electricity for light, heat and power by steam or water, furnish and distribute the same through the streets of Milford and neighboring towns; takes franchise heretofore held by the Souhegan Electric Light and Power Company. Capital stock, $50,000. Promoters: Henry A. Burnham, Gloucester, Mass.; Henry C. Buck, Winchester, Mass.; Frank T. Clark, Boston, Mass.

The Glenwood and Dravosburg Electric Street Railway Company, Pittsburg, Pa.—to construct and operate an electric railway in Allegheny County, Pa. Capital stock, $27,000. Promoters: Ira J. Wilson, James P. Wilson, Homer H. Swaney.

The General Manufacturing Company, Bound Brook, N.J.—to manufacture, buy, sell and deal in sewing machines, electrical devices, tools, machines and machinery. Capital stock, $2,500,000. Promoters: Abnes W. Pollard, Louis A. Pollard, Brooklyn, N. Y.; S. O. Loughlin, N. Y. City, N. Y.; Edward C. Kidder, Williamsbridge, N. Y.; Jos. B. Cleaver, Bound Brook, N. J.

The Chamberlain Electric Light and Power Company, Chamberlain, S. D.—to produce electric light and power. Capital stock, $200,000. Promoters: H. H. Natwick, J. L. Stene, M. E. Distad.

Fuller Incandescent Heat and Light Company, at Chicago. Capital stock, $1,000,000. Incorporators: J. T. Kreitzinger, C. E. V. Akerberg, M. F. Gallagher.

The Belleville Electric Railway Company have filed articles of incorporation at Springfield, Ill. It is proposed to build a railroad from Belleville to East St. Louis. The capital stock is $300,000. The incorporators and first board of directors are J. H. Atterbury, John W. Griswold and R. Ross, of Litchfield; John J. McLean, of Hillsboro, and Paul W. Abt, of East St. Louis.

Universal Electric Heat and Light Company, Chicago. Capital stock, $100,000. Incorporators: J. T. Kreitzinger, C. E. V. Akerberg, M. F. Gallagher.

Turney Electric Manufacturing Company, Chicago. Capital stock, $75,000. Incorporators: Eugene T. Turney, Walter H. Crowdus and William E. Mason.

The Rockaway Electric Light and Power Company, Rockaway, L. I.—to furnish electric light, etc. Capital stock, $20,000. Alderman Samuel Myers, of Brooklyn, is president, and John A. Seely treasurer.

Slocum Electric Company, at Albany—to deal in and manufacture automatic machines. Capital stock, $50,000. Directors: Paul C. Grening, J. J. Vail, Harry F. Slocum.

The Chesapeake and Ohio Transportation Company, Baltimore—organized for the operation of canal boats by electricity. Capital stock, $250,000. Most of the shares are held by canal operators in Western Maryland.

The Cortland Fire Alarm Company, Toledo, Ohio—to manufacture, buy and sell all kinds of electrical appliances, wire buildings, operate Cortland fire alarm system, etc. Capital stock, $100,000. Promoters: Geo. J. Sherman, Albion E. Lang, Jas. A. Corbusier, Calvin Barker, Harvey Cortland.

The National Electric Company, Eau Claire, Wis.—to purchase and operate the plant formerly owned by the National Electric Manufacturing Company, of Eau Claire, Wis. Capital stock, $50,000. Promoters: Peter Truax, W. A. Rust, G. T. Thompson.

Standard Electric Time Company, of Laconia, N. H.—to construct, maintain and operate electric time clocks and signals, furnishing electric time and other purposes. Capital stock, $1,200. Promoters: O. W. Tibbetts, C. W. Tyler, Dennis O'Shea.

The Pioneer Electric Power Company, Salt Lake, Utah—for the acquiring, storage and utilization of the waters of Odgen River for the purpose of deriving power therefrom, and the acquirement of land and the use of water for irrigation; the use of the power for manufacturing, for railways, heating, lighting and other uses, either by electric transmission or otherwise; the acquirement of franchises in cities and towns to operate railway lines, water and power plants, heating, lighting, etc.; the business of operating said plants and the sale of power to other corporations or individuals and the use of the water for irrigation, domestic and other uses. The officers are George Q. Cannon, president; F. J. Keisel, vice-president; C. K. Bannister, secretary and treasurer, and Frank J. Cannon, general manager. A deed has been placed on record in Salt Lake City from C. K. Bannister and wife to the Pioneer Electric Power Company of the waters of Ogden River, the consideration being $1,000,000.

The Berkshire Electric Light, Heat and Power Company has been organized at Monterey, Mass. The following directors were chosen at a meeting of the stockholders: John L. Dodge, G. A. Stevens, W. Hyer, Samuel Camp, J. A. Brewer, G. Otto Eltrich and O. W. Lane. W. Hyer was appointed treasurer and secretary. The plant will be located at Hartsville. The company expect to have their lights installed in about two months, although considerable trouble is expected from the old company.

The Prescott Electric Light and Power Company, Prescott, Ariz.—to manufacture, create, supply, furnish, sell and distribute electricity for light, motive power, heating and any and all purposes for which electricity can in any way or method be used, to build, construct, maintain and operate electric street car railways and telephone lines, to manufacture, construct, purchase and sell any and all classes of electrical appliances and fixtures, etc. Capital stock, $25,000. Directors: F. L. Wright, George W. Mittendorf, Henry K. Behn.

The Non-Electric Fibre Manufacturing Company—to manufacture materials for insulating electric conductors, wires and other electric devices. A plant for such manufacture will be established in either New York or Brooklyn. Capital stock, $250,000. Directors: Mark L. Deering and Royal C. Peabody, of Brooklyn; William J. Maidhof and William J. Comly, of New York; and Edward Lyon, of Orange, N. J.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED DECEMBER 5, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

510,061. Conduit Electric Railway. William R. De Voe, Shreveport, La., assignor of seven-twelfths to C. W. Dawley, Dallas, Tex., and Patrick B. Cash, Shreveport, La. Filed June 12, 1893.

510,142. Conduit Railway-Trolley. Paul C. Just, Chicago, Ill. Filed Jan. 31, 1893.

510,201. Trolley and Trolley-Switch. David V. B. Smart, Troy, N. Y. Filed Feb. 1, 1893.

510,217. Support for Trolley-Wires. James E. Walker, Denver, Colo. Filed May 3, 1893.

510,384. Electrically-Operated Railway-Switch. Henry L. Falco, Brooklyn, N. Y. Filed Jan. 26, 1893.

ELECTRIC LIGHTS AND APPLIANCES.

510,018. Incandescent Electric Lamp. Henry Green, Hartford, Conn. Filed Oct. 17, 1892.

510,095. Shade for Electric Lamps. George F. Seavey, Boston, Mass. Filed July 23, 1892.

510,188. Electric-Lighting System. George B. Pennock, Chicago, Ill. Filed Feb. 20, 1893.

510,260. Electric-Arc-Lighting System. Daniel Higham, Boston, Mass. Filed July 6, 1893.

510,303. Arc-Lamp Support and Connection. Lucius E. Thompson, Dunkirk, N. Y. Filed May 10, 1893.

510,317. Bracket for Incandescent Lights. Charles M. Berry, San Francisco, Cal., assignor to Ellsworth D. Middlekauff, same place. Filed June 14, 1893.

MOTORS, DYNAMOS, ETC.

509,953. Regulator for Dynamo-Electric Machines. Chas. E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Dec. 10, 1888.

509,954. Dynamo-Electric Machine. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed June 1, 1889.

509,955. Regulator for Dynamo-Electric Machines. Chas. E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed June 1, 1889.

510,059. Electric Motor. Arthur H. Beard, Manchester, Ala. Filed June 10, 1892. Renewed Oct. 27, 1893.

510,102. Electric Motor or Dynamo. Herman K. Thiel, Alpena, Mich. Filed April 10, 1893.

510,367. Reciprocating Electric Motor. Arthur R. Roe, Duluth, Minn., assignor to the Electric Motor Company, same place. Filed Nov. 21, 1892.

TELEPHONE AND TELEGRAPH APPARATUS.

509,873. Signaling-Telegraph. Michael J. Burns, Lowell, Mass., assignor to the Gamewell Fire Alarm Telegraph Company, of New York. Filed Nov. 25, 1892.

509,956. Annunciator for Telephone-Switchboards. Chas. E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed May 2, 1893.

509,934. Telegraph-Key. Josef Steiner, Brooklyn, N. Y., assignor to the Western Electric Company, Chicago, Ill. Filed May 8, 1893.

509,965. Telephonic Transmission. John S. Stone, Boston, Mass., assignor to the American Bell Telephone Company, same place. Filed May 22, 1893.

510,002. Telegraphy. Patrick B. Delany, South Orange, N. J. Filed July 25, 1891.

510,003. Telegraphy. Patrick B. Delany, South Orange, N. J. Filed Jan. 22, 1892.

510,004. Telegraphy. Patrick B. Delany, South Orange, N. J. Filed Jan. 22, 1892.

510,005. Telegraphy. Patrick B. Delany, South Orange, N. J. Filed April 14, 1893.

510,006. Telegraphy. Patrick B. Delany, South Orange, N. J. Filed July 22, 1893.

510,007. Telegraphy. Patrick B. Delany, South Orange, N. J. Filed Jan. 22, 1892. Renewed Sept. 25, 1893.

510,195. Automatic Telephone Exchange System. John Serdinko, New Braunfels, Texas. Filed April 22, 1893.

510,209. Electric Telegraphy. Charles Thom, Jr., Brooklyn, N. Y. Filed Feb. 2, 1893.

ELECTRICAL MEASURING INSTRUMENTS.

510,074. Electrical Measuring Instrument. Otto T. Louis, Philadelphia, Pa. Filed March 28, 1893.

510,177. Combined Ammeter and Voltmeter. Edward W. Jewell, Wheaton, Ill. Filed July 1, 1893.

MISCELLANEOUS.

509,932. Testing Apparatus for Multiple Switchboards. Frank R. McBerty, Downer's Grove, assignor to the Western Electric Company, Chicago, Ill. Filed Feb. 7, 1893.

509,985. Thermometric Alarm. Otto Weyrich, Elberfield, Germany, assignor to Isidor Cahn, same place. Filed May 16, 1893.

510,026. Non-Conducting Covering. Henry W. Johns, New York, N. Y. Filed Feb. 15, 1893.

510,041. Overhead Traveling Crane. William H. Morgan, Alliance, Ohio, assignor of three-fourths to Thomas R. Morgan, Sr., Thomas R. Morgan, Jr., and John R. Morgan, same place. Filed May 28, 1892.

510,048. Electrical Apparatus for Operating Dental Implements. Oscar H. Pieper, San Jose, Cal. Filed Nov. 25, 1892.

510,083. Cash Register, Indicator and Recorder. William T. McGraw, Plymouth, Mich. Filed June 19, 1893.

510,113. Emergency Wagon for Electric Line Work. Edwin S. Breed, Waterbury, Conn. Filed May 15, 1893.

510,115. Electric Fire Alarm. Milton C. Cantrell, Springfield, Mo. Filed March 2, 1893.

510,156. Circuit Breaking Apparatus. John Burry, New York, N. Y. Filed July 14, 1893.

510,276. Process of Electrolytically Decomposing Fused Metallic Chlorides. Farnham M. Lyte, London, England. Filed June 30, 1893.

510,320. Magneto Apparatus. Arthur F. Boardman, Somerville, assignor of one-half to John Tyler Hicks, Boston, Mass. Filed Sept. 20, 1893.

To Inventors and Others.

United States and Foreign Patents Procured.

A PATENT DEPARTMENT has been established in connection with the publication office of ELECTRICITY, for the transaction of all business connected with the procuring of patents on inventions and devices of all classes. The object is to furnish inventors and others, at moderate cost, with a reliable, well-equipped and accommodating bureau through which they may be aided in procuring United States and foreign patents and obtain all information necessary to a successful prosecution of their claims.

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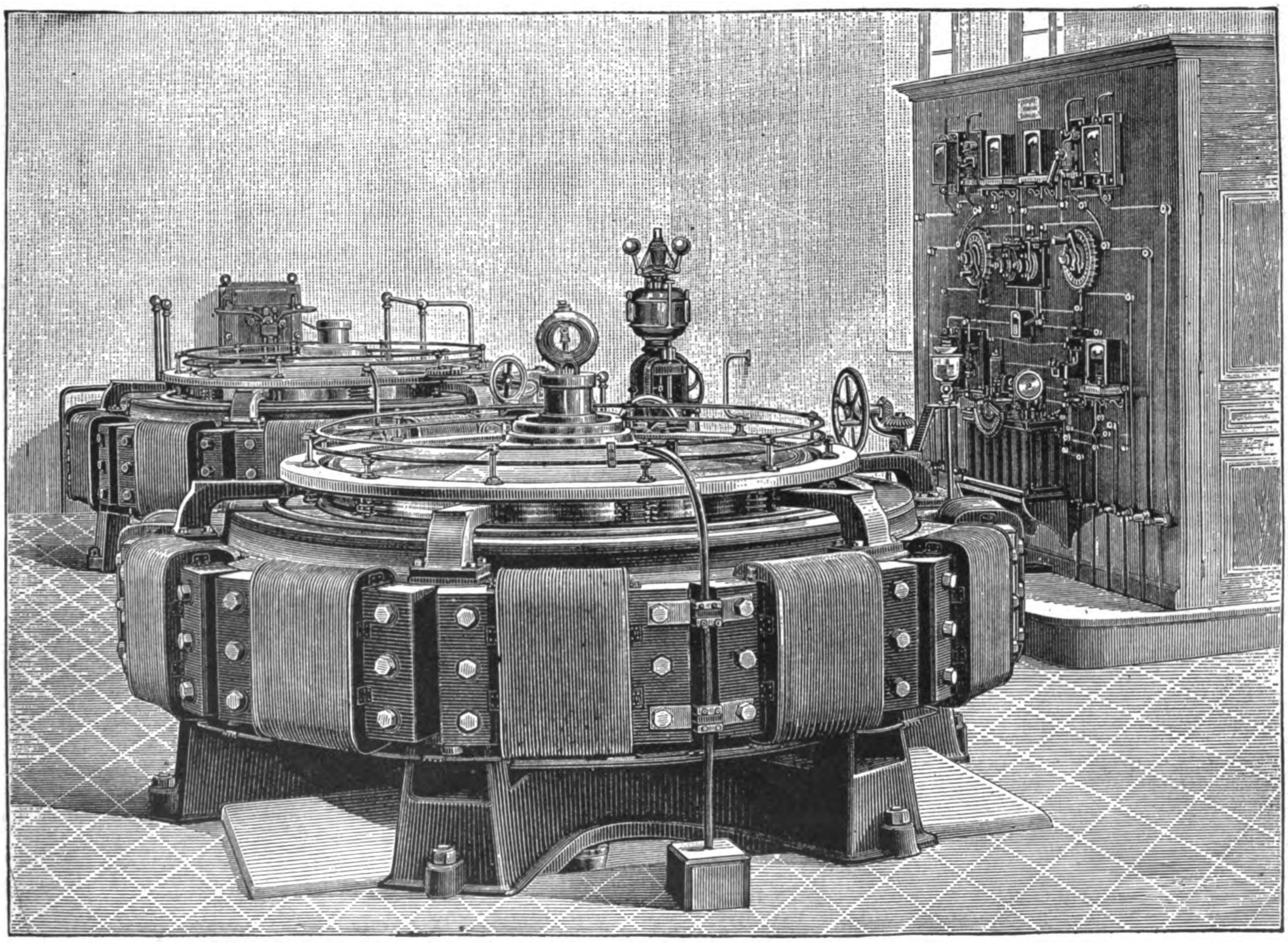

THE SELEVE, SWITZERLAND, HYDRAULIC STATION. (SEE PAGE 282.)

A Swiss Railway Plant.

Seleve, Switzerland, which is a popular resort for tourists both in summer and winter, has an electric railway driven by water power, a description of which is given in *L'Industrie Électrique*. The power is derived from the river Arve, upon whose bank the power house is situated. A channel has been cut across a narrow point of rock around which the river makes a sharp turn. This channel is capable of supplying 20 cubic meters of water per second, which is the minimum supply of the river in winter. A dam at the head of the channel secures a fall of three meters, giving a capacity of about 600 horse power for the plant.

The building, which is well constructed, has beneath it three cemented chambers, two of which contain 250 horse power turbines with vertical shafts and running at but 45 revolutions per minute. The mechanical part of the plant was constructed by J. J. Rieter & Company, of Wintherthur. One of these turbines is sufficient ordinarily for the work during the week, but the number of visitors on Sundays and holidays makes it necessary to employ both machines, and a third one is to be added to the plant for a reserve, the place for which was provided in advance.

A small turbine of 20 horse power running at 82 revolutions is used to drive a Thury dynamo giving 140 amperes at 110 volts. This current is used to excite the fields of the large horizontal dynamos, shown in the Frontispiece. The large Thury machines have an outside diameter of 3.2 meters and the total weight of each is 19 tons. The armatures are mounted on the vertical shaft of the turbines and the field has 12 poles which rest on a special flooring. These dynamos furnish 275 amperes at 600 volts, and as the speed of the turbines is constant the regulation is effected by an automatic Thury regulator in the exciter circuit.

General Electric.

Notes and Comments from Various Sources.

The stockholders of the Atlanta street railway are invited by circular to pay $17.50 per share to wipe out the floating debt, for which they are offered consolidated and income bonds. Bondholders are also asked to accept a scaling of the 6 per cent. gold bonds to 3 per cent., beginning January 1, 1894, for two years, and 5 per cent. thereafter. Thomson Houston people were among the promoters of the street railway undertaking.—*Boston Herald.*

Sales of General Electric were accompanied by renewed rumors of some kind of reorganization in the business; among them a story that the present company will sell the plant at Lynn, and the motor patents to the old Thomson-Houston interests and confine its business wholly to electric lighting.—*N. Y. Evening Post.*

Howell Osborne has had nothing, positively nothing, to do with the manipulation or purchase of General Electric.—*Town Topics.*

It is reported from Albany that the Schenectady Works will start up on full time January 1. Several carloads of patents, in addition to much machinery, have been received there from the Lynn Works.

Do Coming Events Cast Their Shadows Before?

Boston is again enthusing on this property (G. E.) Yesterday's despatches from that city stated that the insiders aver that the report for the year ending February 1 will show a very good financial position, and some assert that before July 1, 1894, the General Electric Company will not only be out of debt directly, but indirectly, with all endorsed bills receivable paid.—*Wall Street News.*

Every large corporation which has gone into the hands of a receiver during the last six months has issued statements similar to the above within ten days previous to the collapse.

Recollections of Werner Von Siemens.*

V.—Active Business Life Begun.

Summary of Inventions Previous to 1850.

For publication in scientific and technical journals there was no time; even patents were taken out only in rare cases. There was then no German patent rights, and in Prussia patents, given almost arbitrarily for from three to five years, were therefore without practical value. The inventions and improvements proceeding from us at that time therefore in the majority of cases lack the attestation of their origin by publication or patent.

A conspicuous illustration of this occurred a few years ago. There turned up somebody in the United States who asserted that he was the inventor of underground conductors, especially of those insulated by gutta-percha, and who tried after the lapse of more than a quarter of a century to obtain a patent for the same, which threatened considerable loss to the large American telegraph company.

The company sent a special commission headed by their director, General Eckert, to Berlin, to search for verification by printed publications that in 1846 I had already introduced wires with gutta percha insulation. To their written enquiry I was obliged to reply that nothing was to be found in print on the subject, but that the official records of the Staff Commission and of the subsequent Telegraph Board contained proof complete.

This however did not suffice for the lawsuit. The Americans chose another very practical way to procure printed information on the matter. They advertised in several German papers that they would pay a considerable sum for a description, printed in 1847, of the underground telegraph lines laid on the track of the Anhalt Railway. That succeeded. After a few days there arrived from different places in Germany newspaper cuttings with the desired description. The commission congratulated me as the undoubted inventor of the gutta-percha conductors and traveled home.

The proposed publication of the results however never came off, because, it is said, in the meantime a compromise with the reputed inventor had brought greater profit to the company.

In Germany, after the construction of the lines to Frankfort-on-the-Main and Cologne, the system of underground communications had become the fashion. Not only were the Government telegraph lines from Berlin to Hamburg, Breslau, Königsberg and Dresden constructed underground with unprotected wires, buried at a depth of two feet, but even the railways preferred to lay such underground lines, although the indications of the speedy destruction of these lines increased daily. In particular the destructive action of rats and mice became more evident —especially on the first lines, which were laid in the sandy railway embankments one and a half to two feet deep. The wires laid over two feet deep were indeed at first exposed to no such destruction; but subsequently it occurred even in them.

I then believed that a coating of lead would completely cope with this evil. To coat the wires with lead I proceeded at first in the following manner: Leaden tubes were straightened out, then a hempen band was blown through them by means of a bellows, and with its help the conducting wire insulated by gutta-percha was drawn into the tube. Thereupon the tube was passed through a draw-plate, in order to effect a firm attachment to the insulated layer of the conductor. We afterwards succeeded in pressing the leaden tube directly round the insulated wire when the lead had exactly acquired a certain temperature and permanently retained it. The difficulty of continually controlling this temperature I overcame by a thermo-electric arrangement.

Such conductors, surrounded by lead casing were frequently furnished by Halske and me in the beginning of the fifties. So among others in the telegraphic system, which we set up for the police service and the fire brigade of Berlin. These lead lines acted quite satisfactorily for a long series of years. They were then gradually replaced by cable conductors, yet lead conductors have remained in excellent condition to the present day, after the lapse of 40 years. Only where the lead has come in contact with decaying matter in the soil, whereby the formation of acetate and carbonate of lead is facilitated, is it liable to rapid destruction.

The just mentioned police and fire-brigade telegraph was intended to unite fifty stations in different parts of Berlin with the central office of the police department and the central office of the fire-brigade, so that the report of fire might be simultaneously communicated to all stations, whilst the police reports were only to be received and comprehended at the central police bureau. Our arrangement solved this interesting problem very satisfactorily and worked for over twenty years well and accurately, but then succumbed to the simpler Morse system.

Morse's writing telegraph first became known in Germany through a Mr. Robinson who, in the year 1850, gave exhibitions with it in Hamburg. The simplicity of Morse's apparatus, the relative facility of acquiring the alphabet, and the pride which fills every one who has learnt to use it, and causes him to become an apostle of the system, have in a short time ousted all dial and older letter-printing apparatus.

Halske and I at once perceived this superiority of the Morse telegraph, resting on manual dexterity, and made it therefore our task to improve and perfect the system mechanically as far as possible.

We gave the apparatus good wheel-works with automatic regulation of the velocity, a reliable magnetic system, sure contacts and commutators, improved the relays, and introduced a complete system of translation. This consisted in an arrangement whereby all the currents circulating in a telegraphic circuit were automatically transferred to a neighboring circuit provided with its own battery, so that the whole line was divided into several separate closed circuits, but yet without the assistance of the telegraph clerks of the intermediate stations communications could be directly held between the terminal stations.

Such a system of translation I had elaborated as early as 1847 for my dial and printing telegraphs, and had laid before the Staff Commission an apparatus constructed by myself for this purpose, the so-called go-between (relay). Translation however only attained its full importance through the application to the Morse apparatus; it came into use for the first time on the Berlin-Vienna line, which was provided in Breslau and Oderberg with translation stations. It may be here mentioned that the contrivance was subsequently very considerably improved by Prof. Dr. Steinheil, the then Director of the Austrian telegraphs, by fitting an automatic contact to the wheel-work.

My time on entering the business was entirely claimed by constructive work for the factory, and by the laying down of numerous railway telegraph lines undertaken by my firm. Still in the winter of 1849-50 I found a period of leisure, which I employed in putting together for publication my experiences on telegraphic communication and apparatus. In April, 1850, I laid my work, with the title "*Mémoire sur la télégraphie électrique*," before the Paris Academy of Sciences. This had been rendered possible to me through a lucky accident, which enabled me to meet in Paris my friend Du Bois-Reymond, who intended to present a work of his own to the Academy, and gave me his friendly assistance for the French remodelling of my essay. I still remember with great satisfaction the stimulating, and to me extremely interesting and instructive, time of this four weeks sojourn in Paris, the living together with friend Du Bois, and the intercourse with the most celebrated Paris *savants*. To the members of the committee appointed by the Academy for considering my work belonged Pouillet and Regnault. The report on my memoir was read by Regnault at a sitting of the Academy, to which Du Bois and I had received formal invitations. Leverrier appeared as opposer, and defended the electro-chemical telegraph of Bain, which had likewise been presented to the Academy. The presiding *secrétaire perpétuel*, Arago, however, cut short Leverrier's opposition by moving the thanks of the Academy for the memoir and its reception in the "*savants étrangers*."

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* Selected from "Personal Recollections of Werner Von Siemens," recently published in America by D. Appleton & Company, New York, 416 pp., 12mo, uncut edges, wide margin, photogravure portrait.

This public testing of my literary firstling in the telegraphic domain by famous members of the first scientific tribunal in the world produced a deep and very stimulating impression upon me. Many reasons can be offered against such an official trial of scientific and technical performances, which supplies a kind of hall mark and may easily be very injurious to the free unfolding of science; it is indeed only admissible under full control by the publicity of the *séances*—can then however be very useful and stimulative.

I content myself here with a concise summary of the most important scientific and technical improvements, the priority of which is secured to me by that publication:

Introduction of the automatic break of the electric current at the end of every movement of the armature through a predetermined distance. Or one may put it thus: increase of the movement of the Neef hammer by a mechanism answering to the slide of the steam-engine. All automatic electric alarums without clockwork and many other constructions rest on this principle.

Production of the synchronous action of two or more electric machines by allowing a fresh impulse to take place only when all the automatic contact-breakers are again closed, i. e., the armature movement of all the apparatus inserted in the circuit is completed.

Manufacture of insulated conductors for subterranean or submarine telegraphs by coating wires with gutta-percha.

Construction of machines which press the gutta percha without seam round the wires to be insulated.

Discovery of the phenomena of the charge in insulated subterranean or submarine conductors, and establishment of the law of the charge for open and closed circuits.

Establishment of the methods, measurements, and formulæ for determining the place of faulty conduction and insulation in subterranean circuits.

Through the admission of my memoir into the "*savants étrangers*," and another essay published the same year in Poggendorff's Annalen "On electrical lines and apparatus," which reproduced entire the contents of the memoir so far as they had reference to underground electrical lines, my priority in respect of various scientific and technical achievements has been placed beyond dispute. Nevertheless, unwarranted claims to certain of them were subsequently raised in divers quarters. This leads me to make here a few remarks on the need of an international literary tribunal, which has in recent times come to be felt with increasing acuteness. It must first of all be granted that in the course of the last decennia it has become ever more difficult, nay almost impossible, completely to survey the vast mass of material contained in scientific and technological publications, in many different languages moreover. It is also natural that those who are entirely absorbed in their own special work, but especially those who actively co-operate in furthering the development of the technical application of physical science, find but little leisure to make a thorough study of the doings of others working on the same or on related lines, even if masters of the several languages, and that they in general have also little inclination to turn their attention to the past. As an example of this I might point to the most highly gifted and copiously inventive physicist of any age, Faraday. He got to know the insulation with pressed gutta-percha only many years after its invention, when it began to be employed in England for submarine cables, the external protection of the insulated conductor being secured by surrounding the latter with iron wires. The surprising phenomena of electrical charges, which Faraday observed in these cables, induced him to publish an essay on the subject. When Du Bois-Reymond, however, sent him without further comment a copy of my memoir presented to the French Academy, Faraday did not lose any time in following up his first work with another, in which he cited the relevant sections of my treatise, and made the declaration that the priority both of the observation and also of the explanation of the phenomena belonged to me. Other English writers, as Wheatstone, Jenkin and many others, have certainly not troubled themselves about either this declaration of Faraday's or any of my other publications.

In Germany the good custom formerly prevailed of always prefacing the description of one's own scientific or technical discoveries and inventions by a description of the achievements of predecessors in the same department, thereby giving the progress about to be described its place in the historic evolution—a custom which unfortunately has never been observed in other countries with like conscientiousness. Hence it has hitherto been the peculiar glory of the Germans to recognize more than other nations the services of foreigners, and always to connect their own achievements with those of their precursors. This has been essentially facilitated by the knowledge, more diffused in Germany than in other countries, of foreign languages; but even apart from that, German science has always regarded it as a point of honor to practise literary justice equally towards natives and foreigners, and let us hope that this will be so also in future and that we shall thereby be spared the literary piracy which unhappily threatens to become prevalent even among ourselves.

(To be Continued.

An Electrical Fountain.

The various exhibitions which have been held during recent years have done much to stimulate electrical developments, especially on the artistic and spectacular side.

The electrical fountain is one of these productions and visitors to Paris and Chicago will recall the fascination that surrounded the extraordinary brilliancy produced by a combination of powerful streams of rising and falling water the main body of which was made to assume in rapid successions the varying tints of the rainbow, while the scattering drops and spray glistened and flashed like the dew in the morning sunshine. The continued development of electrical science and a constant demand for something new were united in the evolution of the electric fountain display at the World's Fair, which was one of the most attractive features in the electrical department.

Electrical Fountain, Lynn, Mass.

So attractive are these displays that corporations and private individuals have conceived the idea of beautifying public parks or private grounds by the erection of electric fountains upon them.

Lincoln Park, Chicago, has had for several years a most elaborate fountain of the kind, which is a never ending source of wonder and delight to the crowds who visit that favorite pleasure resort. Kansas City likewise was fortunate enough to secure one about a year ago.

A public spirited citizen of Lynn, Mass., now deceased, conceived the idea of bequeathing a sum of money to the City Council for the express purpose of erecting and maintaining such a fountain, and the accompanying illustration, with the following description, illustrates what has been attained and accomplished in carrying out the wish and intent of Mr. Wm. Shute.

The amount of the legacy, we believe, was something like $2,500, not an extravagant amount to be sure, but which, now that it has been judiciously expended, has produced something which may be considered "a thing of beauty," and therefore will be "a joy forever."

Some time ago the City Council advertised for bids from firms desirous of building and equipping this fountain on the Lynn Common. The award was finally made to the Franklin Electric Company, Kansas City, Mo., a corporation which makes a specialty of such work.

Mr. W. H. Blood, Jr., one of the principals in the Franklin Electric Company, took personal charge of the work, designed the entire structure and gave it his personal supervision until completed and accepted by the city of Lynn on Thursday evening, October 5.

In describing the fountain we may say that on Lynn Common there is what is known as the Frog Pond, in the centre of which the fountain has been erected. It consists of a circular wall built of field or cobble stones, some eleven feet high from base to parapet. The inside of the circle, which is about fourteen feet in diameter, is roofed over flat about four feet below the parapet, thus forming a submerged chamber about seven feet high and perfectly watertight. In this chamber have been installed all the apparatus requisite and necessary for producing the weird and beautiful effects that render it the most brilliant novelty in the East.

Looking at the structure from the edge of the pond there is no apparent entrance to the fountain except by climbing the wall, which forms a large bowl or miniature pond, in which, however, there is no water. In the floor of this bowl, which of course forms also the roof of the submerged chamber, is a trap door leading to the room below. There are also five circular windows in this roof, one in the centre and four equidistant around it, fitted with thick sheets of glass. Over these windows are water pipes, bent in circles and perforated with small holes through which the water is forced.

In the centre of each circle nozzles are fixed, the apparatus pointing upward. The central window has two circles of pipe, one within the other, in the centre being fixed a four-armed revolving arrangement for throwing a rotating twisting spray.

Beneath the windows are parabolic reflectors in each of which are fixed, not vertically as in the ordinary arc lamp, but horizontally, two carbons which form the arc lights, the rays from which shoot up through the windows into the rising and falling columns of water with an intensity that is fairly dazzling. By this means the water is simply illuminated, nothing more, and additional devices have to produce the changes of color which it is impossible to adequately describe. These changes are wrought out by an ingenious arrangement somewhat as follows: Between the upper flat open sides of the reflectors and the upper side of the circular windows, close under the roof of the chamber, are revolving frames containing six compartments filled in each with a different colored glass. These frames revolve horizontally on pivots by means of a sprocket chain connecting and moving them simultaneously. As the different colored glasses pass into the focus of the arc light the color of the water rising and falling outside is changed. This practically includes the whole electrical apparatus. The supply of water, however, is secured to the different circular pipes and groups of nozzles by a novel arrangement of pipes and valves that display much ingenuity in their installation. A big supply pipe coming up from the floor branches off into a number of smaller pipes, graduated in size like the pipes of a church organ, and each supplied with a valve.

Through one large pipe flows the water supply to the outer circle over the centre window; through another the water flows to the inner circle over the same window. A third pipe supplies water to the four outer circles; a fourth pipe to the central nozzle; a fifth to the central whirligig, and the last and smallest pipe of all to the four outer nozzles.

By the aid of these series of pipes and valves, and a plentiful supply of water, when the fountain is to be played, two men are enabled to produce the most brilliant effects. One man manipulates the valves while the other attends to the revolving colored glasses. Combinations and changes can be effected instantaneously.

As we have above stated, the fountain is the gift of a deceased citizen, and will be forever known as the Shute Fountain, that being the name of the donor.

After the work was completed, it was exhibited in operation by Mr. Blood on several evenings, to the intense delight and admiration of thousands of spectators. On the evening of Thursday, October 5, the fountain was finally exhibited before being accepted by the City Council. On that occasion there was a crowd of some 25,000 gathered on the Common, the Thomson-Houston Brass Band was in attendance, the entire City Council attended in a body, and at a given signal the water was turned on, current was switched in from the street circuit, and the light flashed forth in variegated tints.

Brief speeches were then made by prominent citizens, the designer and builder, Mr. W. H. Blood, Jr., receiving warm congratulations. An address to Mrs. Shute, wife of the donor, who was too ill to be present, was received with acclamation, and sent to her residence accompanying a handsome floral tribute. The Mayor accepted the fountain as a gift to the city, and with music, the playing fountain and general jubilation, the enthusiasm was kept up until a late hour.

A Foreign Notice of American Work.

BY ARTHUR SANKEY.

The comments of the London *Electrician* of December 1 on Lieutenant Patten's recently published description of "A System for Obtaining High Frequency Currents by Mechanical Means" should not be allowed to pass unnoticed. Judging from the lines quoted below it would seem the writer of them had not looked over the article he refers to in the New York *Electrical World* of November 18. He says:

"The device might have been useful for the production of very high frequency currents for theoretical purposes if it had turned out that the frequency was doubled at each additional armature, as in that case only a few armatures would have been needed to produce very rapid alternations, but, unfortunately, the frequency is only increased by a constant amount with each successive armature, and the chief value of the method for experimental purposes is found in cases where it is desired to know the exact frequency."

Those lines contain about as much misrepresentation of facts as could well be put into so many words, and though I am myself a Britisher, chance made me Lieut. Patten's assistant at his laboratory through all the course of experiments described in his beautiful series of "Laboratory Notes," published in the *Electrical World* of New York, and the experiments he describes are not fictions—they are facts.

If there is a feature of any value in his method of obtaining high frequency currents by mechanical means, it lies in the fact that the apparatus does precisely that which the London reviewer damns it for not doing, and such blunders in reviewing are only pardonable when done on purpose.

In the first column of Lieut. Patten's description of his multi-frequency experiments we find the following:

"Plainly in such a system the frequencies from one machine to the next *go on doubling*, as the series 2, 4, 8, 16, etc. Thus, if the first machine had twelve poles and made forty revolutions a second it would give 480 reversals a second, while the third would give four times this frequency or 1,920 a second."

Is there any ambiguity or haziness about that statement?

Quoting a few lines further on he says: "A practical speed for such machines gives 1,200 reversals at the first machine for the initial frequency—nearly 10,000 a second at the fourth, about 20,000 at the fifth, and the eleventh armature in series would give more than a million and a quarter reversals a second of absolutely uniform frequency." And this is what our critic refers to as the unfortunate and lamentable fact that the frequency is increased "only by a constant amount at each successive armature of such a machine," and were it not for this the machine might have been of some use for something. I would indeed like to know how a machine can be figured out to give a *constant increase* at each successive armature as stated by the *Electrician*.

Do Mr. Trouton's footsteps referred to show that? If they do I think Lieut. Patten would like to see them and follow them carefully as far as they go in that direction.

Now, here are some of the possibilities of the system described and put into operation at Lieut. Patten's laboratory:

Assume the machine spindle to revolve at fifty revolutions a second. Let there be twenty-four field poles for each armature, and let there be fourteen successive armatures secured to the common spindle. The first armature would evidently give 1,200 alternations per second and the successive armatures up to the fourteenth would give the following different frequencies: 2,400—4,800—9,600—19,200—38,400—76,800—153,600—307,200—614,400—1,228,800—2,457,600—4,915,200—9,830,400.

Thus you have quite a selection to choose from, that ranges from about 1,000 to 10,000,000 reversals a second. But that is not quite all the system is capable of giving, for suppose we vary the speed by 1 per cent., or 2 per cent., or 10 per cent., or any desired amount, then any one of these various higher frequencies will be increased or diminished by 1 per cent., or 2 per cent., or 10 per cent. of its respective value as above given. The system is thus not only capable of giving any frequency desired, but we are enabled to determine just what the frequency is, and hold any desired rate within very narrow limits of variation. The more complicated questions concerning the self-induction effects, capacity of condensers, etc., are out of place here, I simply contend that Lieut. Patten has invented and put into operation a system of obtaining high frequency currents by mechanical means by which he can obtain almost any desired frequency and know just what the frequency is and hold it nearly constant or vary it as desired, and I seriously doubt that there is any other way under the sun to do it.

A Miniature Electric Railway.

Among the novelties in electrical toys which are to be found in the holiday displays is an electric railway such as is shown in the following cut, which operates on a small battery current. The car trucks are 15 inches long, and the gauge of the wheels 3½ inches. The different styles of car bodies are made interchangeable, and may be used on any truck. The track is made of hard rolled brass and serves as a conductor for the current.

The motor is of the Premier No. 1 type built by M. R. Rodrigues, of Brooklyn, and is supplied with a pole changer so that the direction of the cars may be reversed. The motor is the single reduction type, the reduction being seven to one, and with half an ampere at six volts the motor car if loaded with two pounds will draw a trailer with a load of eight pounds and will ascend considerable grades with ease.

A Miniature Electric Railway.

At any point on the track a switch block, consisting of an angular block of wood, may be placed, which engages the lever of the pole changer and reverses the direction of the car automatically, so that by placing a switch at each end of a straight track the cars will run back and forth without attention. The track may also be laid either curved or circular at any radius above thirty inches. The truck is fitted up with springs and journals, and is substantially built to stand rough usage.

The complete outfit consists of one motor truck, three cars, the locomotive cab, passenger and freight cars, three cells of Premier No. 2 battery, 18 feet of track and necessary connections. A power house is provided at extra cost, which is used as a containing box for the batteries. These cells will run the cars for about thirty-five hours at a cost of fifty cents. Any of these parts are sold separately, and the outfit is easily set up and run by any intelligent child.

The price of the complete set is $25, and a motor truck and one car body $10. A locomotive with one battery which will make eight miles an hour and an electric launch are also about to be placed on the market.

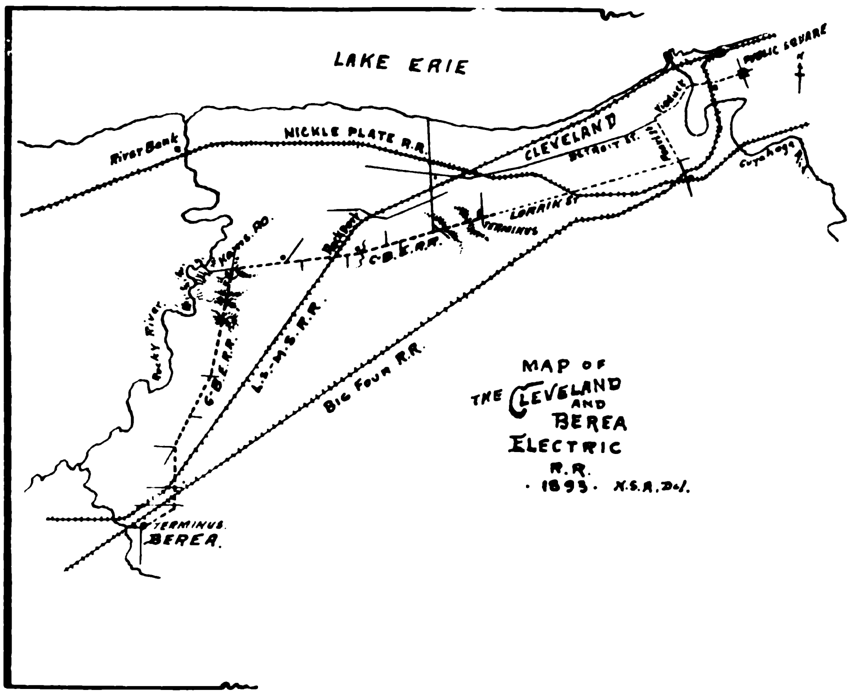
The Cleveland and Berea Electric Road.

This company has for some weeks operated its road with a storage battery car, of the Ford-Washburn type, with attendant success. The road is built of 60 pound rails, and extends along a public highway from the Henley street terminus of the Cleveland City Railway Company's Lorain street line to Berea, some ten miles distant. The roadbed has not yet been placed in the best condition, some of the curves needing easing up, and quite a material amount of ballasting is yet necessary. There are two grades of about 6 per cent. near the Cleveland end of the line, and at the Berea end there is quite a perceptible grade where the track passes beneath the Big Four railroad.

A number of the curves on the line are exceedingly sharp. Several bridges of considerable height are crossed, and a ride along this line is a rare treat. The scenery is quite varied; and from the fact that the section, through which the road passes is quite thickly populated for a country district, large patronage from this direction can reasonably be expected, as well as the larger patronage between the cities of Cleveland and Berea, where there is located quite a flourishing seat of education known as Baldwin University.

The road follows substantially the general direction outlined in the accompanying map, shown as Fig. 1. From this it will be seen that at Kam's post-office the road approaches near to Rocky River, whose precipitous banks upon either side make a ramble among the picturesque scenery which borders its sides a most delightful pleasure, and with this facility of transit open to the public, "a day in the country" is at once available to any one disposed to take advantage of it. This system certainly effects a large saving in the matter of equipment, since it is well known that the cost of overhead construction for a distance from eight to ten miles is a material obstacle, which undoubtedly stands in the way of many projects of this kind, for it is clearly obvious that the field of the trolley is confined to the shorter lengths of trips with a maximum number of car equipments, as against the field which seems to be difficult for the trolley to enter—viz., the long trips and a minimum number of cars.

So far but one car has been placed in operation, making six trips daily, three in each direction, leaving the Cleveland end at 8:30 A.M., 1:30 P. M. and 6:30 evening, and on the return trips leaving Berea at 6:30 A. M., 11:30 A. M. and 4:30 P. M.



The trip was made some days since by the writer, leaving the Lorain street terminus on schedule time at 1:30 P. M., in company with Mr. George A. Ford, president of the Ford-Washburn Store-Electro Company, and G. A. Washburn, inventor of the system and electrician of the company, and a complement of passengers.

Mr. Washburn was at the controlling stand, and manipulated in an expeditious manner all the successive movements of the car throughout the trip.

The car is equipped with 168 cells, and the controlling stand is provided with four successive positions which first divide the cells in four sets, placing them all in parallel; second, placing the cells in two sets and connecting them in parallel; third, placing them in series; and fourth, being the position when the cells are disconnected entirely. The first position gives 84 volts, the second 168, and the third 336. From this the following ammeter and voltmeter readings will be more intelligible:

The battery after being charged for about half an hour through a connection to the trolley wire, responded readily to the controlling lever, and the car quickly got under speed, to encounter within a few hundred yards the first grade of 5 per cent., which demanded an output from the battery of 90 amperes for a period of at least five minutes. The car, of course, did not travel at the speed it would if the controller had been placed in the third position. Ordinarily, on the level, the amperes required for the second position of the controller varied between 35 and 50, according to the condition of the track, while with the third position the ampere output ranged from 20 to 30.

Quite a large number of stops were made between Cleveland and Berea, the most in and about Rockport, where the line first crosses the Lake Shore and Michigan Southern Railroad, and the heaviest grades of the whole line had to be encountered in the outward trip. Near Berea the Lake Shore track is crossed a second time, and about a half mile nearer to the Berea terminus the track passes underneath the Big Four Railroad. At this point there is quite a grade on either side of the depression of the track.

The run was made in a little less than an hour, and the voltage of the cells as the car stopped within the temporary power house was 336, or two volts per cell.

Change of Name.

Prof. Wilbur M. Stine, director of the department of electricity at the Armour Institute, Chicago, in addition to his other duties, will have editorial charge of the monthly magazine, *Electrical Engineering*, and of the monthly summary of current technical literature, which heretofore has borne the title of *De Land's Synoptical Index*, but hereafter to be published under a separate cover bearing the title of *Electrical Literature*. Mr. Fred. De Land will retain the business management of both publications.

Trade Note.

The Interior Conduit and Insulation Company have recently sold Lundell motors, which are to be installed on the U. S. S. New York, now on the dry dock at the Brooklyn Yard.

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NOTICE.—Hereafter cuts will be admitted to the first page of "Electricity," not to exceed one square inch in size.

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Whom Does Patent Litigation Benefit?

If it is a fact, as reported, that Mr. Frederick P. Fish has handed in his resignation to the Board of Directors of the General Electric Company, there is only one sensible way to act upon it: it should be accepted by acclamation, not that Mr. Fish is either a dishonorable or an incompetent man, but because it is essential to the very life and existence of all the large manufacturing companies that ill advised patent litigation cease.

A direct saving of $25,000 a year in salary would be made by Mr. Fish's retirement, and this should be followed by the dismissal of every member of the legal staff except perhaps one or two to handle the routine matters of the office. If the General Electric Company had inaugurated this plan immediately upon its beginning business, the sales of the company would have been at least 25 per cent. larger, thousands of friends would have been saved to it, its suspended dividends could have been paid, and ELECTRICITY's campaign would not perhaps have been made.

Mr. Fish came into the electrical business fresh from his great successes in telephone litigation. He had proved himself a splendid lawyer, but like a great many others who have achieved fame at the bar, his head was so full of law that there was little room left for a clear understanding of the business situation.

He fell short of true greatness in that he was a lawyer only, and not a *wise and broad-minded counsellor*.

His perception of legal points was accurate, but he seems to have failed to see the difference in breadth and scope between the telephone business and the general electrical business. He failed utterly to realize that while the opposition in the establishment of the telephone monopoly had been fierce, the fight being won only after an exhausting contest, all the opposition in the telephone business was as nothing compared to what he had to meet in the electrical field.

In the telephone matter not over a half-dozen rival inventors appeared to offer serious contest to the claims of the Bell people; the art was little known and had tempted few workers; there was no established manufacturing business whatever in the opposition.

How different the situation in the electrical business. Here the fundamental principles of the art had been an open book for years; they had been taught in schools and colleges, and scores of able inventors had been at work, each contributing something towards the completion of successful systems for lighting and power; no one man had ever assumed to claim it all; manufacturing plants were scattered throughout the country, and millions of capital were invested. Those engaged in the business were neither thieves nor poachers; they believed they had a legal right to be in it, and their belief was backed up by the opinion of every man well informed in the history of the art that the moral and legal rights were not held by any one man or any one company or possible combination of companies.

Thus the opposition were not fighting for an idea; they were fighting for their vested property rights, and they were bound to fight like good Americans.

That they have done so Mr. Fish and his associates now know. Similar knowledge a few years ago would have saved millions of money to the companies which has now been scattered among lawyers, strikers and "experts," who have disgraced the whole system of expert testimony.

Under the pressure of the bitter and bloodthirsty competition which has prevailed, many deals have been made, collusive suits have been brought between two of the rivals, snap judgments procured, and so on to the nauseating end. But in each one of these cases the next turn of the wheel has changed the respective positions of the companies that joined hands for the nonce, leaving one or the other worse off than if no deal had been made. Collusive lawsuits, like chickens, always come home to roost.

All other litigation has been of minor importance to that over the incandescent lamp, and even a brief study of the lamp situation to-day should cause the stockholders in all the large companies to assert their rights, and demand that litigation be stopped. The lawyers have had their innings; the stockholders should now have theirs. Millions of money have been spent, valuable time wasted and splendid energies exhausted, to establish the fundamental Edison lamp patent.

What has it all amounted to? What electrical company is receiving one dollar of benefit?

After lawsuits without end, the legal fight is at best a draw, there is no monopoly in sight, and with only a few months more of life for their patent the owners themselves are compelled, in order to maintain an *even footing* in the business, to reduce the price of lamps to a point where profits are cut in two, a price which, if the owners of the patent sold *all the lamps during the next ten years*, would not reimburse them for the money spent in litigation.

And even now, after the public acknowledgment, by this reduction, that the *large profits*, which are generally held to be all there is worth fighting for in patent suits, are gone forever, lamp litigation still goes on apace. We have now awaiting decision the Buckeye case at Cleveland, where it is held the Edison patent has already expired; the Oconto case, the cases against the Novak people and De Khotinsky, and perhaps others.

With the *legal right* in this lamp patent we have not at present to do; the *moral right* was buried long since under tons of printed misstatements, perjured testimony and oratorical rot.

We repeat the question, Is it not time for the stockholders to take things into their own hands, throw overboard the lawyers, who are not *wise counsellors*, and who delight in showing their legal prowess, through long years of arguments and rearguments, while others foot the bills?

For several months the legal staff of the General Electric Company has been busy in preparation for numberless suits on the feeder patent.

One of these suits has been begun against the firm of contractors, E. G. Bernard & Company, who were about to install a plant at the Watervliet Arsenal, for which they had purchased Siemens & Halske apparatus. A preliminary injunction, based on the claim of intended infringement, was granted against the Bernard Company, and the hearing is set down for January 2.

Another suit has been brought against the Westinghouse and New York Insulated Wire companies for an alleged infringement on the World's Fair plant. We are not familiar with the plan pursued at the plant in question, but certain it is that even admitting the validity of the feeder patent (which we are not prepared to do) *no one needs to infringe it.* There are various ways of accomplishing the same object without doing so.

Feeder patent litigation has in it the possibilities of great annoyance, of an expenditure of large sums of money, of another rich harvest for the lawyers and venal experts, *but not one dollar of revenue* to the owners of the patent.

It is a matter of history that a short time before the consolidation of the Edison and Thomson-Houston interests a conference between these two companies and the Westinghouse Company was held to discuss this subject of patent litigation. A comparison of notes showed that all three had spent enough in lawsuits to pay full dividends for a number of years. It was agreed without discussion to discontinue the suicidal policy, and to compete on more sensible grounds. Not the least of the evils brought about by the combination referred to was the enforced nullification of this agreement or "understanding among gentlemen."

It is a fact which ought to have penetrated the heads of the stockholders long since, that the patents in this business worth fighting for are few in number, and that the revenue from a thoroughly established patent is not likely to return half the cost of litigation. The lamp patent more nearly approached the control of an essential feature than any other, and in this the results are plainly seen. Patents on minor details, once established, will be avoided and rendered of no avail by scores of the bright minds engaged in the business, who will accomplish the same object in other, often better, ways.

Patent suits so far have injured many and benefited none. If the trade is ever to be conducted on a profit earning basis, it will be after patents suits are dropped and the money and energy thus saved are directed to pushing the business in legitimate ways, perfecting the manufactured product and reducing its cost to the consumer.

A group of maniacs or savages standing on a narrow cliff might enter into a general struggle to see who would be the man to secure a monopoly of the position after the others had been hurled over the edge; civilized and sensible men, however, would prefer to go about their natural business.

We do not hold that patents should not be respected. They should be. More than this, they are respected, when properly used by their owners. It will be remembered that all the independent lamp makers stood in readiness a year ago to pay a royalty of ten cents per lamp to the owners of the Edison patent. Would it not have been a wise move to accept that proposition? Vast legal expenses would have been saved, and the patent would have been productive of a good income.

To properly appreciate the status of inventors, and owners of patents, it is only necessary to study the Constitution of the United States. There are not three interested parties — the Government, the people and the inventor—but only two, *the inventor* and *the people*, as the Government and the people are one.

The intention of the people in establishing the patent system was to stimulate inventions for the benefit of the people, with consequent benefit to the inventor. Patents handled in a business-like manner should be, and will be, recognized, respected and treated with proper consideration. Used as a club, to force something to which the inventor is not entitled, they are sure to meet with an unconquerable opposition—the opposition of right and justice.

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Electrical Fire Risks. The question of fire risks from electrical sources is one that is constantly being agitated by different boards of fire underwriters throughout the country, and the prominence which has been attached to the subject has given rise to an exaggerated opinion on the danger of electric wires in the minds of the public. While a number of fires have been traced to electric wires, the proportion of these is very small compared with almost any other of the ordinary causes of fire, and in every instance the trouble can be traced to some defect of material or construction due to carelessness or cheap work. Every electrician feels confident that electric illumination is the safest possible method of lighting that has ever been devised, but this opinion will carry but little weight with the public as long as fires occur from this source, nor does the assertion that electrical wiring can be made absolutely safe make the risk any more desirable to the underwriters whose experience has been gained from several years' statistics.

In view of the fact, however, that in many cases the theoretical safety of electrical systems has not been demonstrated in practical operation, it is pertinent to inquire into the reasons for these failures, and to distinguish between any inherent defects in the system and the possible faults in the workmanship or materials employed. The electric light and electric railway wires are the only ones which in themselves present any great element of danger, and the telegraph and telephone circuits are merely considered as risks on account of their possible connection with the circuit carrying heavy currents. The multiplicity of overhead wires in many streets, to which may be added their often miserable and shiftless arrangement, has made this crossing between different circuits a too common occurrence, and besides the direct danger from fire this has frequently seriously handicapped the firemen in their work. This argues at once the necessity of first-class line work and the importance of high-class insulation; and although the most of the work put up at the present time is a great improvement over that of the past, there are hundreds of lines all over the country that testify to the ignorance and carelessness in regard to aerial lines a few years ago. Wherever such lines remain they involve a grave danger and will eventually, if not replaced, result in the demand to place all street lines underground.

The electrical companies in New York City were forced to make this change at a very great expense on account of the dangerous condition of the overhead lines, many of which had been abandoned. As a single bad line may cause trouble with every other line with which it may come into contact, it behooves every company to pay strict attention to its line work in order to avert the cost of underground construction, which will be likely to follow any succession of accidents.

It is within the reach of every city to bury all wires except the trolley lines, and now that the practicability of underground wires has been proved, and with that construction the companies are forced to maintain a high standard of insulation in order to operate, this method is likely to be demanded if any provocation exists. The poor work which remains from years ago will always remain a menace to safety as long as it is in existence, and until it is entirely weeded out electricity cannot attain the standard of safety which under proper conditions it deserves. The subject of interior wiring will be considered in the next number.

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The patent litigation of the General Electric Company has been a series of blunders. The greatest blunder of all has been in attacking a plant in which the Siemens & Halske Company have a direct interest. A mine of information as to the history of the art has been dug into, and the utter confusion of the General Electric Company is inevitable.

Personal

Mr. Alex. H. Lewis, now representing the Curtis Electric Company in the West, was in town last week.

Messrs. James I. Ayer and H. P. Broughton, two gentlemen well known to most of our readers, have started in business as consulting engineers at St. Louis, under the firm name of Jas. I. Ayer & Company.

Mr. F. R. Chinnock, who has many years of successful work to his credit in the electrical field, has resigned the agency of the Ball Engine Company in New York, and will again be identified with the electrical business directly as representative of the Excelsior Electric Company.

Messrs. C. H. Angier & Company have succeeded Claflin & Kimball as agents for the Mather Electric Company in New England. Mr. Angier has had charge of the selling department of the Mather Electric Company. Mr. C. A. Bowditch will be at the head of the motor department of the new concern.

The Correspondence School of Messrs. E. P. Roberts & Company, in Cleveland, is in a flourishing condition, and has proved a thorough success.

What Judge Shipman Said as to Non-Infringing Lamps.

Considerable comment has been heard on the remarks made by Judge Shipman during the hearing in the Novak lamp case at Hartford in regard to the stopper lamp. The matter is of great importance, and the correct version is here printed for the first time, from the stenographic report taken by our Mr. W. S. Key :

" Judge Shipman said that in some of the cases which had been tried certain rebuttal evidence had been put in and accepted as being relevant to the case. In the Novak case, then under consideration, any rebuttal evidence would be of slight importance. This, however, applied only to infringing lamps; if a lamp that really did not infringe the Edison patents was brought into court, rebuttal evidence might not be admitted, and he (Judge Shipman) conceived of such a case coming up for settlement at some time, for there was a lamp that had been made for some time past, in fact was being made now and sold in quantities, that apparently did not infringe. It was known as a 'stopper lamp,' and was being made by the Westinghouse Electric Company. He had heard that lamp spoken of disparagingly by some as though it were a failure. Be that as it might, there was the fact that the Westinghouse Electric Company had introduced the stopper lamp as an economical, efficient and commercially valuable device; they contracted to light the whole of the World's Fair buildings with that lamp, and did so satisfactorily, and he had yet to learn that the Westinghouse Electric Company was any poorer as the result of introducing and using its stopper lamp."

A Boston View.

(*From the U. S. Investor.*)

The feeling existing between the two factions in the General Electric Company does not seem to be the pleasantest, and if it were in their power to do so, there can be no doubt that the old Thomson-Houston crowd would be glad to take measures to get their company back into their hands. It seems to be good opinion that. they would welcome the opportunity to bring suit for the annulment of the agreement on the ground of misrepresentation. We understand that it is claimed that after the consolidation it was found that the Edison Company came short about $1,000,000 of possessing the amount of assets credited to it before that event. In addition to this there was the enormous floating debt of the Edison Company, concerning which the Thomson-Houston people claim to have been in ignorance. The belief that these two companies will eventually be severed has gone so far that the policy of the Thomson-Houston, as a separate concern, is already being outlined. The company, it is said, will in the future lay itself out on the street railway business, paying little regard to the present lighting business of the General Electric. It is said, however, that Prof. Thomson has perfected a new incandescent light, which is superior to anything yet put on the market, and that he has assigned this to friends of the old Thomson-Houston Company outside of the General Electric.

There would be no necessity for outlining the policy of the Thomson-Houston Company under these circumstances. This company has always followed the golden rule in its treatment of competitors and licensees, " Whatsoever ye would that men should do to you, do ye even so to them." Of course it would not at this late day deviate from the policy which has made it beloved by all.

National Electric Light Association.

At a meeting of the Committee on Arrangements, held in Washington on the 19th inst., the Ebbitt House was selected as the headquarters of the Association for the Convention in February.

The meetings will be held in Grand Army Hall, 1412 Pennsylvania Avenue, within one block of the hotel.

The Electrical Transmission of Power from Niagara Falls.—IV.

BY PROF. GEO. FORBES.*

GENERAL DESCRIPTION OF A 5,000 H. P. ALTERNATOR.

On the bed-plate a vertical cylinder is bolted, with projections to support the fixed armature and the bearings of the revolving part. The armature coils are wound independently and can be removed and changed. They are fixed in slots in the fixed armature. They are encased in an oil-tight casing through which oil can be circulated. The field magnet is external to the armature, and has the poles pointing radially inwards.

It consists preferably of forged steel supported by a spider with eight arms, which may be of steel with a covering of thin sheet metal, on which cups are provided for forcing air into the interior of the machine. The pole-pieces are bolted on to the steel rim. The field coils are of copper strip, two coils being wound upon each pole, with a space between them for air circulation. The exciting current is applied by rings of tempered copper on the spider, having fixed brushes rubbing on them. The hub of the spider is firmly fixed to the upper end of the shaft. The spider supports the heavy rim by 16 studs and nuts. The shaft is supported by two bearings, each of which has four radial arms, which are bolted to four corresponding projections on the cast-iron cylinder. This cast-iron cylinder is bolted to the bed-plate and adjusted thereon by wedges. Besides having on it the projections for carrying the bearings on its inner side, it has on its outer periphery a series of vertical ribs against which the stampings, or sheets of iron forming the armature, rest. It also supports the lower end plate on which the armature is built up, and the armature is keyed to it by a single key. The armature is wound drum fashion—that is, all on the outside. This enables the coils to be wound independently and laid in their place, and also to be easily replaced in case of accident. In order to do this satisfactorily, the slots for each coil in the iron are cut, not radially, but parallel to each other. Each coil is encased in insulating material, which forms a tube through which oil may flow as in a transformer, but may be forced, in which case its circulation is maintained by a pump. Round the base of the machine there are two oil pipes, one being the inlet, the other the outlet. The inlet pipe is connected with a reservoir of oil in the power-house. The outlet pipe leads by another pipe to cooling arrangements in running water, from which the oil is pumped to the reservoir. From the inlet pipe 16 brass tubes are led to the junction boxes at the bottom of the 16 coils; the 16 other brass tubes are led from the junction boxes at the top of the coils through the interior of the fixed armature and bent over the foundation plate, and so connected to the outlet pipe which surrounds the bed-plate. The bed-plate is a single iron casting, and in order to enable it to be transported over the railways it was necessary to limit its diameter, as shown in a supplementary drawing, which shows the improved oiling arrangements, which were worked out by my chief draughtsman at Niagara Falls, Mr. Baumann. The armature is built up of thin sheet iron, with ventilating spaces, as shown on the drawings. The bolts which hold the armature together are eight in number, to be made of nickel steel, a metal which has the great advantage of being non-magnetic and of very high electrical resistance and great mechanical strength. The amount of nickel is 25 per cent.

There are 16 armature coils, eight being of one kind, called "short" coils, and eight of another kind, called "long" coils, the length of wire on each coil being the same. The short coils are bent over at the end plate, and the long coils are wound in one plane and enclose the short coils. I find that if we are to have a very stiff field, with first-class quality of iron in the fields, each coil would consist of 72 turns of pure copper wire No. 0 of the Brown and Sharpe gauge, which gives a very low density of current, and reduces the heating. In fact, it has been my view that in designing the machines for so great and permanent a work every effort should be made to reduce the rise in temperature, even to far below what has ever been done in the past. The unequal expansions and contractions of materials in a machine of this kind are very injurious to its permanence, and affect the insulating material seriously. The layers of wire in the coils are separated by mica. Each coil when wound has strips of insulating material laid spirally round it, so that oil may circulate freely in the intervals, and the whole is encased in a casing of strong insulating material. The material which I prefer for this purpose is certainly woodite, an eighth of an inch of which will not break down with 30,000 volts, and which is not acted upon by oil even at high temperatures. I have a record of tests with oil which are conclusive on this point. It is quite the best material I have seen for the purpose, though costly, and, being a secret process, it may be difficult to ensure uniformity.

The frames of the bearings are of cast iron, with four radial arms, which rest upon four projections cast on the vertical cylinder, and are bolted to them. By this means, when the field magnet with the shaft have been lifted out of place, the bearings can be twisted through an angle of 45 degrees in a horizontal plane and then raised out of place, leaving a space of five feet in diameter through which portions of the turbine shaft can be raised for repair. The bearings are oiled at the centre by oil forced under pressure through a pipe. The oil is then distributed over the bearings by spiral grooves. A spiral groove is also cut in the hub of the frame, with a pipe at each end to admit of water circulation to cool the bushing. At two opposite sides of each bearing the bushing is made thin, and a rod of bismuth is soldered thereto; so that if the bushing is heated a thermo-electric current shall be created which, by means of a relay, can ring a bell in the power house. When this occurs, water can be immediately admitted to cool the bearings, and the attention of the workmen is drawn to the necessity of an examination.

One of the parts which required most consideration was the material of which the spider supporting the field magnets should be constructed. The best plan is to make it of steel, for the sake of lightness, and to cover it with a copper covering, which might, I think, be spun; or perhaps better, electro-deposited nickel might be used.

Between the pole-pieces the space is filled up with a screen or plate of metal so as to direct the air ventilation only upon the parts which most require cooling.

The methods finally selected for oil circulation are shown in a separate drawing.

It will be obvious from this design, considering that the speed of revolution is 250 per minute, that great care has to be devoted to the balancing of the revolving parts; everything has to be calculated not only for a speed of 250 revolutions, but for double that amount, which is the maximum speed at which the turbines could possibly run—at which speed they might run through a breakdown of the governor, although this is an accident almost impossible to occur. Each of the revolving parts will of course be balanced individually, and I have suggested a plan for the final balancing which seems likely to be effective.

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* From a paper read before the Institution of Electrical Engineers, England.

A temporary bushing would be put in the bearings, of india-rubber lined by a thin metal tube. The dynamo would then be rotated slowly and the balance adjusted in the usual way. The speed of revolution would be gradually increased—a new adjustment being made at each speed—until a speed of 500 revolutions a minute is attained, and when an adjustment has been made at this speed it is pretty sure that the balance at 250 revolutions per minute will be very perfect, and the mechanical friction reduced to a minimum.

As stated before, the oiling arrangements have been introduced not only to ensure higher insulation and to preserve the insulating material, but also to lower the temperature as much as is possible, because every step we take in the reduction of temperature is an advance. These oiling arrangements may perhaps be adopted in the future, but at present we are not making use of them in the machines which are in process of construction. When we have had experience with these we may in future adopt the oiling arrangements; and as there is likely to be a great development in the direction of electric transmission of power in connection with the utilization of water power in many parts of the world, it has seemed well to me to put before you these details, so that they may be considered in other cases that may arise.

At a meeting of the board of directors in New York lately it was resolved, on the recommendation of the consulting engineers of the company, that the contract for two or three alternators, each of 5,000 H. P., should be assigned to the Westinghouse Electric and Manufacturing Company, of Pittsburg. I would wish to state how much we owe to Mr. Westinghouse, and to his chief engineer, Mr. Schmid, for the zeal with which they have taken this matter up, and their desire to meet our views and to secure for us machines of which they felt they could guarantee the satisfactory performance.

Before leaving the subject of the dynamo, I would wish to point out that it has been designed for special circumstances in connection with the Cataract Construction Company's work. If a dynamo of the same type were being constructed for another place, it is certain that modifications would have to be introduced. I particularly draw attention to the fact that some trouble in getting out a good mechanical design arose from the necessity which existed of being able to provide a clear space of about 5 ft. diameter in the middle of the machine without taking the whole machine to pieces, the object of this being to enable us to lift up portions of the turbine shaft which it might be required to put into repair. In any case, where the long shaft existing in our case is not required, the design of the dynamo is much simplified and would more nearly approximate to the first design, of which a drawing is shown, but arrranged for 33 periods a second.

If the present Paper were intended to relate solely to the subject of utilization of power at Niagara Falls, I would be content with describing what has actually been done: but I foresee that there is going to be a great development in utilization of water-power and its electrical transmission. I am therefore inclined to say a few words on some other details which we have been carefully considering, but about which no definite decision has been arrived at.

Before doing this I would direct your attention to the drawing representing a plan of our power-house, in which you will preceive the inlet passages, A, from the great canal, B, which draws its supply of water from the upper river. From these inlet passages the iron pipes, or flumes, C, pass vertically downwards to the bottom of the great wheel-pit, which is a slot cut in the ground to a depth of nearly 200 ft., at present large enough to contain four turbines in line, but which can be extended to a much greater length, the whole capacity of our tunnel being 100,000 H. P. The drawing shows circles, D, in the plan, which indicate the position of the turbine and dynamo above it, and the position of a hatchway, F, by which material can be raised or lowered. It will be noticed that between the inlet channels and the wheel-pit the flumes are bent downwards, and thus leave a V shaped space, G, which I have appropriated to make a subway, running along the whole length of the power-house, to carry the high-pressure conductors. It will of course be understood that the slot forming the wheel-pit is arched over at the top to form the floor of the power-house, upon which the dynamos rest. It will be noticed that at the north end of the power-house there is a large square chamber, H, in which I propose that all the measuring instruments and other apparatus under the control of the chief electrician shall be assembled. Underneath this chamber there is a cellar in direct communication, first, with the subway which I have described as existing in the power-house; and, second, with the subway which leads outwards from the power-house at present as far as the Pittsburg Reduction Company's works, and may possibly eventually lead to Buffalo. In the cellar all the high pressure wires, the transformers, the artificial load and other high pressure machinery will be placed. It will be noticed that other spaces are left in the floor forming trenches along which the conductors can be carried. With these arrangements there can be no possibility of danger to any person in the power-house; and if any wires are to be found laid along the walls of the power-house or elsewhere, I wish it to be a maxim that we shall be able to place upon these wires a card marked "No Danger," so that there will be no possibility of any danger from any person touching anything in the power-house.

With regard to the exciting current, the best plan available at this moment is to use one of the machines which are generally known as the Schuckert machines for converting the alternating into a continuous current, transformers being inserted in order to lower the pressure. In order that the exciting current may increase with the load, it would be well to make these transformers of special construction, each having two primaries and one secondary. One of the primary coils would be in series with the main circuit, and the other in shunt. I would furthermore make these transformers sufficiently large to deal with all the dynamos which are in the central station, and I would subdivide the secondary coil into sections, to enable us to cut out a section of the transformer when we cut out one of the dynamos. When we wish to cut out a dynamo, a switch would be worked which would at the same time short-circuit the field coils of that dynamo and also cut out one section of the secondary of the transformer which is supplying the exciting current to all the dynamos. This plan allows the fields of all the alternators to be put in series—a desirable arrangement for parallel working. A resistance may, of course, be put in circuit with the fields of the alternators for regulation.

I presume it will be taken for granted that in any large work of this sort the primary circuit should never be broken when in action. For my part, I hold that this should be the case even in smaller stations.

An important feature for putting the dynamos in parallel, and for removing a dynamo, is an artificial load. It is desirable that this artificial load should consist partly of a resistance and partly of self-induction. It is only by this means that the dynamo which is going to be put in circuit can be brought to exactly the same conditions as those which are working, both as regards volts and amperes. It may be well to describe the operations which take place when a dynamo is switched in parallel with the others. First, connection is made between the armature and the artificial load; then the exciting switch is turned so that an extra section of the transformer is put into play, and the short circuit on the field coils of the dynamo is broken. The dynamo being excited, the turbine is then started, or this may be done at first. The artificial load is then adjusted until the dynamo is giving the same volts and amperes as the others. A synchronizer is then placed between the artificial load and the external circuit, and so soon as the synchronism is attained a switch is closed which connects the artificial load with the external circuit. Resistance is then put into the artificial load until there is very little current going through it, when it is switched out, and the dynamos are all working in parallel. To cut out a dynamo from the circuit the operations are performed in the opposite order. The artificial load with high resistance is put in connection with the external circuit; this resistance is gradually diminished until it indicates the amount of work that is being performed by one dynamo; the connection between the artificial load and the main circuit is then broken, leaving the dynamo (which is being switched out) feeding the artificial load. The resistance of the latter may then be increased, and the exciting switch actuated so as to short-circuit the fields of the dynamo, and to remove one section from the secondary of the exciting transformer. The supply of water to the turbine may then be shut off.

If machinery is worked, even at 20,000 volts, in the manner I have described, there is no possibility of injury from any great rise of electrical pressure, unless the external circuit be by any means accidentally broken. To provide against this sort of trouble I would have wires coming from the external circuit where it enters the power-house, connected through a large resistance, or through the primary of a transformer the secondary of which contains a resistance. In circuits with it I would have a break consisting of two carbon points at a distance of about half an inch apart if we were dealing with 20,000 volts, so that an arc could not be formed unless the pressure rose above the normal value. Under these circumstances, so soon as any resonant effect due to the breaking of the circuit or due to any other cause raises the electric pressure above the normal, an arc is established across the carbon points, and so a load is put on which removes the cause of the extra high pressure. This is the only automatic means which I have been hitherto able to think of which is sufficiently rapid in its action to overcome any possibility of injury to the dynamo or transformers.

I have attempted in the course of this paper to give you some idea of the work which has been actually done or decided upon at Niagara Falls, and also to show you the views to which I have been led by any special experiences which I may have had as to the general ideas which ought to guide us in the construction of the plant in the future for transmitting power to a distance electrically.

In describing the different plans which are available I have avoided mentioning the names of those numerous electrical engineers and manufacturers who, by their inventions, researches or applications have advanced the art; or discussing their claims to priority; but I cannot conclude this paper without mentioning the names of some of those who, in one way or another, have made great steps in the applications of alternating currents to power purposes. I would particularly mention the names of Messrs. Ganz & Company, Mr. Schuckert, the Allgemeine Electricitäts Gesellschaft (of Berlin), the Oerlikon Fabrik and Messrs. Brown, Boveri & Company; also Mr. Eickemeyer, Mr. Ferranti, Prof. Ferraris, Prof. Fleming, Dr. J. Hopkinson, Messrs. Hutin and Leblanc, Mr. Rankin Kennedy, Prof. Mengarini, Mr. Mordey, Mr. Tesla, Prof. Elihu Thomson and Mr. Henry Wilde. I feel that all of us owe a great deal to their work.

In conclusion, I wish to draw attention to the figures which show the relative merits of high and low frequency with polyphase motors.

Everything is identical in the two figures except that the frequency of one (a) being double of the other (b); a has 16 poles, b has 8. The armature is identical in both, and revolves at the same speed and does the same work; and the field revolves at the same rate in both, and the induction and current-density are the same. The differences are that a has more copper and less iron than b. The comparison of efficiency depends on the depths of both. As an example, assume that a has 50 per cent. more copper in the fields than b, the ampere turns per pole being necessarily the same in both, and that b has 50 per cent. more iron than a, and that the hysteresis loss in b ($= H_b$) is equal to the resistance loss in its copper coils ($= C_b$). The values for a are:

$$H_a = 2 \times \frac{2}{3} \times H_b;$$

$$C_a = \frac{3}{2} C_b;$$

$$H_a + C_a = \left(\frac{4}{3} + \frac{3}{2}\right) \frac{H_b + C_b}{2}$$
$$= 1{\cdot}42 \times (H_b + C_b).$$

Thus the total losses in the field of higher frequency (neglecting eddy-currents) are 42 per cent. more than in the field of lower frequency.

(*Concluded.*)

SOCIETY NEWS.

Franklin Institute Lecture.

Prof. Elihu Thomson delivered a lecture Tuesday evening, December 19, before the Electrical Section of the Franklin Institute, upon "Cosmical Electricity." He presented several speculations concerning the earth, solar system and other bodies in regard to their electrical relations with each other, and whether the earth is electrified and undergoes various changes of electrical conditions. By means of some apparatus he defined and illustrated electrostatic capacity, potential, the relations existing between electrified bodies, etc. Although there is a difference of opinion regarding the question, "Can a true gas carry or retain a charge of electricity?" he regarded it in a negative sense from some personal experiments. Thus the dense atmosphere quite near the earth indicates only a very low potential. However, it is well known, he said, that as we ascend we come into layers of air more rarefied and in a different electrical state from our own atmosphere, for instance, the top of Washington Monument—550 feet, shows a potential of 3,000 to 5,000 volts, Eiffel Tower, 1,000 feet, about 10,000 volts potential, and if the same increases as we continue to ascend, it should be about 1,000,000 volts 20 miles up.

From this reasoning, he speculated that the earth was electrically charged like a high condenser with negative electricity, and the upper layers of air highly positively charged with respect to the earth, the dense atmosphere acting as the dielectric. Thunderstorms might be produced by a flow in the dielectric, that is, a portion of the air more rarefied than the rest, which would give an opportunity for potentials to even up and a redistribution to take place. After stating that the potential on a charged body would be greatly increased by the contraction of the body, which of course lessens the capacity by decreasing the surface, he supposes the sun to be electrically charged, the noted disturbances, etc., occurring every eleven years, due to the fact that the contraction of its surface raised the potential enormously, and that a discharge was necessary for an equalization. After the discharge, it took the next period for a like amount to accumulate. The discharge would be conducted outwards by the coronal lines at the time of an eclipse, and so powerfully that after reaching our earth there comes an equalization of potential with accompanying meteorological effects.

Comets, which are rarefied gaseous bodies, might be similarly charged, and coming into contact with one of these rays from the sun, would be luminously affected by a redistribution of its potential. Thus they would be visible to us while passing through the ray only.

Temporary stars might be accounted for in a like manner, and it is quite probable they shine, like brilliant arc lights, during the time they traverse such an electrified medium, and afterwards disappear entirely from our view.

The subject was most interesting and entertaining, even if it was quite speculative and not dignified enough, as the Professor said, to be called theory.

COMMUNICATIONS.

The Vulcanized Fibre Company.

To the Editor of ELECTRICITY.

DEAR SIR: In your issue of December 13 you say editorially: "It would be interesting to know just how much stock in the Vulcanized Fibre Company of Wilmington, Del., is held by Mr. F. H. Webster, the purchasing agent of the General Electric Company, and just how and for what considerations Mr. Webster obtained the same."

As I am in position to answer that question officially, and from my own positive knowledge, I desire to say that neither Mr. Webster nor any other officer, director, agent, or employe of the General Electric Company, or any of its branches, ever held or owned a share of stock in Vulcanized Fibre Company, either directly or indirectly, nor have any of them ever been interested in any way, directly or indirectly, in the business or profits of said company, or received any commission, fee, gratuity, reward, or even social entertainment, from said company or any of its officers or employes. Nor has this company had any oral or written communication with Mr. Webster for the past fourteen months.

Respectfully yours,
WILLIAM COURTENAY, President.
New York, December 22, 1893.

[The above statement from Mr. Courtenay is accepted by us as correct as to all matters to which his knowledge extends, and we regret having done an apparent injustice. In regard to the inner workings of the purchasing agency of the General Electric Company we may have something further to say.—ED.]

Electrical Words, Terms and Phrases.

Desiring to find the definition of the phrase "Johnny, go get your gun, shoot!" which I noticed was used in an electrical journal, I bought an electrical dictionary and looked it up with the following result:

I naturally first looked under "J," where I found "Johnny, shoot, gun, get, your, go, —— ——. (*See* Get, gun, Johnny, go, shoot your ——)." Under this heading I was referred to: "*See* Gun, your, Johnny, go get shot." Under this I was further referred to: "*See* Go Johnny, shoot, your gun," and upon looking this up I was referred back again to "Johnny," where I had started my search. I was told by the author that it was in his dictionary but he did not remember where. Not wishing to go through this cycle again, and being determined to find it, I began at A and read over the whole dictionary, being rewarded at finding *near the end*, under Y, (!) the following: "Your, go get gun, shoot Johnny. —— —— A phrase proposed to signify that Johnny should get his gun before shooting it."

My curiosity as to why this phrase was in an *electrical* dictionary was satisfied when I read on and found the following: "It might be used in electrical writings in case the gun was electrical or Johnny an electrician. It would seem that a more polite phrase would be preferable."

I presume it was my fault for not looking under "Y," but perhaps you can give me and your other readers a general rule to go by which avoids having to read over the whole dictionary.

New York, Dec. 22. AMATEUR.

Boston Notes.

The Union Traction Company of New York and New Jersey have for some time past been figuring on a plan for purchasing the entire system known as the Interstate Electric Street Railway, which joins the States of Massachusetts and Rhode Island, passing through the towns of Attleboro, Wrentham and the cities of Pawtucket and Providence. The purchase has not yet been quite consummated, but is likely to be, and this fact is stirring up the local capitalists a good deal, for many of them are opposed to the sale of the system, believing that such a change would be detrimental to the interests of some of the towns in the district, hence they are having the whole matter carefully examined into by two experts with a view to securing it against being transferred to foreign capitalists.

The Eastern Electric Cable Company has just declared its regular semi-annual dividend of 3 per cent., payable January 1, 1894.

The Christmas decorations in the large dry goods, furniture, jewelry and other stores in Boston are in many respects more attractive than in any former year. Certainly they are much more brilliant than ever, owing to the liberal use of electricity. For both exterior and interior decorations nothing has ever been seen like it. The most weird, uncanny, as well as the most artistic, effects are to be seen here and there, with the result that several of our principal streets are absolutely impassable in the evenings by reason of the wondering and admiring crowds which are everywhere.

With few exceptions the various electrical supply houses and manufacturing firms in Boston are again busy, and feeling themselves in something like their old-time form. Only let the politicians—one had nearly written statesmen—at Washington, define the extent of their tariff reform labors, and the electric business will once more boom.

The rumors which have been rife for several weeks past in and around Boston and Lynn, to the effect that the works of the General Electric Company were to be removed from Lynn to Schenectady, have created quite a stir and commotion. Of course the reports are denied by officials at the works, nevertheless there seems good reason for believing there is some truth in the rumors. Mr. E. Wilbur Rice, Jr., superintendent of the works, is emphatic in denying these rumors as having no foundation. When asked a day or two ago what was the outlook for business at Lynn, his reply was: "I do not know how much business we may do, but our condition will in all probability be like that of the rest of the country; if business is good generally it will be so with us; if, on the contrary, the depression exists for any length of time, we shall, like other concerns, continue to feel the effects of it." Asked about the rumors that the predominant interest in the General Electric Company was opposed to the works remaining in Lynn, Mr. Rice said: "That is pure rot. Our factories are, of course, run in the interest of the corporation, and not for the purpose of benefiting any particular section; but it is a fact that we are getting even more than our share of the work, and rumors to the contrary are utterly false and misleading. The present condition of affairs at Schenectady is, if anything, worse than that here, and I have no doubt whatever that when business revives on a healthy basis we shall get our full share of it." True, Oh King! we shall see what we shall see.

General News.

What is Going on in the Electrical World.

Houston, Tex.—This city has now over fifty miles of electric car lines, comprising twelve different routes.

Worcester, Mass.—The plant of the Leicester Electric Light Company was damaged by fire on the 19th to the extent of $5,000.

Huntington, L. I.—An electric railway from Huntington to Oyster Bay by way of Cold Spring Harbor is projected. The distance is about eight miles.

Westfield, N. J.—A route has been surveyed for an electric railway from Westfield to Millburn. Work will begin on construction early in the spring.

Charlottesville, Va.—D. Harmon, attorney of an incorporated company, has applied to the council for a franchise for an electric street railway in this city.

Columbia, S. C.—The Columbia Street Electric Railway and Power Company have petitioned the council for permission to extend the railway on several streets.

Gloversville, N. Y.—The Gloversville Street Railway Company and the Cayadutta Electric Railroad Company have been consolidated, with a joint capital stock of $350,000.

Cohoes, N. Y.—The contract for putting in the new fire alarm system has been awarded to the Gamewell Fire Alarm Telegraph Company, which agrees to do the work for $6,300.

Jamestown, N. Y.—A fly wheel making 250 revolutions a minute burst on the 15th inst. at the electric light station, doing considerable damage to the plant but injuring no employees.

Elwood, Ind.—A meeting has been held here in which favorable consideration was given to the projected electric railway to Alexandria, and thence to Franklin, a distance of eighteen miles.

Auburn, N. Y.—The Electric Light Company have had a large force of men at work preparing the lines for the prompt fulfilment of their contract for lighting the streets, beginning next month.

New Brighton, N. Y.—The Electric Power Company has come to an agreement with the village trustees and will receive the old price for arc and incandescent lights for the year ending April next.

Geneseo, N. Y.—The people of this village are yearning for electric lights, and are about wrought up to the point of demanding from their hesitating officials the necessary action to obtain them.

Tamaqua, Pa.—The Citizens' Gas Company of this place have sold their plant to Philadelphia capitalists, who will take possession on January 1 and greatly enlarge it and add arc and incandescent electric lighting.

Little Rock, Ark.—The contract for the erection of the new electric lighting plant has been secured by the Fort Wayne Electric Company, the consideration being $26,650. Including the building the total cost of the plant will be $29,875.

Rutland, Vt.—The Marble City Electric Company are hurrying the work on the lines laid out by the Committee on Lights. A large number of men have been employed in erecting poles and making the foundation for the new electric light station.

Geneva, N. Y.—It is reported that plans have been made here for putting on Seneca Lake an electric boat for commercial purposes. The boat is to be 150 feet long, 25 feet wide and 9 feet deep, with 5 feet draught. It will be driven by twin screws.

New Britain, Conn.—The contract for street lighting now held by the Central Railway and Electric Company will expire on the 1st of January. The present contract price is $91 per year each for 96 electric lights, and it is thought the existing service will be continued.

Toronto, Can.—The Reliance Electric Manufacturing Company have petitioned for a franchise for lighting in the section of the city west of the subway. It is the purpose of the company to begin with a small circuit, and gradually extend their wires and business until they will compete with existing companies both in arc and incandescent lighting as well as supplying power.

Terre Haute, Ind.—A. R. Markle, electrician, has purchased the first incandescent light plant introduced in Indiana, and has removed it from the old Hutman building where it was installed. It was brought here in the summer of 1880 at a cost nearly four times as much as the same plant could be purchased for now. The old plant is about as good as when first placed in the building.

Falls Church, Va.—At a meeting of the citizens held on the 18th inst. a resolution was passed asking the council to submit to the freeholders the question as to whether or not they should bond the town of Falls Church for the sum of $10,000, said sum to be paid to the first electric railroad company that would build a road from Falls Church to Washington.

Hagerstown, Md.—The South Mountain Electric Railway, Light and Power Company, which is constructing a railway between Boonsboro and Keedysville, has filed here for record a mortgage executed in favor of the Baltimore Trust and Guarantee Company to secure an issue of bonds to the extent of $100,000.

Manchester, N. H.—At the last regular monthly meeting of the Board of Trade, the following members were appointed a committee to confer with the Haverhill Board on the subject of the proposed electric road: H. D. Upton, Frank W. Fitts, William Corey, Arthur S. Campbell, F. T. Dunlap and Secretary Eastman.

Long Island City, N. Y.—A new corporation has purchased the system of street railways owned and operated hitherto by the Steinway Railroad Company, and will use the trolley on the three routes composing it. Mr. Steinway retains a large interest in the new company, whose directors are Messrs. Babcock, McCabe, Peabody, Pruyn, William Steinway, Cord Meyer, John R. Lamson, Thomas W. Olcott and Eugene S. Bushe.

Syracuse, N. Y.—The Syracuse Heat and Power Company have applied to the common council for permission to use the streets and public places of the city so far as may be necessary for the construction and operation of a suitable plant for generating and furnishing electricity, electric light and electric power. The application is meeting with vigorous opposition from the old electric light company.

Cleveland, Ohio.—To secure an issue of bonds the Cleveland General Electric Company filed a duplicate chattel and real estate mortgage last week with the county recorder. The mortgages represented a loan of $1,000,000 and were drawn in favor of the New York Guaranty and Indemnity Company.—The announcement is made that the Walker Manufacturing Company is to change its cable machinery plant to an electric street railway machinery plant.

Pottstown, Pa.—It is understood that the contract for the construction of that part of the Pottstown, Boyertown and Reading Railway Company's electric road between this city and Boyertown has been let. The officers of the company are: President, James B. Craighead, Philadelphia; secretary, Mahlon G. Taylor, Pottstown; directors, James B. Craighead, J. M. Zook, Philadelphia; Charles K. Spatz, Boyertown; Mahlon G. Taylor, Pottstown.

Middletown, Conn.—The Middletown Electric Road Company will equip with electricity and extend its tracks next spring to Meriden and neighboring suburban villages. When the bridge to Portland is constructed the tracks will be laid across to Portland up along the river, meeting the Glastonbury road. Another winter will see a network of electric roads connecting Hartford, New Britain, Meriden, Middletown, Portland and Glastonbury.

St. Louis, Mo.—Assistant Chief Emile Gross, of the Fire Department, holds the opinion that the present apparatus used in putting out fires is too heavy and cumbersome, and thinks that electricity might do the work in a better way. He says: "I'd have wires come up at every fire plug. . . . A few small power plants scattered about the city would give a continuous current. We would have engines costing not one-half what present engines cost and weighing not one-third. A wire on them would connect with the wire at the plug. The minute the hose was ready the power would be turned on. No coal wagons—no fireman. Economy all around. One horse could take an electric fire engine to a fire."

Sioux City, Iowa.—A company has been organized here by John Pierce, A. E. Pierce, Peter Moller, Chris. Moller and H. A. Johns, to be known as the Consolidated Company. It has absorbed the Sioux City Cable Railway and expects to consolidate all the street railway systems in the city, namely, the Sioux City Street Railway, the Rapid Transit lines, Riverside Electric and Sioux City and Leeds Electric, into one electric system with forty-five miles of line. The company is capitalized at $1,000,000, with offices in New York and Sioux City. The incorporators have deeded property valued at $1,200,000 to the company, consisting largely of desirable real estate.

Philadelphia.—The Electric Traction Company have been experimenting with the storage battery system, and have reached the conclusion that it cannot be utilized on any of their lines. —The *Times* of the 19th says: "The immense value of the trolley system as a money-earner and dividend-maker have been more than demonstrated by the brief experience of the Traction Company's Thirteenth and Fifteenth Streets Line. President Widener stated yesterday that in the two days in which the trolley has been in operation—Saturday and Sunday—the earnings of the line have increased no less than $2,200 and that without any increase whatever in the expenses, making a clear gain of $1,100 per day." —The Philadelphia Traction Company has awarded the contract for the engines and generators necessary to fully equip the central power plant, at Thirteenth and Mt. Vernon streets to the Westinghouse Electric and Manufacturing Company. It will furnish six 1,500-horse power Westinghouse engines, direct connected to six generators of the same power.

Chicago.—"Lake Street Elevated officials," says the *Herald*, "are planning for a downtown loop of their own to extend from the present terminus at Market and Madison streets east to Wabash avenue, north to Lake street on Wabash avenue, and west on Lake street to a junction with its tracks on Market street. If the right of way and an ordinance can be secured the company will change its motive power from steam to electricity and dispose of the steam engines now in use. Before the first day of January, 1894, the Lake Street Elevated Railway Company will submit an ordinance to the city council providing for an extension of its line above detailed."—The Metropolitan Elevated Railroad Company has purchased from the city for $100,000 the electric lighting plant in the block bounded by Throop, Congress and Van Buren streets and Centre avenue as it was in the way of a proposed extension of its line. It is expected that the city will be able to put up a new building, with new machinery, for less than $100,000. There will therefore be left a considerable sum for the extension of the electric lighting system on the West Side.

The Fishkill Landing Machine Company.

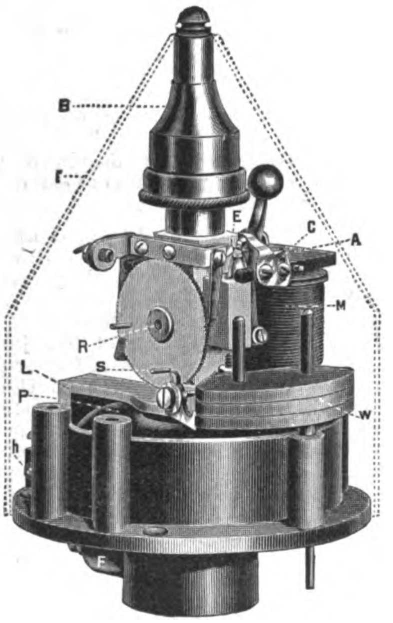
The Fishkill Landing Machine Company, Fishkill-on-the-Hudson, N. Y., builders of the improved Fishkill-Corliss Engine, are doing a large business. Their engines are in demand by all kinds of manufacturers and are also used for electric lighting and street car purposes. The Rochester (N. Y.) Electric Light Company are using a Fishkill-Corliss engine of 500 h. p.

Among the larger engines which they have recently erected are two of 300 h. p. each for the Atlas Cement Company, at Coplay, Pa.; one of 250 h. p. for the Grand Central Palace, New York City, where the World's Fair Exhibition is now being held; one of 175 h. p. for R. M. Wilson, Rome, N. Y.; one 175 h. p. for F. Hosch, Brooklyn, N. Y.; one 250 and one 100 h. p. for the Canda Manufacturing Company's Car Works, at Carteret, N. J.; one 100 h. p. for the Smith Premier Typewriter Company, Syracuse, N. Y.; one 175 h. p. for the Cortland (N. Y.) Wagon Company; one 200 h. p. for David Miller, New York; one 100 h. p. for the Eastman Kodak Company, Rochester, N. Y.; one 300 h. p. for the Metropolitan Realty Company, New York; one 200 h. p. for the National Casket Company, Oneida, N. Y.; one 300 h. p. for the Glen Falls Paper Mill Company, Fort Edward, N. Y.; one 250 h. p. for Kinney Bros., New York; and one each of 300 and 350 h. p. for sugar plantations in Cuba. It will be recalled that the engines for the immense grain elevators of the New York Central and Hudson River Railroad Company, New York City, and the West Shore Railroad, at Weehawken, N. J. (one of 1,000 and one of 800 h. p.), were built by this company, as well as those in use in many of the largest elevators in the Western cities. The officers of the Fishkill Landing Machine Company are Robt. J. Haigin, president; W. F. Sage, vice-president, and Jas. L. Teller, secretary.

A New System of Lighting and Extinguishing Street Gas Lamps Without the Use of Wires.

The Cutler system of gas lighting discards overhead wires and the expensive underground circuit, and adopts an entirely new and inexpensive method. Each lamp is supplied with two sal ammoniac batteries and a spark coil placed in an iron box buried in the ground at the foot of the post. In the lantern is a miniature gas holder about two cubic inches capacity, pivoted on a hinge and held down by weights, and directly over this holder is an automatic gas lighter similar to those used in houses, only much simpler, larger and stronger. Two wires about ten feet long connect the lighter with the batteries through the post. Such an installation is under complete control from the gas works. When it is desired to light the lamps of a city, it is only necessary to open a valve connecting one of the large gas holders at the works direct with the gas mains. This results in a decided increase of pressure in the gas all over the city sufficient to cause all the little gas holders in the lamp posts to lift up about one-eighth of an inch against a platinum stop, and thus close the local battery circuit at each post. The automatic lighter being then supplied with current, immediately turns on and lights the gas.

The cut below shows the lighter. P is the pressure gauge or gas holder sealed with mercury and held down by the weights W. When the gauge lifts, it closes the electric circuit through the magnet M ; the armature A is attracted and caused to vibrate, throwing sparks at E and turning the ratchet wheel R. The first movement of the ratchet wheel admits the gas to a small auxiliary outlet at E, as well as to the main burner. The electric sparks formed at E ignite the auxiliary jet, which immediately shoots up and lights the main burner. As the ratchet wheel continues to turn, the auxiliary jet is closed, leaving the main burner open. The ratchet wheel is finally stopped with the gas turned full on and lighted by a pin in the wheel striking against a stop S attached to the pressure gauge P.



The Cutler Gas Lighting System.

It has been shown in practice that fifteen seconds is amply sufficient for maintaining this increased pressure to give time to make the increase everywhere felt. It can then be brought back to normal pressure when the pressure gauge P will drop back and open the electric circuit. This operation, if repeated, will extinguish the lamps.

The mechanism of the lighter is extremely simple, and made so strong as to insure it from getting out of order or requiring attention of any kind. A heavy cast iron shell, three-sixteenths of an inch thick, shown by dotted lines in the cut, entirely surrounds the mechanism and thoroughly protects it from all kinds of external abuse. No part of the lighter is exposed except the lava tip, which is easily replaced should it become stopped up or broken. An outlet at P provides a passage for pouring in alcohol should the gas freeze in the riser pipe in winter. The iron battery boxes are supplied with covers flush with the ground, which are intended to be removed once a year for cleaning the batteries. This operation constitutes the entire operating expenses.

Complete outfits of this system of gas lighting can be obtained by addressing the manufacturers, the Cutler-Hammer Manufacturing Company, 247 South Jefferson street, Chicago.

The "Mac Tape."

The "Mac Tape" has superior insulating qualities; is guaranteed to withstand the severest climatic changes; is not affected by acids and possesses many meritorious qualities. It sticks to the wire and not to the hands and will not oxidize the wire. Its adhesive qualities are such that it is practically indestructible, and hence will not deteriorate with age. It is specially adapted for armature and field magnet wrapping. When ordering please be careful to state whether black or white is desired. It is put up in ¾ inch widths and in half pound packages. Special widths furnished to order. Beware of imitations. None genuine unless the words "Mac Tape" are on every roll. Made by the Metropolitan Electric Company, Chicago.

INCORPORATIONS.

The American Signal Company, Baltimore, Md.—to manufacture electrical and other machinery. Capital stock, $5,000. Promoters: G. E. Patterson, W. M. Stewart, H. M. Benzinger, G. W. Smith, R. O'Toole.

The Montana Construction Company, Helena, Mont.—to contract for construction of railways and tramways, manufactures of all kinds, water rights, and powers, electric plants and real estate. Capital stock, $150,000. Promoters: Henry Elling, Richard A. Harlow and Samuel Word.

Weaver Electric Company, Jackson, Miss.—to manufacture and sell all kinds of electric and telegraph instruments, invented, improved or acquired by said company. Capital stock, $20,000. Promoters: A. P. Weaver, Wm. Watson, W. W. Stone, W. D. Holder, A. L. Jukiene, R. J. Hardin and T. M. Henry, Jackson.

The Tiffin and Inter-Urban Consolidated Railway Company, Tiffin, Ohio.—to construct street railways, to be operated by electric, steam, cable, horse or other motive power, etc. Capital stock, $800,000. Promoters: Thos. B. Williams, Chas. F. Williams, Frank W. Brihtman, Nelson W. Miller, Meshech Frost, Amandus Betts, Rollo W. Brown and Tunison T. Rosendale.

The Flatbush (L. I.) Gas Company has filed a certificate with the Secretary of State at Albany announcing that it proposes to extend its objects so as to include the manufacture and use of electricity for producing light, heat and power. It also announces that it has acquired the property and rights of the Knickerbocker Electric Light and Power Company of Flatbush. The capital stock of the Flatbush Gas Company has been increased from $150,000 to $200,000.

The Electric Cash Carrier and Change Maker Company, Kansas City, Mo.—to manufacture and sell store service apparatus for making change. Capital stock, $100,000. Incorporators: George P. Gross, Mark Coppinger, Charles A. Gaiser and Charles A. McKiernan, of Kansas City, Edwin R. Gill, of Independence.

The New York and East River Gas Company, New York City—to carry on the business of manufacturing and supplying gas and electricity in New York and elsewhere, for lighting, heating and power purposes. Capital stock, $700,000. Directors: Michael Coleman, Samuel B. Lawrence and William T. Barnard, of New York City; John B. Summerfield, of Brooklyn, and William C. Houston, Jr., of Philadelphia.

The Russ Fender Company (incorporated in W. Va.), Washington, D. C.—to furnish steam, electric, cable and other cars with safety fenders and other appliances to prevent accidents, etc. Capital stock, $250,000. Promoters: Alamando B. Russ, Chicago; A. Hotchkiss, Baltimore; H. H. Blackburn, Washington, D. C.

The Oakland Water Company, San Francisco, Cal.—to supply cities and towns with water and deal in and operate water works, electric light and power. Capital stock, $3,000,000. Promoters: Alviniza Hayward, Andrew Rose, Jr., San Mateo, Cal.; Wm. J. Dingee, Oakland; H. G. Stevenson, Menlo Park; W. E. Sell, Berkeley.

Soldiers' Grove Electric Company, Soldiers' Grove, Wis. —to build and operate an electric plant at Soldiers' Grove, Wis. Capital stock, $1,500. Promoters: Attley Peterson, M. B. Seward, F. P. Priggs.

ELECTRICAL PATENT RECORD.

Letters Patent Issued December 12, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

510,485. Trolley Wire Support. Leroy S. Pfouts, Canton, Ohio. Filed July 19, 1893.
510,600. Speed Reducing and Power Multiplying Hydraulic Gear for Electric Railroad Cars. William Hochhausen, Brooklyn, N. Y. Filed Dec. 26, 1890.
510,634. Electric Railway Conduit. William R. DeVoe, Shreveport, La. Filed July 20, 1893.
510,647. Conduit Electric Railway. John P. Michiell, San Francisco, Cal. Filed July 14, 1893.
510,661. Electric Car Truck. Charles P. Winkler, Troy, N. Y. Filed Nov. 26, 1892.
510,850. Closed Conduit System for Electric Railways. Robert A. Elliott, Birmingham, Ala. Filed July 5, 1893.

ELECTRIC LIGHTS AND APPLIANCES.

510,486. Electric Lamp Support. James J. Renehan, New Britain, Conn. Filed March 20, 1893.
510,479. Electric Light Tower. Hiram Jones, Detroit, Mich. Filed March 10, 1893.
510,605. Electric Arc Lamp. Jesse F. Keser, La Grande, Ill., assignor to the F. P. Little Electrical Construction and Supply Company, Buffalo, N. Y. Filed April 24, 1893.

MOTORS, DYNAMOS, ETC.

510,460. Dynamo-Electric Machine. David H. Wilson, Chicago, Ill. Filed Dec. 27, 1892.
510,465. Regulator for Dynamo-Electric Machines. Louis Bell, Boston, Mass., assignor to the General Electric Company, same place. Filed April 3, 1893.
510,472. Dynamo-Electric Machine. Rudolf Eickemeyer, Yonkers, N. Y. Filed May 23, 1889.
510,487. System of Electric Distribution. Edwin W. Rice, Jr., Swampscott, assignor to the General Electric Company, Boston, Mass. Filed July 10, 1893.
510,534. Rotary Current Motor. Johannes H. F. Gorges, Berlin, Germany, assignor to Siemens & Halske, same place. Filed April 30, 1891.
510,596. Reversing Switch for Electric Motors. John G. Germann, Erie, Pa. Filed April 19, 1893.
510,601. Alternating Current Motor. William Hochhausen, Brooklyn, N. Y. Filed Sept. 4, 1891.
510,602. Dynamo-Electric Regulator for an Engine Driving a Generator. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Oct. 29, 1892.
510,603. Power Applying Device for Electric Motors. Arthur H. Johnson, Rahway, N. J., assignor to the Hall Signal Company of New York and Maine. Filed Dec. 15, 1892.
510,662. Electric Motor. Charles F. Winkler, Troy, N. Y. Filed Dec. 24, 1892.

TELEPHONE AND TELEGRAPH APPARATUS.

510,430. Telegraph or Telephone System. Wallace R. Kirk, Kansas City, Mo. Filed Nov. 3, 1892.
510,508. Simultaneous Telegraphy and Telephony. Silas W. Holman, Boston, Mass. Filed May 31, 1893.
510,535. Telephone Toll Apparatus. William Gray, Hartford, Conn., assignor of one-half to Charles Soby, same place. Filed May 21, 1889.
510,612. System of Telegraphy. Charles J. Reed, Orange, N. J., assignor of one-half to Gustav Stahl, Philadelphia, Pa. Filed April 12, 1892.
510,863. Telephone Exchange System. William W. Jacques, Newton, assignor to the American Bell Telephone Company, Boston, Mass. Filed Dec. 1, 1892.

BATTERIES.

510,604. Electric Battery. Louis F. Johnson, Poughkeepsie, N. Y. Filed July 11, 1893.
510,808. Machine for Making Storage Battery Grids. Robert M. Lloyd, New York, N. Y. Filed Oct. 31, 1892.

MISCELLANEOUS.

510,417. Range-Indicator. Bradley A. Fiske, U. S. Navy. Filed March 3, 1893.
510,418. Position-Finder. Bradley A. Fiske, U. S. Navy. Filed April 10, 1893.
510,457. Electric-Call System. Samuel Whitehall, South Bend, and Euphrates W. Whitehall, Attica, Ind. Filed March 7, 1893.
510,466. Electric Fan. Edwin H. Bennett, Jr., Bayonne, N. J. Filed October 17, 1891.
510,533. Electric Switch. Jacob S. Gibbs, Hartford, Conn., assignor to the Perkins Electric Switch Manufacturing Company, same place. Filed March 15, 1893.
510,540. Push-Button. Rudolph M. Hunter, Philadelphia, Pa. Filed April 3, 1891.
510,613. Magneto-Electric Induction Apparatus. Chas. J. Reed, Orange, N. J., assignor of one-half to Gustav Stahl, Philadelphia, Pa. Filed Sept. 10, 1892.
510,640. Electric-Current Transformers. William H. Hornberger, Elkhart, Ind. Filed March 31, 1893.
510,646. Automatic Circuit-Controller. Charles L. Mayhew, Saratoga Springs, N. Y. Filed May 26, 1893.
510,759. Aerial Camera. Cornele B. Adams, Augusta, Ga. Filed Feb. 10, 1893
510,777. Apparatus for Heating Metals Electrically. Chas. L. Coffin, Detroit, Mich. Filed July 8, 1893.
510,809. Insulator-Pin. Fred M. Locke, Victor, assignor of one-half to George A. Paddock, Auburn, and Willard C. Page, Palmyra, N. Y. Filed April 5, 1893.
510,834. Process of and Apparatus for Dissociating Soluble Salts by Electrolysis. Henry S. Blackmore, Mount Vernon, N. Y. Filed March 16, 1893.
510,862. Regulating Parallel-Circuited Alternate-Current Machines. Carl Hoffman, Berlin, Germany. Filed Sept. 28, 1893.

RE-ISSUE.

11,395. Electric Snap-Switch. Gerald W. Hart, Windsor, assignor, by direct and mesne assignments, to the Hart & Hegeman Manufacturing Company, Hartford, Conn. Filed Feb. 13, 1893. Original No. 459,706, dated Sept. 15, 1891.

To Inventors and Others.

United States and Foreign Patents Procured.

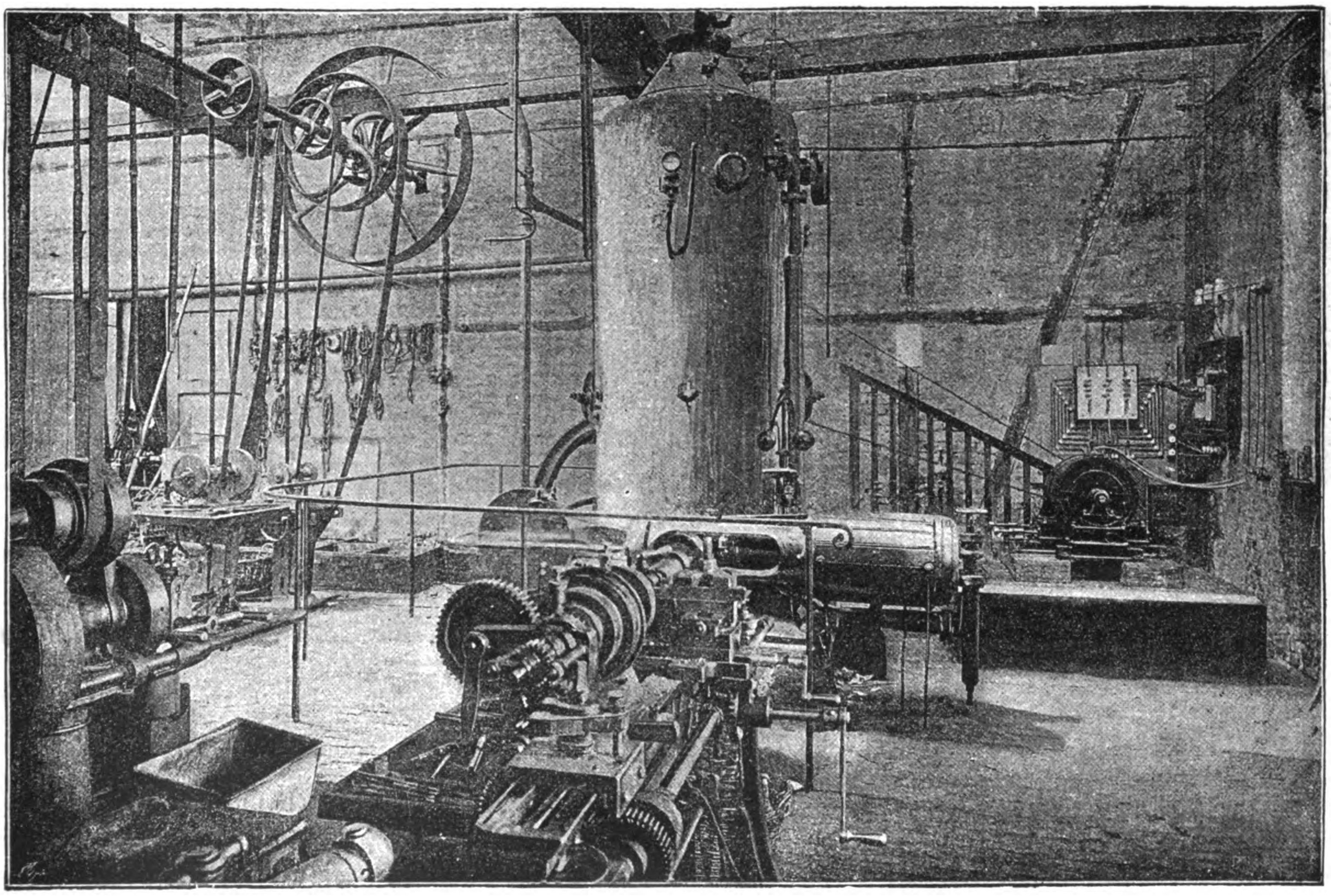
A PATENT DEPARTMENT has been established in connection with the publication office of Electricity, for the transaction of all business connected with the procuring of patents on inventions and devices of all classes. The object is to furnish inventors and others, at moderate cost, with a reliable, well-equipped and accommodating bureau through which they may be aided in procuring United States and foreign patents and obtain all information necessary to a successful prosecution of their claims.

Immediate attention will be given to inquiries and orders by addressing

T. F. BOURNE,
Manager Patent Department Electricity,
6 Park Place, New York City.

ELECTRICITY.

Vol. V. New York. JANUARY 3, 1894. Chicago. No. 25



SCREW FACTORY, RUN WITH TRIPHASE MOTOR. (See Page 294.)

The Bockenheim Triphase System.

The distribution of current by the multiphase alternating system is still a comparative novelty in the electrical field, and plants operating on this system are therefore of special interest at this time. Such a one is in operation in Bockenheim, Frankfort, which includes what might be called a mixed system, the long distance transmission being on the multiphase plan and the local distribution being with continuous currents.

The building in which the station is situated comprises two main rooms separated by a partition wall, the first being occupied by the boilers and the second by the machinery. The boiler house also contains the accumulator room, office and store-room.

The boilers, of the tubular type, are two in number, having 95 square meters of heating surface, and are worked at 150 pounds pressure. A reserve space has been provided for two extra boilers of the same size. The boiler feed is supplied by a steam pump and two injectors. The water which serves the condensers is carried to an apparatus in which it is cooled at the rate of from 50 to 60 cubic meters an hour and is then returned to the source of supply.

There are two engines, each having a capacity of 250 horse power, of the tandem compound type, and are run condensing. These are made by Pokorny & Wittekind, of Bockenheim. The diameter of the high pressure cylinders is 40 centimeters and that of the low pressure 60 centimeters, length of stroke 85 centimeters, and speed 100 revolutions per minute.

Each of the engines is coupled direct to a triphase dynamo of 130 K. W. at a pressure of 80 volts, and also drives by means of a belt a continuous current machine of 36.8 K. W. capacity at 110 volts. From the latter a continuous current is supplied to the 48 poles of the triphase machines by which their fields are excited. The direct current machines are of the Lahmeyer system, and a general view of the station is shown in Fig. 1.

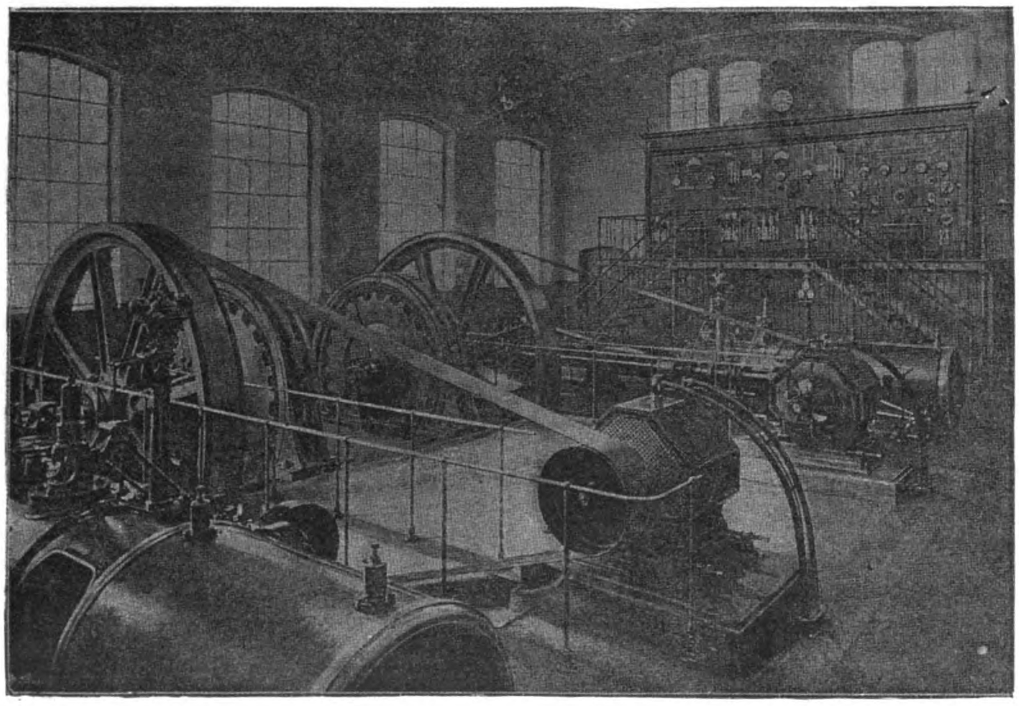


FIG. 1.

The distributing system includes both the direct and triphase. The two direct current machines are coupled in parallel and are led to the bus bars on the switchboard, from which the outside system is supplied directly, and a battery of accumulators and the fields of the triphase machines are also run on these machines. Either the dynamos or the battery can be used to supply the exciting current.

Each of the triphase dynamos are connected to a set of distributing bars by three lines in one of which an ampere meter is placed and each of which has a switch. These are the low tension bus bars, having only 80 volts difference of potential between them. There are phase indicators which are connected with both machines in order to facilitate the operation of throwing the dynamos in parallel.

Three other bus bars are placed near the point where the triphase circuit leaves the building, and these are connected to the low tension bars by means of transformers which raise the voltage from 80 to 700 volts, at which pressure the current is distributed.

The accumulators are of the Tudor type and there are 64 cells in the battery. Its capacity is 450 ampere-hours and its maximum discharge 143 amperes.

The lines for the continuous current distribution are lead-covered cables buried in the ground without further protection. The cables for the triphase system are also lead-armored cables but with concentric conductors having a cross section of 3.7 square millimeters. In the outside of the city, which is a manufacturing district, aerial wires have been run with bare copper, which largely reduced the cost of construction. Thomson lightning-arresters are placed at intervals along this part of the line.

About 1,200 meters from the central station is a sub-station which contains two transformers of 25 K. W. capacity each. One of these is in constant use and the other is held in reserve. They convert the high tension triphase current into a low tension direct current which is used for local distribution. The converter is a dynamotor in which the motor armature is run by the triphase system and drives a direct current generator armature. In this way the triphase system is used simply to transmit the power over long distances while the distributing lines are run on the usual low tension direct current system.

This station is of interest on account of the various applications of electric motors which have been made there. The type of motors usually employed are connected directly to the mains of the triphase system without the interposition of transformers, and from a practical standpoint this operation has been very satisfactory, their care only demanding the replenishing of the oil cups every two or three weeks. The service already includes about 15 triphase motors of capacities varying from 3 K. W. to 15 K. W. which are in use in the neighboring manufacturing and machine shops. The Frontispiece shows a screw factory in which the steam engine has been replaced by a triphase motor. A number of direct current motors are also in use on the low pressure system.

The price of the current is graded for different kinds of service, lighting, constant current motors and multiphase motors being fixed at different prices, which are subject to discounts varying from 7 per cent. to 30 per cent. according to the length of time and the amount of power supplied.
—*L'Industrie Electrique.*

University Extension in the Electrical Field.

The Brotherhood of Electrical Workers Inaugurates a Progressive Educational Plan.

Local Union 3 of the Brotherhood of Inside Electrical Workers has taken the lead in a new movement looking to the intellectual benefit of its members, and for some time to come the course of lectures which its members have helped to bring about will be the centre of interest among a large number of practical workers.

The union has organized a club under the name of the Electrical Workers' University Extension Club, with 400 members, under the auspices of which there will be given, with the co-operation of Columbia College and President Seth Low, a course of ten lectures on electricity and its practical uses, the first of which will be delivered in Cooper Union on the 15th instant.

President Low has contributed $1,000, and the various firms of the Electrical Contractors' Association have also contributed generously. The union's club has raised $800 for the course, each member taking a ticket at the rate of $2 for the whole ten lectures.

That part of the public which is interested will have to pay 25 cents admission to each lecture.

After the first discourse a class will be organized for those who wish to follow up the lectures. The class will be under the direction of W. H. Freedman, tutor of electricity in Columbia College.

A prominent officer of the union says: "It is the ambition of Local Union 3 to rise above strikes and boycotts, and to educate its members for their own good. The strikes of 1892 cost this union $25,000, and the return was comparatively small. The foundation of the present educational movement was the establishment of an examining board last July.

"The electrical trade," he continued, "is second to none in its demands upon the intellectual ability of the workman as well as his mechanical skill."

First Lecture—C. O. Mailloux, "Batteries: primary, secondary and thermo."
Second Lecture—S. S. Wheeler, S. C., "Dynamos and Motors. Direct current."
Third Lecture—W. F. Stanley, "Dynamos and Motors. Alternating current."
Fourth Lecture—A. E. Kennelly, "Electrical Measurements."
Fifth Lecture—F. B. Crocker, "Lighting."
Sixth Lecture—Nikola Tesla, "Power."
Seventh Lecture—T. C. Martin, "Street Railways."
Eighth Lecture—W. Maver, Jr., "Telegraphy."
Ninth Lecture—Also by Mr. Maver, "Alarms."
Tenth Lecture—J. J. Carty, "Telephones."

A Large Contract.

The contract for the structural steel to be used in the construction of the immense new plant of the Westinghouse Electric and Manufacturing Company at Wilmerding has been awarded to the Carnegie Steel Company.

There were several bidders and the competition was extremely lively. Carnegie & Company's figures were considerably under those of the other firms.

PATENT LITIGATION.

A Final Effort to be Made to Crush Competition.

PAPERS ALREADY PREPARED FOR A VIGOROUS CAMPAIGN.

INJUSTICE AND WEAKNESS OF THE PATENTS.

Is the General Electric Company Digging its Own Grave?

I····THE EDISON FEEDER AND MAIN PATENT.

In the issue of ELECTRICITY for December 27 our views on patent litigation were plainly expressed. We have been made aware during the past week that a large proportion of our readers agree fully with our view of the case. Not so the General Electric Company.

It is now the well-matured plan of this company to practise rigid economy in all departments save one, the *legal department.*

New arrangements with counsel have been made, and explicit orders have been given for a vigorous and relentless campaign of patent litigation. Manufacturers, contractors, and users are all to be sued, and with as much celerity as is possible. A half dozen suits have already been begun on other than lamp patents, and twice as many more are already prepared and will no doubt be announced early in January. It is the firm conviction of the New York element in the management that by a multiplicity of suits the desired monopoly may yet be achieved, and that even if the campaign fail ultimately, contractors and builders will be thoroughly intimidated, and will at least purchase no new apparatus from the manufacturers who are under suit.

The situation is in our judgment more critical than at any previous time in the history of the General Electric Company.

There is only one plan possible whereby the business of independent concerns can be saved from irreparable injury and an open market for their wares retained: they must stand shoulder to shoulder, united in defence against the attacks of a common enemy. Many of the patents which the General Electric Company seeks to sustain, and upon which these suits are based, are positively ridiculous, and an intelligent and honest defence is all that is required for their overthrow; but the small contractor cannot and should not be expected to make the defence without the assistance of others who are in equal danger from suits later on.

The General Electric Company is evidently not discouraged by the unfortunate results of the lamp litigation, and has learned nothing of wisdom therefrom.

The feeder and main patent already has a decision of a United States Circuit Court Judge in its favor, however unjust that decision may seem to practical men. Other patents to be fought over are the Edison patents on compound wound machines, the three-wire system, sockets, cut-outs, and even fuses.

In the line of its established policy to do whatever is possible to bring about a new era in the business, when patent extortion and injustice may be wiped out forever, ELECTRICITY will consider carefully the merits of these various patents, trusting that we may be able to throw some new light on the subject.

The first article of the series will be devoted to the

FEEDER AND MAIN PATENT

and a review of the Trenton case, as follows:

The interest which was aroused last winter by the trial of the case of the Edison Electric Light Company against Westinghouse, Church, Kerr & Company, involving the validity of the patent of Thomas A. Edison on what has become known as the "Feeder and Main System," culminated in the decision of Judge Green upholding the patent.

Important as this decision was thought to be at the time, its full force was probably not appreciated until recently, when the General Electric Company sought and obtained an injunction against a contractor because it appeared that in the fulfilment of a contract which he had taken he *intended* to use methods which in accordance with Judge Green's decision were infringements of the patents referred to.

The claims relied on by the complainant read as follows:

1. A consumption circuit, in the main conductors of which the drop in tension is not sufficient to vary practically the candle power of the lamps connected therewith, in combination with feeding conductors connecting the consumption circuit with the source of electrical energy, and having no translating devices connected therewith, the drop in tension upon such feeding conductors not affecting the relative candle power of the lamps of the consumption circuit, substantially as set forth.

2. A consumption circuit, in the main conductors of which there is a definite small drop in tension, not sufficient to vary practically the candle power of the lamps connected therewith, in combination with feeding conductors connecting the consumption circuit with the source of electrical energy, and having no translating devices connected therewith, the loss upon such feeding conductors being greater than upon the main conductors of the consumption circuit, substantially as set forth.

3. The combination of a consumption circuit, in the main conductors of which the drop in tension is not sufficient to vary practically the candle power of the lamps connected therewith, with a feeding circuit having no translating devices, and extending from the source of electrical energy to the centre of the consumption circuit, substantially as set forth.

The patent in question was granted to Edison on September 19, 1882, and the alleged infringement was the construction and operation of an electric light plant in the city of Trenton, N. J. Judge Green's decision was filed in the United States Circuit Court at Trenton, April 10, 1893.

It was evident that if Edison's patent was valid it practically controlled not only the distribution of current for lighting purposes but also for power where the multiphase arc system is used.

The defendants by their answer denied infringement and insisted that there was no patentable novelty in the alleged invention, contending that it had been anticipated by various preceding patents, viz., of Werdermann, Lane Fox, Khotinsky and Sawyer & Man, and had been described in numerous scientific and technical publications (the description of the method of distribution of current to the electro-plating tanks of the Roberts & Havell plant, devised by Edward Weston, which appeared in the *Scientific American*, being an instance in point), and that the systems of gas and water supply now customarily in use in large cities were entirely analogous and similar to the scheme devised by Edison for electrical distribution.

Judge Green, after having heard a great deal of "expert" testimony on both sides, rendered a decision which had no uncertain sound, upholding the validity of the Edison patent, and so far-reaching has been this decision that it seems that any one *intending* to erect an incandescent lighting plant may be enjoined or restrained from proceeding to carry out his intention, without a hearing, under penalty of contempt.

Inasmuch as the feeder system is now almost universally used in the distribution of current for incandescent lighting, if on final hearing in the higher courts Judge Green's decision is affirmed, it means disaster to everyone engaged in this business who has not made his peace with the General Electric Company, or so at least they would have it understood.

It therefore becomes of interest to study the reasons upon which Judge Green founded his opinion, to discover, if possible, some hope for a reversal on appeal. Fortunately for us, he has given them at length in his Opinion, which fills a pamphlet of 48 pages, in which he gives in clear and unmistakable terms the testimony that led him to his conclusion.

Unversed in science himself, as he freely admits, he has had to rely upon the statements of so-called expert testimony, and that which impressed him the most, whether logical or not, was that which governed.

This brings us at once to the question of the weight which should be given to expert testimony. Of the value of *disinterested* expert testimony there can be no question, but we have little of that now before the courts, and there was none in the case in question. When the so-called expert is hired by and paid by either side he is neither hired nor paid to give disinterested testimony, nor is he longer a disinterested party. He is hired and paid, like the attorneys in the case, to present in the best possible form that side of the question and those facts which will assist his client the most. He not infrequently directs both the examination of the witnesses and the general conduct of the case, and in this way becomes an advocate for his client just as truly as are the attorneys. Why then should his statements be given any more weight than those of the attorney?

Let us see what the sources of inspiration were that influenced Judge Green's mind.

The leading experts for the General Electric Company were W. J. Jenks, Lord Kelvin and Dr. C. F. Chandler. These three were more frequently quoted in Judge Green's Opinion than any other witnesses on their side. Mr. Jenks, as is well known, has for years been a salaried employee of the plaintiff company, one of his chief duties being on occasions of this kind to appear in the rôle of an expert witness in behalf of the Edison interests, and that his services have been retained so long speaks well for his fidelity to his duties. That he is an expert in some things, and an honorable gentleman, there is probably no question, but that he is an *electrical* expert on whose testimony far-reaching judicial opinions can be safely founded, no man of prominence in the electrical field would for a moment admit. In fact, he so far disabused the electrical world of any such notion, if it ever existed, by a communication to one of the electrical journals about the time that this suit was pending, in which he showed his absolute ignorance of the very A B C's of electricity, that it would seem he would never again attempt to instruct a judge or a jury.

Lord Kelvin is a man whom the whole world delights to honor, and there is no one now living who has done more for the advancement of abstract science than he, or whose name is more intimately associated with its progress than his. The weight of his testimony is therefore deservedly great, but his testimony was obtained for the plaintiffs by this same Mr. Jenks, who went to England for the purpose, and he was therefore presumably retained by that side.

When Lord Kelvin stated in substance that to the best of his knowledge there was no practicable method known to science of distributing current to incandescent lamps prior to Edison's invention of the feeder system, though this was testimony of a purely negative character, it must naturally have had great influence upon those who suppose that because a man is eminent in one branch of science, or in many, he must be conversant with every development in that science, or the many. But even Lord Kelvin is fallible, and the fact that he did not know that such a system was in existence before the issue of the Edison patent is not conclusive evidence that it did not exist. As evidence of his fallibility may be cited the enthusiasm with which he proclaimed the accomplishment of a great scientific triumph, when in 1881 he exhibited the little storage battery of Faure with its 1,200,000 foot pounds of electrical energy, that he had carried across the Channel to England. These large figures and his enthusiasm set investors wild, who did not know that the former represented but about the same amount of energy as is locked up in a half ounce of good coal, and that the latter was due to a remarkable ignorance of easily ascertained facts; but the result was, as one writer expresses it, that "the shores of Old England are strewn with the wreckage of secondary battery ventures, and the bones of many a victim lie bleaching in the sun."

Nor has he alone shown himself fallible in his knowledge of the practical application of electricity, with which he has had far less to do than with the more purely theoretical or scientific. There is no branch of electrical development with which Lord Kelvin's name is more closely identified than that which includes instruments of precision for the measurement of the current and other electrical phenomena. In these the question of suitable materials for resistances is of paramount importance, and the world has been striving for years to discover a substance whose temperature coefficient should approach more closely to zero than German silver or platinoid. Since the accuracy of these instruments, the designing of which has formed an important part of Lord Kelvin's life work, depends very largely upon the discovery of a metal or alloy which has a very low temperature coefficient that is constant through a reasonably wide range of temperature, one would think it entirely safe to assume that Sir William Thompson, or Lord Kelvin as he is now called, would know everything that had been accomplished in that line. But it seems that his knowledge even in this, his own special line, is deficient. Some time ago several of Prof. Von Helmholtz's assistants in the Physikalisch Technische Reichsanstalt at Charlottenburg undertook in their official capacity to investigate what had been accomplished in the production of substances having low temperature coefficients, and among others tested by them were three alloys invented some years ago by Edward Weston and *patented* by him, two of which *had a temperature coefficient of zero*, and the other a *small negative coefficient.* These qualities had been claimed by Weston in his patents, and the tests made by these scientists confirmed the remarkable claims that had been made for them, and in their report they so stated officially. Lord Kelvin, in referring to the work of the Reichsanstalt on a recent public occasion, spoke of the *discovery* by these gentlemen of alloys having a zero temperature coefficient, and of one having a coefficient with a negative sign. These gentlemen, however, had not been appointed to the task to discover anything new, nor did they claim to have done so. They gave Mr. Weston the credit of the discovery, though perhaps not in as pronounced a manner as justice would demand, yet Lord Kelvin, if he had been called to testify in court as to whom belonged the glory of this most important discovery—to the assistants in the Reichsanstalt or to Mr. Weston—would have lent the full weight of his mighty name to the former by answering that "so far as my knowledge goes there was no such thing as an alloy having either a zero or negative temperature coefficient known to science prior to the investigations of Prof. Von Helmholtz's assistants in the Physikalisch Technische Reichsanstalt."

It will thus be seen how cautious we must be in assigning importance to testimony of a negative character even when it is given by such a great man as Lord Kelvin.

The third expert for the plaintiff was Dr. C. F. Chandler, who is so well and so favorably known in the domain of chemistry. In his testimony he maintained that the feeder system involved central station control or regulation of the current, and apparently convinced the Judge that it did, though the patent in suit is silent on that subject. In other respects he proved a good witness for the defence, as shown below:

425 x Q.—"Is not the distributing system shown in Fig. 13 of the Werdermann English patent and in the figures of the two Werdermann publications in evidence subdivided into two circuits, one of which constitutes the lamp circuit and the other a supply circuit, *not directly connected with any lamps, and the drop in tension upon which does not affect the relative candle power of the lamps ?*" (This is Claim 1 of the patent.)

A.—"IT IS."

426 x Q.—"If it were assumed that some or all of the lamps supplied by the Werdermann distributing system referred to were at a considerable distance from the dynamo, and that the conductors directly connected to the lamps were made sufficiently large, would not the system embody the third and fourth conditions set forth in your answer to cross question 422 ?"

A.—"*I do not see why it would not.*"

427 x Q.—"If the Werdermann system referred to, under the assumptions of the last question, were used for operating a large number of incandescent lamps of such construction as to be capable of being turned on and off independently by the consumer, would not this system also embody the first and second conditions stated in your answer to cross question 422 ?"

A.—"*I do not see why it would not.*"

428 x Q.—"Then, as I understand you, if the distributing system shown in Fig. 13 of the Werdermann English patent were applied to operating a large number of incandescent lamps, so constructed that they could be turned on and off independently, and some or all of which were at a considerable distance from the dynamo, and if the parts of the conductors directly connected to the lamps were made of sufficient size, the system would embody the four essential conditions of the patent in suit, to which you refer in your answer to cross question 422 ? Is that your opinion ?"

A.—"It would, assuming that the number of lamps is sufficiently large, and the distance is sufficiently great to develop the difficulties of drop in tension, referred to in the specifications of the patent in suit. I would further say that in stating the conditions in my answer to cross question 422 I omitted to mention one point which I think is implied in the first three claims, which is, that the loss on the supply conductors and the mains together would be sufficient, if the lamps were placed on the supply conductors as well as on the mains, to affect the relative candle power of the lamps."

429 x Q.—"If this last condition were present also, would the Werdermann system referred to embody all the essential conditions of the patent in suit as you understand the same ?"

A.—"*I do not see but that it would if it complied with all the conditions stated in the last two questions.*"

Essentially the same questions in regard to the Khotinsky French patent brought out the same admissions. It will be observed in this connection that if these conditions must be written into either of these two patents to make them operative, they must also be written into the patent in suit to make it operative, and Prof. Chandler's admissions would therefore seem to be admissions that these two patents *were anticipations* of Edison's patent.

In regard to the methods employed for equalizing the potential in galvanoplastic operations, which it was urged anticipated Edison, Judge Green says (Opinion, p. 31): "It is difficult indeed to see the least possible analogy between a bath, or a vat, or a tank, containing metal in solution through which an electric current is to be passed, first for the purposes of decomposition, and secondly for a fixing of the decomposed molecules of the metal upon an object temporarily placed in the bath, with a system of electric conductors, feeding and consumption, running for miles, perhaps, *through thickly settled territories*, having upon the consumption circuit incandescent lamps permanently fixed and in large numbers, usable at pleasure and wholly beyond the influence of 'drop in tension.'"

In electro-plating the success of the process is absolutely dependent upon a uniform distribution of potential over the whole surface of the object being plated. If there be but one article in the bath an equal potential must be brought to every surface molecule of that object or the process is a failure. If there are many objects in the same bath the same requirements must be fulfilled for each article as for each surface molecule of the individual piece, and the limits between which a variation is permissible are very minute as compared with those allowable in incandescent lighting. In fact, the requirements in such cases are by far more exacting than those of current distribution for lighting purposes. The same methods to accomplish this distribution as patented by Edison were used prior to his patent, and the methods of proportioning the wires for this purpose was known and arrived at through theory as well as by the teachings of practice. Edison said no more than was already known. His method was to have a feeding circuit in which there should be no translating devices, so arranged thus that however great the drop might be it should not affect the relative pressures upon the translating devices connected to the consumption circuits, which should be of such a size that the drop in the latter would not vary the pressure practically at the terminals of the numerous translating devices connected thereto. A definite object is obtained in a definite way. The same object is in view in electro-plating, and it is accomplished in the same way exactly, only the methods employed in the latter are a refinement, or of a higher type, than in the former, because the permissible variation in an electric lighting circuit would be fatal in electroplating. If, however, they were the same, what difference can it possibly make *what* translating device receives the current? And what earthly bearing has the Judge's statement upon the case that the lighting circuits often run "through thickly settled territories?"

Mr. Weston testified that prior to 1880 he planned and erected a large electro plating works for Roberts & Havell, in which there were a number of depositing tanks, and that the circuits for these were so arranged as to equalize the pressures throughout all of the tanks. Prof. Chandler testified that it seemed *probable* that the consumption mains in this case were made relatively very large for purposes of mechanical strength rather than with the view of equalizing the pressure, and this view Judge Green seemed to take *notwithstanding* the *positive statements of Mr. Weston* that he proportioned them large for the same reason, well known to him at the time, that caused Edison to introduce this feature into his patent.

Judge Green also assigns as a reason why electro-plating practice cannot be compared with lighting practice, that in the former the *electromotive force* "*is of so* LOW *a tension* that it would *be utterly futile to consider it as a possible factor in electric lighting.*"

What a remarkable statement to base an opinion on! Every electrician in the land knows that the difficulties are enormously increased as the tension becomes lower. Every electrician in the land knows that any method of regulation or equalization that will be effective where low tensions are used will be far more efficient as the tensions increase, and that if the tensions permissible were high enough there would be no occasion to use Edison's feeder and main system, or any other system of equalization.

As regards the analogies between gas and water distribution and electrical distribution, which are so close that the law of flow of the latter is expressed in units of the same kind as those used in the two former, the learned Judge quotes Lord Kelvin at length, to show minor differences, who says: "The translating devices used for the electric light *are utterly and essentially different from anything used in gas lighting.*" (The italics are Judge Green's.) But what difference does it make *what* the character of the translating devices is so long as the features of distribution desired obtain? And again he says:

"*There is absolutely no analogy in gas to the electric bridge from one main to another main, such as is constituted by the incandescent light.*" (Italics again Judge Green's.)

If there is no close analogy with gas there certainly is with water, for how does the bridge of water issuing from the faucet and gradually finding its way back to its source by percolation through the earth or otherwise, differ from the electric bridge whose current finds its way back by a second conductor? The analogy is very close between the two, and especially so where a ground return is used for the electric circuit.

Again Lord Kelvin is quoted: "The incandescent light has no regulator in connection with it; it is either off or on."

Lord Kelvin must have forgotten that there are electric lamps provided with just such regulators, and that they are articles of regular manufacture and sale and use in this country if not abroad, but his object was to show that because the consumer of gas had a means of regulating the supply, and the consumer of electricity had not, the requirements of equalization of pressure in the former distribution were not so rigid as in the latter. The Judge quotes Lord Kelvin also for this purpose, yet it has been shown that he discarded the electro-plating system for just the reverse fact, that because of the *low* tension the nicety of regulation required was incomparably greater than that required for lamps.

But when all has been said as to the difference between the flow of different fluids through different classes of conduits, the fact remains that they all conform to Ohm's law, which reads that the rate of flow bears some definite relation to the pressure and the resistance. Different constants or factors must be introduced into the equation for each particular fluid and for each kind of conduit, but the fundamental law is essentially the same. No one will probably deny that Ohm's law holds good for alternating currents, but here the law is modified by the substitution of the square root of the mean squares of the impressed electromotive forces for the impressed pressures, viz., the effective head is substituted for the actual head, and a factor is introduced which differs with each frequency, but how does this differ from the law governing the *flow of water or gas?*

But there are some other facts in the history of electrical development having a most important bearing on this case, which for some unexplained reason were not put in evidence before Judge Green.

It is well known that Edison's application for a patent in Germany in 1882 on this same system was denied. The reasons for rejection of the application were briefly these, as given by the Imperial Patent Office:

"The application contains *no new ideas* for which patent protection is applied for, but treats exclusively upon the scientific question, how the conductors are to be arranged so as to provide with the minimum of conducting material many branch conductors from one electrical source with as even as possible a current. This every electrician intends to do, and solves the question by the *use of generally known scientific principles and methods.*" It is then stated that the basis for this figuring which every educated electrician uses are given in "Kirchoff's Laws on the Distribution of Current," which was published in every physical text-book at that time, and taught in every technical school. It was also stated as a sufficient reason for refusing the application that by the patenting "of such generally known scientific construction principles, industry would be completely restricted."

"The patenting of the principle that the section of the feeding or conducting wire must be in proportion to the strength of the currents which flow through the same, would," say the records, "mean about as much as though somebody would take a patent on the principle that when draining the soil the section of the ditches must correspond to the amount of water which flows through the same."

Edison appealed against this ruling, and the matter was again considered. This appeal is interesting reading, but too long for insertion here. It was again rejected, the following objections having been filed:

"Kirchoff's theories give in fact all the means of arranging the conductors, even in the most complicated cases, so that every lamp receives the same current." And as evidence of prior use, the employment of the system in exploding mines was cited; a circular bearing date of 1870 decribing its employment for other purposes was enclosed; a sketch of its use in 1879 on an electric railway at the Berlin Industrial Exhibition was also enclosed, with the asseveration that the system was "entirely identical with Edison's," and so on, mentioning Gulcher's* lighting system and the system employed to supply current to systems of electric clocks as all being anticipations, and concludes the statement as follows:

"From the above it seems to us as not permissible to patent the means known to every expert to obtain known results in a special case, that of incandescent lamp lighting."

The first decision rejecting the application for patent was confirmed for the following reasons:

"The device mentioned in the two claims recently filed is to be considered as an arrangement of the conductors of an electrical current which is known to every expert and that is generally in use in exploding mines and in electrical clock systems where every working point must receive the same current. The arrangement of the conductors, shown in Fig. 9 of the application, coincides exactly with that which was used in the first electrical railway by Siemens & Halske during the Berlin Industrial Exhibition of 1879. No patentable novelty can be seen in the transfer of this device to special lighting purposes."

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* Zeitschrift of Applied Electrical Theories, 1881, No. 20, pp. 392-3.

Franklin Institute Prizes.

The attention of ingenious men and women is hereby directed to the fact that the Franklin Institute of the State of Pennsylvania for the Promotion of the Mechanic Arts may grant, or recommend the grant of, certain medals for meritorious discoveries and inventions which contribute to the promotion of the arts and manufactures.

The character and conditions of these awards are briefly stated in the following:

The Elliott Cresson Medal, founded in 1848 by the gift of the late Elliott Cresson. This medal is of gold, and by the terms of the deed of trust may be granted for some discovery in the arts and sciences, or for the invention or improvement of some useful machine, or for some new process or combination of materials in manufactures, or for ingenuity, skill or perfection in workmanship.

The John Scott Legacy Premium and Medal (twenty dollars and a medal of bronze), awarded by the city of Philadelphia. This medal was founded in 1816 by John Scott, a merchant of Edinburgh, Scotland, who bequeathed to the city of Philadelphia a considerable sum of money, the interest of which should be devoted to rewarding ingenious men and women who make useful inventions. The premium is not to exceed twenty dollars, and the medal is to be of copper and inscribed "To the most deserving."

The control of the Scott Legacy Premium and Medal by Act of the Ordinance of Councils in 1869) passed to the Board of Directors of City Trusts, and has been referred by the Board to its Committee on Minor Trusts, and that committee has resolved that it will receive favorably the name of any person whom the Franklin Institute may from time to time report to the Committee on Minor Trusts as worthy to receive the Scott Legacy Premium and Medal.

The Edward Longstreth Medal of Merit, founded in 1889 by Edward Longstreth, machinist and late member of the Baldwin Locomotive Works. This medal is of silver, and may be awarded for useful invention, important discovery, and meritorious work in, or contributions to, science or the industrial arts.

Full directions as to the manner and form in which applications for the investigation of inventions and discoveries should properly be made will be sent to interested parties on application to WILLIAM H. WAHL; Secretary.

The Navy Yards to Use Electrical Appliances.

The Navy Department at Washington, believing that the use of electrical appliances in the machinery departments of the Navy Yards would result in economy of money and power, has selected a Board to inquire into the advisability of their adoption at the New York and Norfolk Yards. The Board will meet at the Brooklyn Yard at once. It consists of Commander Washburn Maynard, Lieutenant J. D. Murdock and Professor O. G. Dodge, the latter an expert electrician.

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All Aboard for Schenectady.

The decision of the powers that all the offices of the General Electric Company are to be removed to Schenectady immediately created consternation in the ranks of the minor officials when announced on Saturday, and made the "Happy New Year" greeting of the period sound like a mockery and a gibe. The blow has fallen heavily all around, but its effect is particularly crushing in the case of those misguided friends of Mr. Coffin who lost all their money in the stock market, and who really can't afford to move their household effects just now. Several of the gentlemen have quietly expressed their intention of complying with the order, and of remaining in Schenectady until they can find other places, and no longer.

ELECTRICITY congratulates the company on a wise business move, and commiserates the society men who will perforce be compelled to mend their ways. They can console themselves with the reflection, however, that even the Tenderloin has been getting slow of late. The company has now taken its proper place in the procession—near the foot.

For the benefit of those who are not acquainted with the geography of their country, we will state that Schenectady is a small village, lying on the banks of the Mohawk, sixteen miles west-northwest from Albany, which latter town is exactly 145 miles due north of the Hoffman House, 200 miles west of Young's, and the same distance from the Parker House. The town contains about 16,000 souls, mostly contented and prosperous laboring men in the various manufacturing establishments, who rise at 6 A. M. and retire at 9 P. M.

It is an eminently respectable, though not a gay city, founded by the same enterprising Dutch, who first settled Manhattan Island. It is not far from Little Falls, the most important cheese market in the world, where the scenery is acknowledged to be magnificent. It is on the line of the Erie Canal and the New York Central Railroad. All boats and freight trains stop there.

We understand that Messrs. Greene, Ord and others have already grown despondent in contemplation of their enforced absence from Delmonico's, their banishment from the innumerable joys of life in the metropolis, and have unjustly characterized Schenectady as a stupid place. We can assure them that Schenectady is all right. True, they will have to travel a slower gait, and if they would be happy, change their ideas of what constitutes pleasure. Better than they have lived and died there. It is not half so dreary a place as the settlement of Warwick and Coventry in Rhode Island, the ancestral home of the Greenes, and is fully as lively as Princeton, in New Jersey, where Mr. Ord formerly taught the young idea how to shoot.

The country being flat, malaria in its most virulent forms is an ever-present evil; but we are told that the drug stores (of which there are two) make special rates on quinine and cholagogue.

However, life is still worth living, even in Schenectady, and there are many forms of wholesome and innocent enjoyment, as yet, we fear, untried by the gentlemen referred to.

The Edison Hotel, though not on a par with the Imperial or the Plaza, is a very good hotel, and will soon be a scene of wild revelry by night (that is, till 9 P. M.) There will be fierce games of checkers, delirious rubbers of whist, and stories without number of the life which is past and gone.

On holidays and Sundays excursions may be made to the reservation of the Onondagas near Syracuse, where a new kind of "society" can be found.

The General Electric Glee Club will be formed, and "Auld Lang Syne" will be sung with fervor. There will doubtless be many other clubs, including the "O. T. Crosby Zouaves," and the "S. D. Greene Cadets." During the winter there will be ample opportunity for lacrosse and tobogganing, and diverse other healthy sports. In the summer a swimming school could be organized, and a "Cussing Club" will be a necessity the year round.

The newcomers will no doubt be made welcome at the monthly debates of the literary societies of Union College, and those of correct habits will easily find entree to the occasional afternoon teas of the Schenectady matrons. In fact, although it is a state secret, the fame of Mr. Ord's whiskers has preceded him, and he already has several invitations in advance for these events.

On off nights, when there are no other diversions, rides may be taken on Mr. Muir's railroad.

Mr. Ord will, of course, speedily compile a "Book of Etiquette for Electrical Men," something on the plan of his previous "Book of Instructions," which proved so convenient for certain occasions.

Each one may easily adjust himself to the changed conditions of affairs and still enjoy life hugely. The company will save a great deal of money in rent, will get twice as much work out of the men (7 A. M. to 6 P. M), and living being so cheap in Schenectady, a further reduction of 25 per cent. in salaries would certainly not be objected to by any one.

ELECTRICITY'S private telephone will be extended to Schenectady, and we will report the news as heretofore.

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Electrical Fire Risks.

The interior wiring of buildings is a far more fruitful source of fire than overhead wires, and this class of construction calls for correspondingly greater care than the former. It is only within the past three or four years that interior wiring has been made perfectly safe, and this result has been largely due to the efforts and restrictions of the fire underwriters. Many of the devices used in the early days of incandescent lighting, and which at that time were regarded as thoroughly safe, could not now pass the inspection of any insurance company in the country.

Most all of the fires due to the use of electric lighting have their origin in some part of the wiring of the buildings, as it is almost impossible to start a fire from an incandescent lamp, and where arc lamps are used for interior lighting the globes and screens in general use render them very safe if ordinary care is exercised in keeping them properly trimmed. The chief danger here lurks in the hidden parts of the wiring, where a fire may attain considerable headway before being discovered, but if electric wiring is installed in accordance with the best practice known at present its fire risk would practically disappear. As almost every one familiar with the subject admits the possibility of making interior wiring perfectly safe, it follows that where fires occur from this source the work must be defective in some respect.

Faults in interior wiring may be traced to defective insulation, bad materials or workmanship and insufficient capacity of the wires, all of which may be detected with competent inspection, and which are generally the result of too cheap work. The insulation of any house wiring can be fixed at almost any degree demanded, even without the use of materials other than those commonly employed, if the work is put in by competent persons. The use of tubing in which to run the wires is now general, and this tubing consists of a non-inflammable material covered with a metallic sheathing, with which a complete system of piping is run through the building in the same manner as the gas or water pipes, and is provided with suitable outlets for lamps, switches, etc In addition to the insulation provided by the tubing, the wire which is drawn through it is itself covered with a good quality of insulation, and only wires of one polarity need be run in a single tube. With these precautions and the lines between the various outlets of ample capacity to carry their maximum possible current without excessive heating, no possible danger can arise on this part of the system.

The next point is the connections at the different outlets at which junction boxes of incombustible material should be provided. These contain the switches and fuse blocks, in which sparking and melting of fuse wires will inevitably occur at times, thus strongly arguing the use of only the most approved appliances of this kind. The use of wood or any inflammable material in these appliances should not be tolerated, although the old time wooden bases are by no means obsolete. The apparatus used now, enclosed in slate or porcelain, meets every requirement of safety, but even this may be troublesome unless it is set up with care and is properly used. The chance of poor connections and the introduction of light resistances at these points is always present when this work is handled by any but the most experienced and careful workmen. If these fuse blocks are not properly used in regard to the size of the fuse wire required for the current their use becomes a mere farce. It is certain that a great many cases could be found to day where after the proper size fuse wire has been melted it has been replaced by copper wire of perhaps several times the capacity of the wire it was supposed to protect from overload.

The same difference in quality and make may be found in the electric light fixtures as in the other supplies, but their quality has been steadily improving, and if properly installed are very safe.

The kind of plant here outlined includes the best materials, arrangement and workmanship, and until these conditions are departed from the fire risk from this source is almost nominal. The temptation to cheapen the work, which is frequently given to the highest bidder without even the restriction of any specifications or the oversight of any competent engineer, constantly tends to the introduction of poor materials and workmanship, and it is in this way that electric wiring has obained a far worse reputation than it ought to hold under proper conditions. As there are contractors who will take advantage of the general ignorance of customers on this subject, it is as necessary to secure the services of a competent engineer for this work as it is to engage an architect in building a house.

We have so far, however, considered the subject in its worst aspects and taken the most exaggerated view of its dangers; but it is only fair to say that even with as many poor plants as may be found in use, statistics show the fire losses to have been very small in comparison with all other forms of illumination. Figures taken from 82 cities, recently, show that of the total number of fires from all causes a trifle less than 1¼ per cent. were caused by electric circuits, which makes a very favorable showing in comparison with any other method of illumination or power transmission. It also points to the extreme reliability which electricity would present against fire if the installation of this system was always as perfect as possible, and with the constant improvements which are being made, the risk should be constantly on the decrease.

WE are informed that the resignation of Mr. F. P. Fish has been accepted, and that Messrs. Atterbury, Hyde & Betts will direct the campaign of patent suits now under way.

……o……

To Mr. W. J. Hammer: Your pernicious activity as a spy is likely to excite curiosity as to who and what you are. The drubbing which Grand Sheik A. Hickenlooper gave you is not forgotten, and this curiosity may yet be gratified.

To the Mohawk Flats.

The General Electric Company will Retire to its Lodge in the Wilderness.

The Marble Building at 44 Broad Street, too Expensive a Luxury for Present Conditions.

It was officially announced on Saturday last that the Directors of the General Electric Company have decided to concentrate all the various departments of the business at Schenectady. Electrical, engineering and designing departments are already being removed from the Lynn works. Prof. Thomson will be expected to make Schenectady his headquarters, and Mr. E. W. Rice, Jr., has already received his notice of transfer.

The main offices of the company, heretofore at 44 Broad street, are to be moved to Schenectady by February 1, and the entire force transferred.

The company's magnificent building will be offered for rent to other concerns.

Many discharges have already been announced and more are to follow. Among the important ones so far are those of Messrs. Herrick, Muir and Hughes.

Capt. Eugene Griffen is to go to Chicago to take charge of that office, the only district office remaining.

It is not the Schenectady works, but the Lynn works, which are practically dismantled, and this latest move settles a month in advance of the annual meeting the question as to which element is controlling the policy of this company.

Mr. H. McK. Twombly will no doubt be the next president of the company, and Mr. Coffin will be at the head of a competing organization.

MR. COFFIN HAS SPOKEN.

He Furnishes the Chemical Bank with Grounds for a Slander Suit.

A fall of five points last week in General Electric called forth many rumors, in reply to which Mr. Coffin said officially:

"There is no more danger of General Electric going in receivers' hands than the Chemical Bank. I cannot understand why anybody should put such a report in circulation. Surely no insider would do it who knows the facts. Our relations with the Brush Company are most friendly. We own a very large proportion of the capital stock of the Brush Company. General Electric has practically no floating debt and the company is doing more than one-half the business it was doing last year at this time, and it is doing it on a cash basis. The reduction in the price of lamps was inaugurated by General Electric because the company has been able to manufacture lamps cheaper, and it is thus giving the public the benefit. The relations between the Thomson-Houston interests and those of the General Electric are not strained. On the contrary, they are most friendly."

Which all goes to prove that not even the accumulated troubles of the past six months have been sufficient to destroy Mr. Coffin's sense of humor. He can laugh, and make the whole world laugh with him, whenever he chooses.

Personal.

Mr. Walter C. McKinlock, Secretary of the Metropolitan Electric Company, Chicago, has just returned from a successful business trip, and reports the outlook for his new company as very promising.

Death of William Richardson.

William Richardson, known to every street railway man in the country, and a leading spirit in both the New York State and National Street Railway Associations, died at his home in Brooklyn on the 31st ult. of pneumonia.

Mr. Richardson was seventy-one years old, and had had an active career. He was interested in politics up to twenty years ago, and was a friend of Thurlow Weed, who gave him his original start in the street railway business, as president of the Dry Dock, East Broadway and Battery line in New York.

Legal Notes.

An attachment suit by the General Electric Company against the City Electric Street Railway Company of Little Rock, Ark., was begun a few days ago in the Circuit Court at Pulaski, Ark. The suit involves the legality of claims aggregating nearly $300,000 against the railway company, which is now in the hands of a receiver.

Suit was brought lately in the United States Circuit Court at Portland, Ore., by the Northwest General Electric Company against the East Side Railway Company for the appointment of a receiver and the foreclosure of a mortgage on the road for $67,000, which secures about $37,000 due the Northwest General Electric Company, and $29,000 due the Commercial National Bank. The court granted the application, and, with the consent of all parties to the suit, appointed Joseph Simon receiver of the company's property.

A suit brought by Stephen L. Wilson against the Fort Wayne Electric Company was begun in the Supreme Court, Brooklyn, N. Y., on the 19th ult. The action is brought to recover $6,987 and interest under contract. Wilson, who lives in New Milford, Conn., alleges that the defendant agreed to buy the entire output of his mica mine. The defence claims that the mica is not up to the required standard.

Edward C. Hinman, of Battle Creek, Mich., has been appointed receiver of the Battle Creek Electric Railway Company, and his bond has been fixed at $15,000. The orders were entered by Judge Swan in the United States Circuit Court and as the result of the filing of a bill against the company by the Central Trust Company of New York. When the railway was projected, three or four years ago, the stockholders gave a mortgage on their railway property to the trust company to cover a loan of $110,000. There was a default in the payment of $3,300 interest, due on the first of last July, hence the foreclosure proceedings.

The Falls Rivet and Machine Co. has begun a suit at Toledo, O., against the Toledo Electric Company for a balance of $1,692.15, due on machinery furnished for the electric company's new power house. The parties named as defendants are the General Electric Company, Toledo Electric Company, J. S. Rodgers and John S. Moore, trustees and individually.

The Denver (Col.) *Times* says that the final report of Assignee Theodore Holland of the Montclair Electric Light Company has been approved by Judge Allen and the assignee discharged. The total value of assigned property in Holland's hands was $33,700.78.

Judgment for $10,045 has been entered by default against the Union Electric Company, of No. 45 Broadway, New York, in favor of Stephen R. Bradley, the president of the company, of which Stephen R. Bradley, jr., is secretary and treasurer. The company was incorporated under West Virginia laws in July, 1891, with a capital stock of $500,000, for the manufacture of electric storage batteries.

James N. Cropper has been appointed receiver for the Muncie (Ind.) Electrical Works. The company is a new one, organized by Cleveland capitalists for the manufacture of dynamos. The receiver was appointed to enable a dissolution of partnership.

Recollections of Werner Von Siemens.[*]

VI.—The First Laying of a Deep Sea Cable.

The successful use of copper wires coated with gutta-percha as underground conductors suggested their employment also for submarine telegraphic communication. That sea water was not in any way injurious to the gutta-percha had been proved in the case of the insulated wires connected with the torpedoes in Kiel harbor, which were quite unchanged after the lapse of two years.

The first attempt to connect two sea coasts by means of gutta-percha conductors had been made as early as 1850 by Mr. Brett, who had obtained a concession for a submarine telegraphic communication between Dover and Calais. The unprotected wire laid by him retained its efficiency, as was to be expected, not much longer than the time of the actual laying, if indeed it was ever really serviceable. It was replaced in the following year through Messrs. Newall & Gordon by a conductor armed with iron wires, which acted well for some time. This was the commencement of submarine telegraphy, destined speedily to become one of the most important media of communication.

In September, 1855, Mr. Brett, commissioned by the Mediterranean Extension Telegraph Company, had made the attempt to lay a heavy cable with four conductors between the island of Sardinia and the town of Bona in Algeria. He employed for the purpose the same contrivances as in the North Sea, but unfortunately his brake apparatus did not suffice on reaching deep water, and in consequence the whole cable rolled to the bottom without the possibility of detaining it. When a second attempt in 1856 also miscarried he retired from the undertaking, which was then taken up by Newall & Company. The latter contracted with my firm for the delivery of the electric apparatus, and requested me to undertake the electrical testing on and after the laying.

This first laying of a deep sea cable was both interesting and instructive to me. At the beginning of September, 1857, I went, at Genoa, with an assistant and the necessary electrical apparatus, on board a Sardinian corvette, which was to accompany the expedition and take us to Bona, where the steamship laden with the cable awaited us. It was an interesting company which met on board the war-ship. Besides the English contractors and cable manufacturers, Mr. Newall and Mr. Liddell, there were on board several Italian *savants*, telegraph officials, and naval officers, among them the learned Admiral Lamarmora, a very amiable and well-instructed officer, brother of the well-known General Lamarmora; further several French telegraph officials, who were commissioned by their Government to be present at the laying of the cable, in particular the well-known engineer Delamarche.

Already on the passage to the island of Sardinia, which was favored by gloriously calm weather, the party discussed the methods which should be adopted in laying the cable, in order to avoid the failure of previous attempts. Messrs. Newall and Liddell declared that in laying their wire to the Crimea they had found it best to proceed quickly, and let the cable run out without check, when it would sink slowly to the bottom without any strain. They had indeed for precaution's sake provided a powerful brake-wheel, to regulate the speed of the cable, but that would hardly be necessary if the ship was going fast. This theory of Mr. Liddell was strongly opposed by M. Delamarche, who had been present at the unfortunate attempts of Mr. Brett, and had now adopted the theory that the cable must perforce assume the form of a catenary curve in deep water, and under any circumstances break.

I had originally intended to abstain from interfering in the mechanical part of the proceedings, but it appeared to me so utterly impossible to lay a heavy cable, having a weight in water of at least 4 lbs. per yard, at a depth of more than 1,500 fathoms (as was the case between Sardinia and Bona), in the manner intended by Messrs. Newall and Liddell, that I spoke very earnestly against the proposal. On the other hand I could not share the fears of M. Delamarche, and there ensued a warm discussion between Mr. Liddell, M. Delamarche, and myself, in which I expounded the theory, which was subsequently universally adopted. It consists in holding back the cable by brake-apparatus with a force which corresponds to the weight of a piece of cable in water reaching perpendicularly to the bottom. With a uniform motion of the ship the cable then sinks in a straight line, the inclination of which depends on the ship's speed and the velocity of subsidence of a horizontal piece of cable in the water. If the sinking portion of the cable is not perfectly balanced by the force of the brake, a sliding down of the cable takes place at the same time on the inclined plane which it itself forms; it is therefore possible to regulate by the brake the extra amount of cable that is required to lay the cable without strain over the unevenness of the bottom.

This simple theory met with the universal approval of the company. Mr. Newall too came over at last to my view, and requested me to assist him in the preparations for laying the cable in accordance with my theory. It was, however, difficult to do this on the spur of the moment. The brake, which we found on arriving at Bona on the cable-ship that already awaited us, proved much too weak for balancing the weight of the cable at great depths. Moreover the steam power of the ship was too small to overcome the great force with which the cable would endeavor to slide down the inclined plane. Finally there was no contrivance for measuring this force, and for determining accordingly the amount of the brake action required. I first had a simple dynamometer constructed by the carpenter, which rendered it possible to ascertain the extent of the actual strain on the cable while it is paid out by the amount of flexion of a length of the cable stretched over two rollers, between which a third weighted roller rides on the cable. Furthermore I had the brake wheel strengthened as far as possible, and furnished with strong water boxes. Lastly I caused the captain of the war ship to pass a tow rope from his vessel to the bows of the cable-ship, in order to obtain the requisite force for overcoming the backward drag exerted by the cable.

Thus barely provided, we began in the evening the laying of the cable from Bona. As long as the water was shallow all went well, and my precautions were soon deemed superfluous. After a few hours, when we got into much deeper water, it appeared however that the attainable brake force was not sufficient. We paid out too much cable, and when morning dawned had already used more than a third of the cable, although a fifth of the distance had not been traversed. It was still just possible to reach with the cable-end a shallow spot near the island of Sardinia, if the cable could from now be paid out without any excess whatever. At the request of Mr. Newall I undertook to try this, on condition that the management was entirely left to me. I now loaded the brake with all the weights which were to be found on the ship. Even filled water tubs from the galley were requisitioned. At last the load sufficed, without the brake giving way. We now laid according to the statement of the measurements without "slack," i. e. without using more cable than exactly answered to the length of the sea-bottom. The cable was always pretty near the breaking point, as was proved by the fact that frequently one of the thick sheathing wires snapped, whereby the cable ran considerable risk. But by the adoption of prompt measures a fraction of the cable was averted, and when the sun set, and the cable end in the ship was almost reached, my dynamometer luckily indicated shallow water, and we were at the goal.

The joy was general and intense, and even Mr. Liddell congratulated me on the success achieved.

This was the first cable which was successfully laid in deep water, i. e. at a depth of more than 1,000 fathoms.

The theory of cable laying expounded on the above occasion I only made public in the year 1874 through the medium of a paper entitled "Contributions to the theory of laying and testing submarine telegraph cables" submitted to the Berlin Academy of Sciences. I have preserved among my papers the copy of a letter, in which on my return I explained my theory to the before-mentioned Mr. Gordon, partner in the firm of Newall & Company. I shall insert this letter here, as it forms the first detailed communication on my theory of cable laying:

Berlin, 26th September, 1857.

Dear Gordon: Returning yesterday from my journey I found your letter of the 17th.

First I will give you some particulars from the report made by Engineer Viechelmann, who has to-day returned from Bona.

There is no doubt that wire No. 1 is injured, and that the injury lies in the neighborhood of the African coast, and consists in the wire being in conducting connection with the water. It is not improbable that the defect exists where the shore end is joined to the thinner cable. It has not been possible to determine the precise place, as it is uncertain how much resistance the connection has between the conductor and the water. The place can however lie no farther than four German miles (19 English) from the land, but is probably much nearer.

Through the amount of the charge and by determinations of the resistance in the metallic circuit according to the accompanying sketch (Fig. 1) the situation of the fault may be more precisely determined, if you will make the attempt to take up the wire again from Bona. *m* and *n* are the two coils of a differential galvanometer, and *w* a rheostat. By its means resistance is interposed, until the currents through the two coils *m* and *n* are of equal strength and the needle stands at zero. Then the fault *f* lies midway, and the distance from the coast can be calculated.

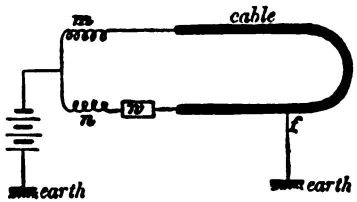

Fig. 1.

With well-insulated wires this can be done with perfect exactitude, with badly insulated ones, such as the Bona cable, at any rate approximately correctly. Mr. Viechelmann has left the apparatus in the custom-house of Marseilles at your disposal. In the telegraph office there lies a letter from Viechelmann to Newall, in which the authority for its delivery is contained.

As regards the cable theory the following is my view:

If *A B* (Fig. 2) represents a flexible piece of cable, which is attached to the sky by a weightless wire *B C*, the cable will fall to the ground, without being able to deviate from the straight line in the suspended part, as at every point it falls with equal velocity. *m n*, *o p* are of equal length. Every point falls with equal velocity, and the new connecting line *n p* must again be a straight one. The active force pulling upon the wire $B\ C$ during the fall is $K = Q \,.\, \sin a$, if Q is the weight of the suspended cable in the water, or the weight of a piece of cable $B\ D$ hanging vertically downwards, since $A\ B \,.\, \sin a = B\ D$.

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[*] Selected from "Personal Recollections of Werner Von Siemens," recently published in America by D. Appleton & Company, New York, 416 pp., 12mo, uncut edges, wide margin, photogravure portrait.

If the force K is less than is necessary for equilibrium, the cable slides back towards A, and the terminal velocity is reached when the friction water is equal to the lacking force If on the contrary K is greater than necessary, the cable acquires a velocity towards B, consequently the loss, i. e. the difference of the lengths $A\ B$ and $A\ D$ is picked up again, and the cable places itself in a straight line, thus without loss, on the ground. The angle a is accordingly quite independent of the amount of the force K. It simply indicates the proportion of the velocity of sinking to the progressive motion of the ship. For if the cable end B instead of being attached to the weightless wire $B\ C$ is carried over a pulley, and the pulley moves with the ship from B to E, whilst the cable falls the distance $m\ n$, and finally if the cable is kept back with the force K there is no change at all in the conditions of equilibrium. If the brake, which detains the cable, is so applied that equilibrium is just attained, thus $K = Q \,.\, \sin a$, the cable has no axial velocity whatever; it falls perpendicularly, and there is the loss corresponding to the angle. If K is greater, the cable is laid with little or no loss, if K is smaller, the loss may be very great. The quicker in the latter case the motion of the ship, the longer does $A\ B$ become, the greater consequently the friction in the water and the smaller the loss. If on the other hand the force K becomes greater than is necessary for equilibrium, the loss can easily be made up, and the cable then forms a catenary curve. If the transitions are rapid, the whole velocity which the cable has acquired after applying the brake on disturbance of the equilibrium acts in the direction $A\ B$, and tends to strain the cable. When one considers the great mass of the suspended cable, it is clear that these axial velocities of the cable may easily cause a fracture. The only safe guide is the proportion of the ship's velocity to the velocity of the cable. Moreover the ocean currents must be taken into account, especially if they flow in various directions. If the current is everywhere equable, and extends to the bed of the sea, it only produces an additional expenditure of cable. With equilibrium of the force K the cable settles down in the diagonal of the parallelopiped, instead of in the diagonal of the parallelogram, and the cable length bears the same proportion to the distance traversed as the diagonal of the parallelopiped, whose sides are the ship's motion, the depth of water, and the simultaneous velocity of current, bears to the ship's motion. Very violent action on a tightly laid cable may however be exerted by variable currents, as the cable has then to resist the pressure of the water in the form of the catenary curve. Lastly the rising and falling, as well as the lateral movements of the ship, form forces of importance, threatening the fracture of the cable, unless the uncoiling apparatus is very light, or a compensation can be effected whereby the cable may be lengthened or shortened behind the brake, so that no acceleration of the mass takes place. The mechanism which I propose for determining and regulating the tractive force exerted on the cable is easily calculated as under. (Fig. 3).

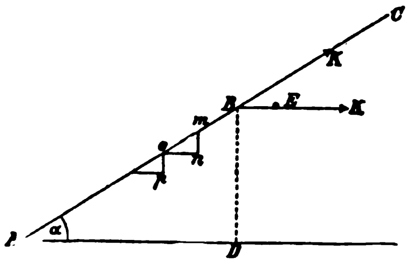


Fig. 2.

$$K \,.\, \sin \alpha = \frac{Q}{2}\,;\quad K = \frac{Q}{2 \sin \alpha}$$

$$\sin \alpha = \frac{h}{ab} = \frac{h}{\sqrt{\frac{e^2}{4} + h^2}}$$

$$K = \frac{Q}{2h} \cdot \sqrt{\frac{e^2}{4} + h^2}.$$

I have asked Löffler to calculate a table in accordance with this formula, of which however I am not yet in possession, as L. is still in Cologne. e was, as you state, 25 feet, i. e. 8·42 metres. The weight Q was 160 kilograms, according to the statement of Newall's people, who weighed it. You seem in your approximative formula to have taken pounds instead, your values are therefore only about half those I have in my memory. The apparatus was constructed of wood the evening before the laying. Previously Mr. Liddel seemed not to be in favor of it, and I did not wish to obtrude myself after having made my proposal. In the first night the frame had become warped through the wet, and the place where the height was measured was about 2 feet lower than the other. A trustworthy measurement with an apparatus so crudely and hurriedly made and calculated is therefore out of the question.

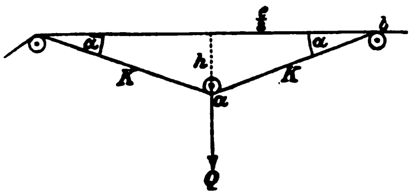


Fig. 3.

That soon after the commencement of the laying much cable was wasted was clear. I therefore at once proposed a stronger loading of the brake, but could not have my way. Undoubtedly there were moments when the cable line was almost straight, although in the ordinary course there was a depression of from 4 to 5 inches, and *one* such moment might have sufficed to break the cable. The brake was also too weak, and I was always in mortal terror lest, with the load of at least 5 hundredweight, which subsequently, when Newall left the matter in my hands, was applied, it should give way. As the cable would have been irrecoverably lost if the brake had given way, it certainly required a prodigious resolution to justify loading it in this manner. It is certain that we strained the cable too severely on the following day. We certainly laid it without any loss whatever, and perhaps already had some catenary curve force in the cable. This was owing to the circumstance that nobody knew how fast the vessel was going. Newall and Liddell thought we were not making 5 knots an hour, whereas in fact we had made 7½. As the cable ran off with the velocity of 7½ knots, I could only conclude that the waste was still too great for reaching shallow water, was obliged therefore to continue the loading. Thus there were moments when the loading reached quite 6 tons, and the fluctuations were even greater.

That there was no regular log in the ship was a serious misfortune, and might easily have had for its consequence the loss of the cable. The greatest danger in cable laying always consists in the snapping of single wires. That under the circumstances we came off as we did is a real marvel. I should not advise attempting a cable laying in deep water without having previously subjected the wire in its whole length to a maximum strain, never to be exceeded in the actual laying.

I have communicated a plan to Newall how this is very easily to be done. Then faulty weldings will be disclosed by rupture, and one may feel pretty safe afterwards. Furthermore a dynamometer of solid iron must be constructed with an accurate scale, and in such a way that with the maximum loading there still remains a deflection of at least one foot. It is better to make use of a well-made spring than a weight, so that the fluctuations of the apparatus may be as small as possible. It would also be very advisable to carry the wire behind the brake over two fixed and one movable pulleys, the latter being pulled down by a weight, cr still better by a very strong spiral spring. The up and down movements of the ship are thereby rendered innocuous.

28th.

As Löffler has not yet returned, I can communicate to you nothing definite in regard to the calculated forces. You are quite right that the assumed forces are not justified by the depths alone. I believe we may go to half the depth for which a cable can support itself with tolerable safety and to a third with great safety. Up to a fifth of the depth 5 to 10 per cent., to a third 10 to 15 per cent. slack may give sufficient safety, if the weather is favorable. At greater depths the loss must be considerably more. Newall's plan of retarding the sinking of the cable by shields is wrong in principle. The cable must sink as quickly as possible on account of the currents. With moderate depths it is more advantageous to take back the slack by somewhat greater loading of the brake. If the depth is greater than one-third to one-half of the minimum strength of the cable, the sliding back of the cable must be slackened as far as possible by disks attached at right angles to the cable. I believe these are best made of sheet iron. A few large ones are far more effective than many small ones. The attachment can be effected in many ways. One must then proceed as quickly as possible, in order to keep the angle acute. For the measurement of velocity I am now having made an electrical apparatus, which turns a large indicator by the side of the brake. The brake wheel must indicate in the same way, so that at any moment the proportion of the velocity and of the exerted force may be known. The vessel must be well lighted, and the breaking of the wires must especially be kept in view. That the two wire fractures did not entail the loss of the cable was a piece of luck such as seldom occurs. Altogether I think you have all reason to be satisfied with the result. I do not consider it difficult to recover the cable end. I likewise consider the repairing of the fourth injured wire feasible, if it is of importance to you. This granted, you have bought the experience and a right theory of laying cheap enough. If you choose to avail yourself of my proposals, you will in future be able to undertake a laying in perfect peace of mind and soon recoup yourself for past losses. With your new brake you should however make the experiment of severing the cable with a maximum strain. Mr. Newall told me before the arrival of the Elba that he could fracture the cable with his brake, but although on the day of laying we had lengthened the lever of the brake by a half, and had suspended at least twice as many weights as the lever and iron band could reasonably be supposed to stand, yet we had not reached such a force by a long way, apart from the great forces which were exerted during fluctuations and in the first mishap. With my own experiments I have unfortunately not succeeded much better than in England. I see however that one can certainly signal better in a metallic than in a semi-metallic circuit, and that it is impossible with long lines to signal through more than a single wire. The future belongs therefore to the metallic circuit, and the patent will be remunerative. I see further that our present construction of the induction telegraph acts remarkably well and accurately, and that several submarine translation stations may at pleasure be set up with absolute certainty, that thus e. g. there may be direct communication between England and India. Your apparatus for Malta-Corfu are despatched to-day. I am quite sure that they will do their work well. According to my present experience the inductors might have been smaller and therefore cheaper, but it is better to err on the safe side. Such fine and solid apparatus have never before been turned out in our workshops. The contacts have given the greatest trouble. Platinum burns too quickly with strong primary currents, we were therefore obliged to use everywhere an alloy of gold and platinum, which with thick pieces has its difficulties. Perhaps you will get along with half the inductors on the Malta line (one coil). You will thereby effect a considerable saving, as the great quantity of silk covered wire is expensive.

I beg you to let me know in good time when and where you wish to have the mechanician, and whether you think one enough. I think you should have plenty of intelligent assistants at your disposal, for any error may be very dangerous even with the best preparation.

I send this letter direct to Birkenhead, where I imagine you still to be, and where William intended to visit you; may I ask you to let William have a look at it?

Would it not be better to defer your Malta line to the winter, when you can more certainly reckon on calm weather? October is said to be a very dangerous month there, and the atmosphere does not become quieter before December.

With sincere regards.

W. SIEMENS.

(To be Continued.

It is reported that Donald Murray of Sydney, New South Wales, has devised a system for setting type by telegraph. Mr. Murray claims that it is possible by his invention to operate at a distance, over a single telegraph wire, a typewriter, a type-setting machine, a piano or any other keyboard instrument.

Boston Notes.

Electricity was impressed into service very generally in Boston for illuminating purposes during the recent Christmas season, and some really wonderful results were attained. Indeed, this city never before looked so brilliant, thanks to electricity and the genius and skill of those who are in the business. Many singularly beautiful displays were made, but the palm was easily carried off by Messrs. Houghton & Dutton, whose mammoth 9-story building, known as the Albion Block, corner Tremont and Beacon streets, was a mass of light radiated from over 1,200 plain and colored incandescent lamps. Being a corner building, two sides of the block were available for the display, which was more than attractive. Long strings of lamps depended from the roof to the sidewalk, while the full name of the firm was wrought in ruby and white lamps. There was also the old legend, "A Merry Christmas," together with crescents and stars of light, while on the parapet of the roof at the corner was an immense American flag wrought in plain and colored lamps. To produce the beautiful effect of the flag fluttering in the breeze there was an ingenious arrangement for cutting out and in, in quick succession, the vertical rows of lamps, producing a most charming and realistic effect. The cut-out was operated by an electric motor, so that the action of the whole was very accurate and very pleasing. The streets in the immediate neighborhood were impassable for several nights in consequence of the crowds. At another store there was a large windmill, the sails of which, studded all over with colored incandescent lamps, were kept constantly revolving by an electric motor. The mill structure was as if covered with snow, the surroundings outside being treated in like manner. The windows in the mill were lighted up from within, the glass in the windows changing its colors continually, including all the tints of the spectrum. There was also a large model of the Ferris wheel, kept in motion by a motor peacocks in gorgeous plumage, and dragons with fiery tongues, forked tails and wings of terrible mien, in which small electric lamps of every conceivable color played an important part. The local Edison Light Company did a good deal of the work, they having in their employ quite a number of experts who have developed very fine tastes in the art of illumination.

The Edison Illuminating Company is constantly adding to its already big business, yet finds that it is now able, with its three finely equipped central stations, to take care of all that comes along. At the present, from these three stations the company is furnishing current for 85,000 incandescent lamps, 7,000 arc lights, and 3,700 H. P. of current wherewith to run 1,300 motors. The foregoing is a showing that compares favorably with most other large companies.

The Massachusetts Electric Light and Power Company, recently organized in Fitchburg, Mass., will construct a large central station on a fine water privilege five miles from Fitchburg, and intends to furnish current for operating the local railroads as well as for lighting the whole of the city and running motor circuits.

Notwithstanding the fact that lamp litigation continues and the General Electric Company still shows a disposition to keep along with its suicidal and antagonizing policy, there is an equally determined disposition to harass the Trust still more, for it is reported that there are at the present moment several new types of incandescent lamps invented in or near Boston about ready for the market, which means that the process of depleting the already nearly exhausted exchequer or coffer—we had nearly said coffin—of the General Electric Company will continue for some time to come—so long, indeed, as the Edison patents shall last. Of course the lawyers don't object to the appearance of new lamps, they bring grist to the legal mill.

It's a hopeful and healthful sign that the electrical business is not by any means at a standstill when we see the opening of new places of business by well known electrical firms. The prosperous Perkins Switch Company of Hartford, Conn., has just located a representative at 620 Atlantic avenue, Boston, who will carry a full line of the Perkins specialties. Mr. F. B. Smith, who will fill this important position, is a gentleman well known in electrical circles, and we bespeak for him a pleasant and profitable welcome into the electrical business of this part of the country. The Perkins electrical goods recommend themselves every time, and have a ready sale everywhere.

The Simplex Electrical Company, makers of the high grade and universally known "Simplex" wires and cables, has removed its chief offices from 620 Atlantic avenue to Cornhill, Boston. Mr. James Mason, chief manager, has just had a severe attack of la grippe, but is again so far recovered as to be able to take the general oversight of the extensive business in wires and cables his company does.

General News.

What is Going on in the Electrical World.

Knoxville, Tenn.—J. F. Scott has applied to council for a franchise for an electric railway on Central avenue and other streets.

Altoona, Pa.—The power house of the Altoona and Logan Valley Electric Street Car Company was damaged $25,000 by fire on the 21st ult.

Syracuse, N. Y.—T. D. Davis, of this city, is the author of a plan for towing canal boats by a motor running on the towpath and getting its power from an overhead trolley.

Parkersburg, W. Va.—The franchise of the Park City Street Railway has been purchased by the American Construction Company of Boston. The purchase includes the track already laid.

Muncie, Ind.—J. N. Cropper having given bond in $20,000 has been appointed receiver of the Muncie Electrical Works. This step was necessary to bring about a dissolution of partnership.

Port Jervis, N.Y.—The Port Jervis Suburban Street Railway Company have been granted a franchise for their proposed line in this place. The applicants are the same men who are now building the Middletown electric railway.

Omaha, Neb.—The mayor having objected to the Thomson-Houston electric lighting bills, believing that the company had failed to supply a 2,000 candle power light, the city council has voted in favor of paying the bills over his veto.

Cleveland, Ohio.—R. D. Geib, of this city, has invented a device he calls a trolley finder which is designed to return the trolley to the wire when it has slipped off. It has been tested and worked with complete success.

Trenton, N. J.—The New Jersey Railway Company, of which Joseph H. Reale, of Bloomfield, seems to be the active head, is planning to build an electric railway from New York to Philadelphia, via Trenton, with spurs to all the side towns.

Richmond, Va.—In printing an item showing the successful operations of an electric freight-railroad in Maine, the *States* remarks that "many such roads will be built in Virginia within the next few years, the first of which, let us hope, is the proposed electric line to Petersburg."

Medina, N. Y.—A single rail railway is projected between Batavia and Oak Orchard, via either Albion or Medina, to practically test Capt. Lina Beecher's new invention. The invention has been tried on a short test line and has been found, it is said, to work in a perfectly satisfactory manner.

Ellenville, N. Y.—It is believed here that an electric railway running down the Rondout valley and connecting a number of villages would be a boom to the locality. The subject is receiving increasing attention. There is a 75 foot waterfall in the vicinity that could be utilized in generating electrical power.

Providence, R. I.—The Interstate Railroad Company, a corporation operating an electric railway between Providence and Pawtucket, has been placed in the hands of Cornelius N. Sweetland as receiver. This it is believed will lead to the absorption of the road by the United Traction Company.

New York.—The Waddell-Entz Company has called the attention of the Metropolitan Traction Company to their storage battery system now in operation on the Second Avenue Railroad line as meeting the requirements specified in the offer of the $50,000 prize for a motive power for street railways dispensing with overhead wires.

Meriden, Conn.—The city authorities, possessed with the idea that they were paying more for their electric light than it would cost if the city did its own lighting, appointed a committee to inquire into the matter. After due investigation, the committee reached the conclusion that they were getting light at a reasonable price, and a three years' contract with the local company was the result.

Fall River, Mass.—At a meeting of the men interested in the proposed electric railway between this city and Stone Bridge, Tiverton, a company was organized by the election of the following officers: President, Daniel T. Church; directors: Daniel T. Church, of Tiverton; Nathaniel B. Church, of Tiverton: Weaver Osborn, of Fall River; George W. Slade, of Fall River; M. G. B. Swift, of Fall River; Frank Stevens, of Swansey, and Robert S. Goff, of Fall River. Work on the road will begin in the spring.

Cincinnati.—The Cincinnati Gas Light and Coke Company have called a meeting of stockholders on the 22d inst. for the purpose of voting on an increase of stock from $7,500,000 to $8,100,000 for the purpose, it is intimated, of enlarging the business by the addition of an electrical department, to be accomplished through the acquisition of the plant of the Cincinnati Electric Company by an exchange of gas stock for an equal volume—par value—of Cincinnati Electric Light stock.

Baltimore, Md.—The company which proposes to build an electric railway between this city and Washington, to be known as the Baltimore and Washington Turnpike and Tramway Company, has been reorganized with the following board of directors: David M. Newbold, president; Robert T. Carswell, Charles B. Calvert, John J. Dobler, William L. Elkins, Peter B. Widener, Thomas Delan, T. Edward Hambleton and Howard Munnikhuysen.

St. Louis, Mo.—The notice of the assignment of the Municipal Electric Light Company to the Edison Company has been filed with the Register. The notice states that October 14, 1893, the entire business of the first named company was assigned to the Edison Company, including two contracts for lighting the streets of the city of St. Louis for ten years from January 1, 1893.—A move is on for the organization by the capitalists of St. Louis of a new electric light company, to be known as the Consumers' Company, for the purpose of fighting the trust.

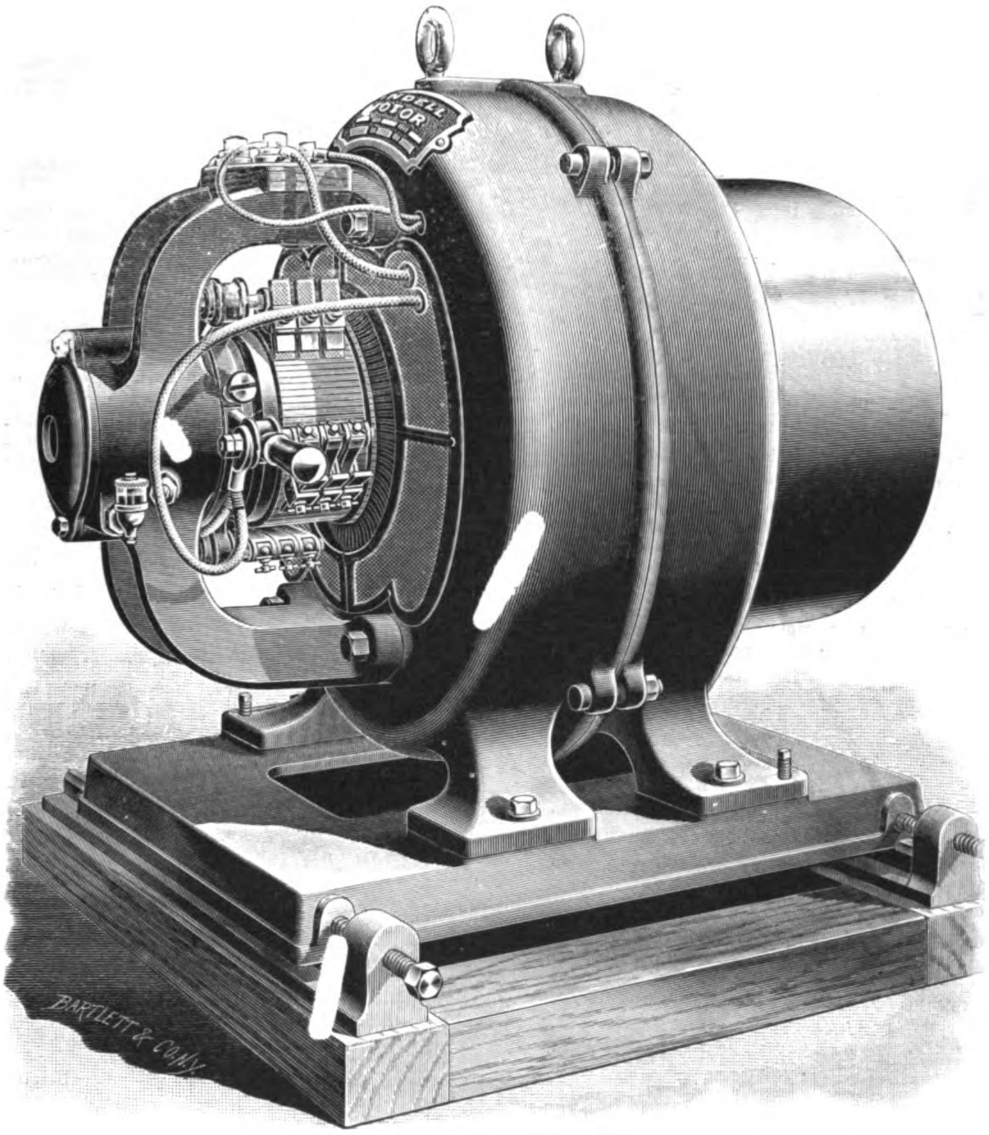
Washington, D. C.—The promoters of the Washington and Marlboro electric road have presented their scheme to the Commissioners. The company proposing to build the line already has a charter from the State of Maryland to build the road from Marlboro to the District line on the other side of the Eastern Branch of the Potomac, and is now making an effort to secure a charter so that it can build its own bridge across the Eastern Branch and to enable it to enter the city in the neighborhood of the Centre Market, its objective point.

Indianapolis, Ind.—The Board of Commissioners of Marion County, Ind., will receive sealed proposals at the County Auditor's office in Indianapolis until January 15, 1894, at 2 o'clock p. m., for an electric lighting plant for the Marion County court house and new jail building, according to plans and specifications for the same now on file in the Auditor's office of said county. Each bidder must file with his bid a good and sufficient bond in amount equal at least to the amount of the bid which it accompanies. The board reserves the right to reject any and all bids.—The scheme to build an electric road from Indianapolis to Broad Ripple, some eight miles beyond the corporation limits, has fallen through.

St. Paul, Minn.—The *Globe* says: "The recent incorporation of the Williams Manufacturing Company is the first step in the organization of a mammoth co-operation concern in St. Paul to manufacture the Kent telegraph typewriter; also electric motors and aluminum wares. The capital stock is fixed at $10,000,000, but it is the intention to begin building the factory as soon as $100,000 is subscribed and paid in. The location of the factory is not settled upon, and while it is the present intention to place it in St. Paul, affairs may turn so that it will go to St. Paul Park. One thing is settled definitely, and that is that it will be a co-operative institution. It is intended that every member of the large force of workmen shall be a shareholder and a sharer of the profits."

New Orleans.—The council ordinance authorizing the St. Charles Street Railroad Company to use electricity as a motive power has been referred to a sub-committee.

Santa Fe, N. M.—Arrangements for enlarging the plant of the Santa Fe Electric Light Company are now under way. At a recent meeting of the stockholders the following officers were elected: G. W. Knaebel, president; Grant Rivenburg, manager and secretary; J. G. Schumann, treasurer.


BARTLETT & CO. N.Y.

THE LUNDELL DYNAMO.

Middletown, Conn.—The Schuyler Electric Company's factory here is entirely closed. It provided work for 600 operatives.

Sandusky, Ohio.—Interest in the projected electric road between Sandusky and Norwalk has been revived, and there is a plan forming for applying the $30,000 that was formerly voted by this city for the Sandusky, Ashland and Southern road and using it to assist in building the new line.

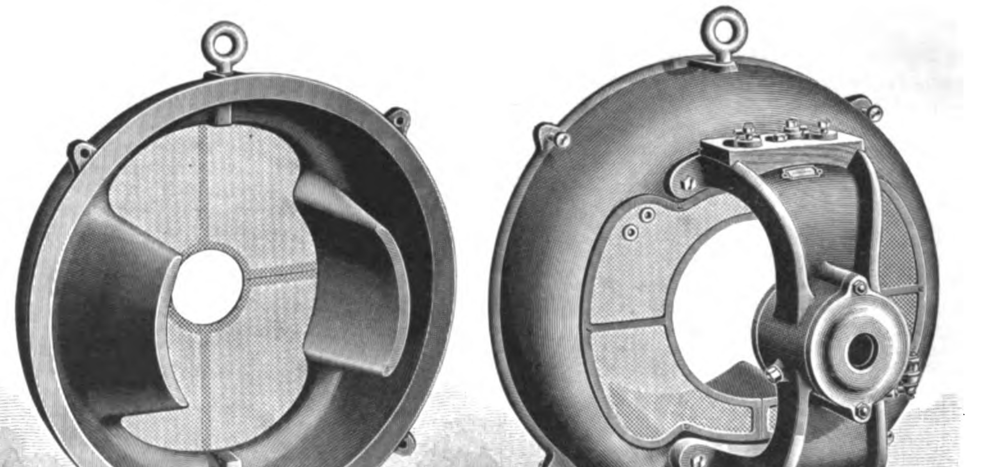
Description of the Lundell Type of Direct-Current Dynamos and Motors.

The Lundell type of direct-current dynamos and motors is the ideal of simplicity and compactness. In fact, this type is so simple that an elaborate description of the different parts is entirely unnecessary. The chief characteristics are embodied in the novel construction of the field magnet, whereby a single energizing coil magnetizes all the pole pieces and a strong protecting shell for the windings of both field and armature forms the magnetic circuit.

The arrangement of the field magnet and its energizing coil is clearly illustrated in our engravings.

It will be noted that the two field magnet halves when bolted together form a shell which completely protects the armature, the whole of the shell being utilized in the magnetic circuit. These field magnet halves are so designed that they are readily withdrawn from the mould in casting. The cross section of the shell equals the cross section of the base of the pole pieces, so that no choking of the lines of force can occur at any point. Cast steel is employed for all these dynamos and motors. The single energizing coil not only reduces the construction of the machine to the simplest point, but by having only two terminals it is especially adapted to be placed in the hands of inexperienced users, as it avoids any possible mistake in connecting up or any bother or delay in examination when such becomes necessary. Another feature of the design is that the pole pieces are magnetized directly, and the resistance of the magnetic circuit reduced to a minimum, whereby a considerable economy in the ampere turns of the energizing coil is effected.

The armature adopted for these machines is of a modern Pacinotti form. This type of armature has in the past been subject to unfavorable criticism on account of the resultant heating of the pole pieces, but it is now pretty well recognized that this heating was not due to the Pacinotti ring itself, but to the lack of knowledge with regard to its proper design. A little reasoning will show that when the ratio of the distance between the teeth and the magnetic gap is too small a concentration of the lines of force will take place so that the pole pieces will be swept over alternately by sections of the highly concentrated lines of force and by practically inert material. The result is that Foucault currents must inevitably be set up in the pole pieces and cause the heating which has been noted in the past. By so proportioning the teeth, however, that the lines of force emanating from the pole pieces are more evenly distributed over their entire surface surrounding the armature, this abrupt demarcation is avoided, with the result that Foucault currents are also avoided in the pole pieces.

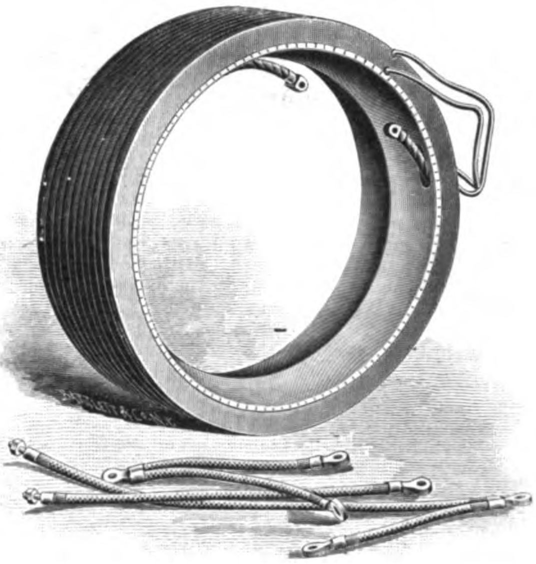

BARTLETT & CO. N.Y.

LUNDELL FIELD MAGNETS.

The result of actual practice with the Lundell machine has shown the soundness of this theory, which is carried into practice by the employment of deep and narrow slots.

Notwithstanding the ironclad nature of the machine, the concentric position of the field coil allows the armature to be withdrawn without disturbing either the field coil or the pole pieces.

The openings around the armature at the ends of the field magnets are, in the larger machines, covered with metal screens to protect the working parts, and to secure at the same time perfect ventilation. The commutator portion of the armature alone projects outside the screen, and is well protected by a strong bracket which carries the out-board bearing. The brushes are arranged diametrically around the commutator and the opposite brushes are in all four-pole machines connected together. They can be raised from the commutator when the machines are not in use.

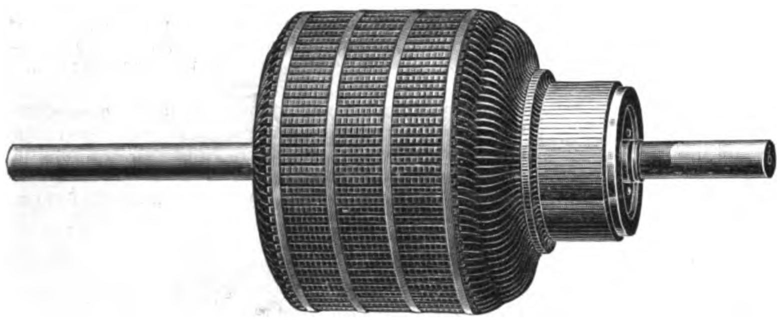


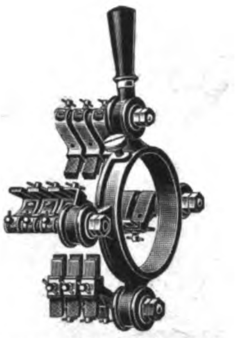
LUNDELL FIELD COIL.

The brushes of the two-pole type have a unique spring arrangement for pressing the carbon brushes against the commutator. The spring has its rear end placed in a curved slot at the end of the brushholder, while its forward end in the shape of a T presses against the carbon which slides in the ways in the brushholder. To remove the carbon, it is merely necessary to press the spring upwards out of the slot, which releases it so that the T can be withdrawn, and the carbon slides out.

The bearings are constructed with mechanical accuracy, are self-oiling and are provided with a vision gauge. The bushings are made of the best material and are so arranged as to be readily removed and renewed when worn out.

Recognizing also the necessity of continuous lubrication, oiling is accomplished by means of a number of rings which encircle the shaft and dip into the reservoir, thus continually feeding fresh oil to the bearing. In order that the attendant may know the exact condition of the oil, a simple oiling device has been added, consisting of an elbow with an oil chamber rising slightly above the normal level of the oil. The vertical arm of this elbow is so arranged that when the visual gauge is half filled the bearing is properly oiled. The glass tube is made so short that by no possible inadvertency can the attendant pour in oil sufficient to flood the bearing and cause the oil to run out at the inner surface of the shaft and so go into the armature.

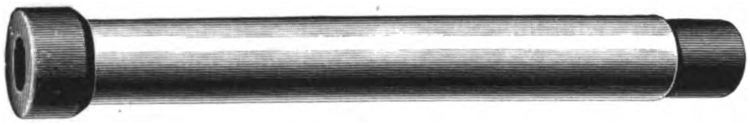

LUNDELL ARMATURE.


LUNDELL BRUSH-HOLDER.

The Interior Conduit and Insulation Company guarantee that the efficiency of the Lundell dynamos and motors is as high as can be obtained by any first class machine.

This company is also introducing an armored bushing which complies with the requirements of the Underwriters' rules. This bushing has points of superiority over any other kind permitted by the rules.

It is thoroughly "waterproof," "non-combustible," and has superior insulating qualities. The armor gives strength and durability, which neither glass, porcelain nor vulcanized rubber composition possesses. It is more serviceable, requiring a smaller hole in beams and joists than porcelain or glass, and for this reason alone should meet with the approval of architects.


ARMORED BUSHING.

Queen & Company's Tachometers.

Queen & Company, Philadelphia, have a very excellent portable tachometer by means of which the speed of engines, dynamos and motors can be quickly and accurately determined. It is compact, convenient to handle and will indicate revolutions up to 3,000 turns per minute. They also have stationary types for permanent attachment. In the economical operation of a lighting or power plant it is highly necessary to run a dynamo very close to schedule speed, which can only be determined by an instrument such as the above.

An Encouraging Report.

Working full time and full capacity, and behind on their deliveries, is the gratifying report furnished by the Clayton Air Compressor Works, of 43 Dey street, New York, as to their shops in Brooklyn.

In the prevailing business depression this speaks volumes for the excellence of the Air Compressors built by this company. They have recently taken out several valuable patents on a new triple compound high pressure air or gas compressor, used largely by manufacturers of carbonic acid gas.

The Ball Engine Company.

The following sales of Ball Engines were made by Mr. F. R. Chinnock during the last few weeks of his connection with the Ball Engine Company:

J. M. Iver Company, Danbury, Conn., 1 engine.
Ridgewood Electric Light and Power Company, Ridgewood, N. J., 1 boiler.
Brooklyn Navy Yard, one 100 h. p. heavy duty engine, for running saw mill.
General Electric Company, for Hot Springs, Va., increase, 2 engines, 1 boiler.
Imperial Hotel, New York City, one 150 h. p. engine.
Messrs. Schwarzenbach, Huber & Company, Union Hill, N. J., 1 boiler.
For export to Cuba, 3 engines.
Big Four Railroad Company, Indianapolis, Ind., complete steam plant, including 2 engines and 3 boilers.
John Goode's Rope, Cordage and Machine Company, Ravenswood, L. I., one 600 h. p. cross compound engine.

The Mather Electric Company.

Messrs. G. H. Angier & Company have succeeded Claflin & Kimball, incorporated, as New England agents of the Mather Electric Company, with offices at No. 116 Bedford street, Boston.

During the last two years Mr. Angier has had charge of the selling department of the Mather Electric Company and its various branch offices located throughout the United States. He has resigned this position, however, and will hereafter be the active manager of the new firm.

The Mather dynamo has been on the market for the past six years, and is in operation in over 1,000 of the largest mills in the country. This machine is particularly adapted for use in large buildings and manufacturing establishments.

Mr. C. A. Bowditch, who has been a very popular and successful attache of the Thomson-Houston and General Electric Companies for the last six years, has resigned his position with the General Electric Company and will have charge of the motor department of the Mather Electric Company, being associated with G. H. Angier & Company.

A Holiday Souvenir.

We have received a souvenir paper weight from the Electric Railway Equipment Company, of Cincinnati, in the form of a miniature trolley car, which was produced at their foundry, and which they are presenting to their friends with the compliments of the season.

INCORPORATIONS.

The Conduit Construction Company, New York City—to construct electrical conduits. Capital stock, $25,000. Promoters: Thos. C. Buck, Chas. W. Keep, Julien L. Myers, New York.

The Mechanics' General Manufacturing Company, St. Paul, Minn.—to manufacture electric motors, hardware and aluminum wares, novelties, machinery tools, materials or goods of any kind. Capital stock, $10,000,000. Promoters: Darwin H. Kent, St. Paul Park; A. A. Price, F. M. Johnson, P. L. Uttly, C. J. Backus, St. Paul.

The Pontiac Standard Lighting Company, Detroit, Mich.—to produce, manufacture and sell electricity for light and power in Pontiac, Mich. Capital stock, $30,000. Promoters: Geo. E. Fisher, O. D. Chase, Detroit; Geo. H. Foster, Pontiac, Mich.

Wallace Electric Company, at Chicago. Capital stock, $2,000. Incorporators: William J. Candish, William V. R. Lansigh and Jessie F. Pebbles.

The Stephenson Electric Light Company, Stromsburg, Neb.—to engage in electric lighting, etc. Capital stock, $25,000. Incorporators: J. B. Buckley, P. T. Buckley, J. A. Frawley, G. S. Osborne and Dr. W. A. Post.

The Cutler-Hammer Manufacturing Company, Chicago—to manufacture electrical appliances. Capital stock, $50,000. Incorporators: H. H. Cutler, E. W. Hammer, R. L. Commons.

The Prairie City Electric Company, Prairie du Chien, Wis.—to establish and operate a general electric plant. Capital stock, $5,000. Promoters: W. H. Thompson, A. I. Heiman, S. N. Bresbee.

The Northwestern Telephone and Electric Company, Milwaukee, Wis.—to engage in general telephone and electric business, manufacturing and dealing in appliances, etc. Capital stock, $50.000. Promoters: A. B. Ferdinand, H. C. Dodge, E. V. Spencer.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED DECEMBER 19, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

511,017. Electric Railway Switch and Crossing. William W. Hendrix, Bowling Green, Ky. Filed Aug. 5, 1892. Renewed Nov. 22, 1893.
511,018. Electric Railway Trolley. William W. Hendrix, Bowling Green, Ky. Filed Aug. 5, 1892. Renewed Nov. 22, 1893.
511,019. Electric Railway Trolley. William W. Hendrix, Bowling Green, Ky. Filed Oct. 7, 1892. Renewed Nov. 22, 1893.
511,131. Electric Railway Signal. Jose Ortega y Espinosa, Mexico, Mexico. Filed Oct. 26, 1891.
511,173. Electrically Operated Railway Switch. Chas. A. Stone, Newton, and Edwin S. Webster, Boston, Mass. Filed Aug. 30, 1892.
511,254. Closed Conduit Electric Railway. William S. Smith, Berkeley, Cal. Filed Feb. 29, 1892.

ELECTRIC LIGHTS AND APPLIANCES.

511,049. Electric Arc Lamp. August Hormel and George S. Junginger, New York, N. Y. Filed March 24, 1893.
511,229. Electric Lamp. Albert Zobel, Munich, Germany. Filed Feb. 15, 1893.

MOTORS, DYNAMOS, ETC.

510,892. Brush-Holder. John R. Coffman, Detroit, Mich., assignor of one-half to the Eureka Tempered Copper Company, North East, Pa. Filed Dec. 9, 1892.
510,947. Electric Locomotive. Charles F. Winkler, Troy, N. Y., assignor to the United Columbian Electric Company of New Jersey. Filed March 11, 1893.
510,952. Brush-Holder for Dynamo-Electric Machines. Frank E. Averill, Syracuse, N. Y. Filed Feb. 13, 1893.
511,157. Hand Regulator for Electric Motors. William D. Packard, Warren, Ohio. Filed Dec. 8, 1892.
511,196. Electric Motor. Oliver F. Conklin, Dayton, Ohio, assignor to the Dayton Fan and Motor Company, same place. Filed July 5, 1893.
511,214. Brush-Holder for Electric Motors. James J. Robison and Fred. B. Perkins, Toledo, Ohio. Filed Feb. 6, 1893.
511,289. Power Transmitting and Speed Regulating Mechanism. William Cooper and George P. Hampton, Minneapolis, Minn., assignors, by mesne assignments, to the Cooper-Hampton Electric Company, same place. Filed Jan. 27, 1892.

TELEPHONE AND TELEGRAPH APPARATUS.

510,929. System of Telegraphy. Josiah A. Parker, St. Louis, Mo., and Leland L. Summers, Chicago, Ill. Filed July 30, 1892.
511,005. Telegraphic Relay. Edward Weston, Newark, N. J. Filed June 4, 1891.
511,081. Telautograph. Rudolph M. Hunter, Philadelphia, Pa. Filed May 26, 1893.
511,118. Magneto-Telephone. James A. Brown, Moline, Ill. Filed Aug. 16, 1893.
511,172. Telegraphic Transmitter. Mary E. Stinde, Red Bud, Ill., administratrix of Herman F. Stinde, deceased. Filed May 4, 1893.
511,234. Morse Transmitter. Albert F. M. Cornand, Brussels, Belgium, assignor of one-half to W. T. Barnard, New York, N. Y. Filed May 29, 1889.
511,244. Telegraph Relay. Frank P. Medina, San Francisco, Cal. Filed May 4, 1891.
511,276. Two Station Telephone Circuit. Frank A. Pickernell, Newark, N. J. Filed Aug. 7, 1893.

BATTERIES.

511,159. Primary Electric Battery. Edward Poppowitsch, Brooklyn, assignor of one-half to Herman Wustenfield, New York, N. Y. Filed Dec. 28, 1892.

ELECTRIC SWITCHES.

511,187. Electric Regulating Switch. Edward A. Barrer, Watertown, N. Y. Filed June 26, 1893.
511,240. Electric Switch. Jesse L. Hinds, Syracuse, N.Y., assignor to the Electric Engineering and Supply Company, same place. Filed Nov. 27, 1891.

MISCELLANEOUS.

510,889. Temperature Regulator for Electric Heaters. Albert M. Butz, Oak Park, Ill. Filed Dec. 24, 1892.
510,898. Electrical Connector. Frank G. Curtis, New York, N. Y. Filed Feb. 13, 1893.
510,899. Method of Adjusting the Joints of Carbon Electrodes. Elisha B. Cutten, New York, N. Y. Filed March 28, 1893.
510,900. Apparatus for Electrolytically Producing Soda and Chlorine. Elisha B. Cutten, New York, N. Y. Filed March 30, 1893.
510,901. Electrode for Voltaic Cells. Elisha B. Cutten, New York, N. Y. Filed May 1, 1893.
510.902. Electrode for Voltaic Cells. Elisha B. Cutten, New York, N. Y. Filed May 1, 1893.
510,921. Electric Pump. Frank N. Merritt, Duluth, Minn., assignor to the Electric Motor Company, same place. Filed Dec. 2, 1892.
510,932. Electric Elevator. Frank A. Perrett, Brooklyn, N. Y., assignor to the Elektron Manufacturing Company of New York. Filed Nov. 12, 1892.
511,188. Electric Signaling Device for Hose. George L. Barnard, Milwaukee, Wis. Filed Aug. 22, 1892.
511,245. Thermo-Electric Element. Max Mestern, Turin, Italy, assignor to the Thermo-Electric Company of West Virginia. Filed April 9, 1889.
511,259. Rheostat. Franklin A. Weller, Boston, Mass. Filed April 20, 1892.
511,286. Resistance Box. Adelbert O. Benecke, Newark, N. J. Filed Sept. 10, 1892.

To Inventors and Others.

United States and Foreign Patents Procured.

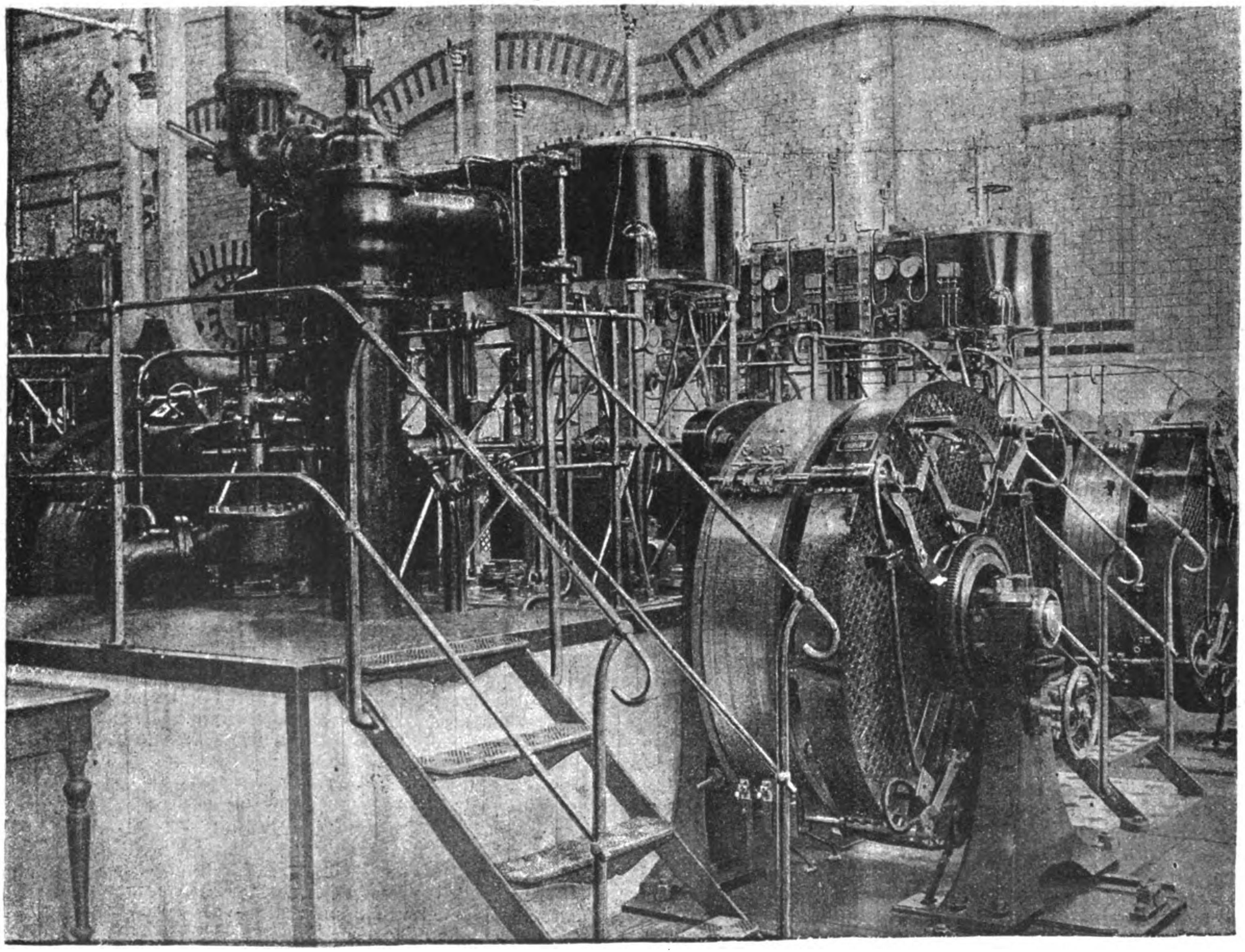
A PATENT DEPARTMENT has been established in connection with the publication office of ELECTRICITY, for the transaction of all business connected with the procuring of patents on inventions and devices of all classes. The object is to furnish inventors and others, at moderate cost, with a reliable, well-equipped and accommodating bureau through which they may be aided in procuring United States and foreign patents and obtain all information necessary to a successful prosecution of their claims.

Immediate attention will be given to inquiries and orders by addressing

T. F. BOURNE,
Manager Patent Department ELECTRICITY,
6 Park Place, New York City.

ELECTRICITY.

VOL. V. NEW YORK. JANUARY 10, 1894. CHICAGO. No. 26



DYNAMO ROOM, KONIGSBERG STATION. (SEE PAGE 306.)

The Five-Wire System at Konigsberg.

The municipal central station at Königsberg is one of only four stations which have adopted the five-wire system of distribution up to the present time. The area covered by this system is approximately a semi-circle whose diameter is about 2½ k. m., and the station is situated 40 metres from the centre of the circle, which is a considerable distance from the centre of distribution. It was for this reason that the five-wire system was decided upon, and the work was designed and installed by Messrs. Naglo Brothers, of Berlin, who proposed to employ dynamos varying from 90 to 160 volts, such as are required for parallel working and charging of accumulators. The accumulator battery had originally been projected by the town of a capacity of 400 lamps of 16 candles each during 10 hours. Such a battery was much too small, and working under these circumstances would have been out of the question. The municipality, accordingly, sanctioned Messrs. Naglo's proposal to increase the capacity of the battery to 1,000 lamps for 10 hours.

It is, however, not only the adoption of the five-wire system which invests the Königsberg Station with special interest, but also the mode of construction of the conducting network. The conditions specified in the tender only prescribed an underground system, leaving to the competitors the choice of details, and Messrs. Naglo Brothers, instead of the customary cables, proposed bare copper strips fastened to porcelain insulators and laid in *Monier* conduits. This mode of construction presents several advantages; in the first place a network of this kind has a high insulating capacity, and even if a leakage should occur through the condensation of moisture on the surface of the insulators, the heat produced by the escaping current would soon decompose the conducting layer of water. Another great advantage is the easy accessibility of the network. This is of special importance when additional conductors have to be laid, through increased consumption.

In the boiler-house there are four tubular boilers, constructed by Dürr, of Ratingen; they are of 134 sq. m. heating surface each, and 12 atmospheres pressure. The engines, coupled direct to the dynamos, have been constructed by F. Schichau, of Elbing; the two larger ones are of 200 horse power, the smaller ones of 100 horse power each. All four are vertical triple-expansion condensing engines, the condensing water being obtained either from a well communicating by a pipe with the river Pregel or from the town supply. All the machines make 200 revolutions per minute. The cylinder diameters of the larger machines are respectively 300, 490, and 750 mm. at a common stroke of 350 mm., while those of the smaller machines are 240, 390, 600 mm. respectively. To either side of the prolonged shaft of the four steam engines a dynamo armature is keyed direct, while the field-magnets are bolted to the engine frames.

The Frontispiece shows part of the machinery room, containing two steam engines together with the dynamos coupled direct to them. The dynamos, as will be seen from the figure, are internal-pole machines, the smaller ones with 4 and the larger ones with 6 poles. The armatures have no special collectors, but the current is taken off from the external circumference of the winding by 4 or 6 groups of three brushes each, the brush-holders being fastened to and movable about a common casting, so that they can, by means of levers fastened to their extremities and connected to a second casting, be simultaneously pressed against or taken off from the armature circumference. The frame carrying the brush-holders can also be turned by means of a hand-wheel, and the position of the brushes altered in this way. The magnet coils of the whole of the 8 dynamos are shunt-wound, and the winding is so arranged that the voltage can be varied between 90 and 160 volts. For the large dynamos an output of 64 kilowatts at 100 horse-power and for the small machines half this output had been guaranteed, which is equivalent to 630 watts per horse-power or 85.6 per cent.

The battery of Tudor accumulators, supplied by the Hagen Accumulator Company, consists of 284 cells of type 24. The capacity of this type of cell at a maximum discharge current of 276 amperes is 920 ampere hours, and rises, at a discharge of 158 amperes, to 1,320 ampere hours. The charging current is 230 amperes, and the battery at present can feed about 1,260 lamps.

The regulation of this battery is effected by automatic cell switches having two sets of connections to the system. One set consists of test wires which are connected to various distributing centres, and the other connection is made to a point of constant potential, and the regulators preserve a balance in the pressures between these points.

The discharge levers of the 5 cell switches are operated automatically. For this purpose 5 switches and relays are provided, the relay leading to the middle cell switch being polarized. The lever can also be operated at will, by making contact through push buttons. Two levers are provided for each cell switch, one for right hand, the other for left hand motion. The charging levers of the cell switches are operated by hand, according to the indications of a voltmeter giving the E. M. F. of the first cell to be switched off. These cell switches are manufactured by the Hagen Accumulator Company.

The current from each dynamo after passing through an ampere meter, fuse and automatic cut-out is led to a switch from which it can be sent either to a bus bar or the charging lever of a cell switch. The discharge levers of the cell switches are connected through ampere meters, cut-outs, etc., to the same bus bars that are connected to the dynamos, from which the feeders are taken off. Relays which operate at a definite voltage are employed to prevent the dynamos from being put into circuit before reaching the proper E. M. F.

The underground system has eight distributing points, to each of which five feeders are run after passing through automatic cut-outs and fuses. The average pressure between the feeders is indicated by four voltmeters constantly in circuit, and there are four other voltmeters with switches for showing the pressure between any two feeders at any distributing point.

In the conduits for the distributing system the insulators carrying the copper conductors are so arranged on their supports, fastened to an iron cross arm, that the distance between two neighboring strips is always 100 mm. Copper conductors are employed from 5 to 345 mm.^{2}, and in length from 6 to 20 m. A number of S shaped flexible strips are inserted at intervals to allow for contraction and expansion of the conductors with changes of temperature. The house services are taken off with two, three, four or five wires according to the amount of current to be supplied, and the regulation of the system is stated to have given entire satisfaction. The above details of this plant are taken from a description in *Electricity*, London.

The New York Electrical Society.

The next meeting of the New York Electrical Society will be held at Columbia College on Tuesday, Jan. 16, at 8 P. M. Prof. M. I. Pupin will deliver a lecture on "Electrical Resonance," accompanied by experiments showing the properties and influence of self-induction and capacity on electric circuits.

Patent Litigation—II.

Absurd Basis for One of the Patents.

Compound Winding Described Twenty Years Ago.

THE STATUS OF COMPOUND WINDING PATENTS.[†]

One of the most important patents which have been claimed in course of the patent litigation launched by the General Electric Company is the United States patent of T. A. Edison, granted September 19. 1882, for a "regulator for dynamo electric machines," the application for which was filed in August of the same year. The specifications of this patent describe compound winding, or the combination of the shunt and series methods, and the object of the invention is stated to be the automatic regulation of the current when the load of the dynamo is varied.

The claim of the company to the exclusive right to use this method of winding is not new. It was put forth with emphasis and with unblushing assurance by Mr. F. P. Fish, at the hearing before the State House Commissioners in Boston on July 18, 1892, when the Mather Company were in controversy with the General Electric Company. Mr. Fish's contention was at that time that no other company in the United States could carry out the specifications for the State House plant without infringing the patents of his company.

It is a matter of surprise to everyone familiar with the history of the art how a patent for this device could have been issued in 1882, as compound winding had not only been described and put into practical and commercial use several years previous to Edison's patent, but a prior United States patent for precisely the same thing had been granted more than two years before. A brief historical glance affords evidence of the truth of these statements, and will be of interest in view of the exclusive claim of the General Electric Company to this winding.

The earliest description of compound winding dates back to 1871, when it was mentioned by Sinisteden in *Poggendorff's Annalen*, and the first machine employing this principle was built by Mr. S. A. Varley, who obtained a patent for it in England in 1876 (No. 4,905). In this machine both a shunt and a series winding were used, both of which were wound on the field coils and both running to the lamp. The shunt coil, also, was a closed circuit, the lamps being connected in the low resistance circuit. This winding differs from that used to-day in having the shunt circuit carried parallel to the main external circuit to the lamps, but it has been declared in the Scotch courts to anticipate the Brush patent for compound winding, which was granted in 1879, and which describes the method in general use at present. That this subject was not novel at that date is evidenced by the fact that C. F. Brush and Edward Weston had filed simultaneous applications for patents on this device which were in interference. As the same parties were also in interference on another patent, the matter was compromised by agreement, Mr. Brush taking the patent on compound winding and Mr. Weston taking the other patent in dispute.

Brush's application was in interference with the application of Edward Weston filed June 6. 1877, the issue of the interference being the second claim of the Brush patent, mentioned below.

At the same time there was another interference, Weston vs. Brush, involving a ventilated armature for dynamo-electric machines. The latter case was "Case B," and the former one "Case A."

[†] On page 296 of our last issue the statement that 1,200,000 foot pounds is contained in ⅛ ounce of good coal should have read 1⅛ ounces. Error was also made in referring to Judge Green as a United States Circuit Court Judge, Judge Green sitting in the United States District Court.

The parties made cross concessions of priority, Weston conceding priority to Brush in "Case A." and Brush conceding priority to Weston in "Case B." No testimony was taken in either case, and the preliminary statements were subsequently withdrawn.

Previous to the settlement of this interference case, Mr. Weston had built more than a dozen compound wound machines for electro-plating purposes (some of them in 1877) which were sold through Messrs. Condit, Henson & Van Winkle, who were then the selling agents for the Weston Dynamo-Electric Machine Company. These machines were sold in New England, and some of them are believed to be still in use. They were referred to in the catalogue of Condit, Hanson & Van Winkle for 1878.[*]

The Wallaces, at Ansonia, had built and sold, *before* 1879, more than one hundred small machines wound in this manner, many of which must still be available.

In the early part of 1878, Messrs. Siemens & Halske shipped to this city from Berlin a compound wound machine, which is still believed to be doing good service and which could be easily located.

Brush had built a number of them before the interference case came up; they were well known in the trade under the name of "Teaser Machines." One of them was installed in Sing Sing Prison in 1878.

Brush was undoubtedly the first to use a compound winding of the usual kind employed at present, and incontrovertible proof of the fact that these machines were identical with the present compound-wound dynamos will be seen by reference to the specifications of Brush's patent of July 22, 1879, which states:

> "*My invention has for its object the maintenance in such (dynamo-electric) machines of a 'magnetic field' while the machine is running, whether the external circuit is closed or open.* . . .
>
> "*I attain my object by diverting from external work a portion of the current of the machine and using it either alone,* **or in connection with the rest of the current,** *for working the field magnets. I prefer the latter plan of the two just above mentioned, especially for electro-plating machines.* . . .
>
> "*In applying my invention to dynamo-electric machines I wind the cores of the field-magnets with a suitable quantity of comparatively fine wire having a high resistance in comparison with that of the external circuit and the rest of the wire on the machine. The ends of this wire are so connected with the other parts of the machine that when the latter is running a current of electricity constantly circulates in such wire whether the external circuit be closed or not. The high resistance of this wire prevents the passage through it of more than a small proportion of the whole current capable of being evolved by the machine; therefore the available external current is not materially lessened.*"

This description covers the present method of compound winding as accurately as it could be expressed, and this fact is still further emphasized by the drawings which accompany the specifications of the patent, and which show the shunt and series windings on one or each magnet-core and include every possible disposition of the two windings.

From the foregoing description it appears probable that all of the advantages of compound winding were not appreciated by Brush at that time. The shunt coils-- then called "teasers"—were adopted at first to prevent a reversal of polarity in the machine when the external circuit was broken, but their functions as regulators at once became apparent, as in 1878 a machine built by Brush was practically self-regulating, showing a variation of less than one volt in pressure through its extreme range of 300 amperes.

About two years subsequent to the date of Brush's patent of 1879, Marcel Deprez demonstrated theoretically the fact that at its normal speed a dynamo would be self-regulating in regard to pressure if wound with an auxiliary coil furnishing a constant excitation of the field-magnets independent of the series coils, and his conclusions were published in *La Lumière Électrique* of December 3, 1881.

Eight months after this publication of Deprez's, and four years after the commercial use of compound wound machines by Brush, Weston, Wallace, Siemens and Halske, after the idea had been described and redescribed and was thoroughly understood by scores of practical workers, an application was filed by Edison for the same device covered by Brush's patent, with the object of self-regulation described by Deprez. To show the absolute identity of the Brush and Edison patents it is only necessary to compare the claims of these patents. In Brush's patent the claims read as follows:

> (1) In a dynamo-electric machine the wire or helix E[*] having a comparatively high resistance and kept constantly in closed circuit while the machine is running, in combination with the magnet wire or helix F[*], as commonly employed.
>
> (2) In a dynamo-electric machine in which the coils around the field-of-force electro-magnets are included in the main or operative circuits, the combination of such main circuit with a constantly-closed differential circuit of prescribed resistance, for the purpose of maintaining the flow of the current through the coils surrounding the electro-magnets in the machine when the main or operative (external) circuit is broken, substantially as shown.

Edison's claims are as follows:

> (1) The combination, with a dynamo-electric machine and devices arranged in multiple-arc of a field circuit of constant resistance for primarily energizing the field magnet. and another circuit whose resistance is varied by the addition and removal of translating devices, substantially as set forth.
>
> (2) The combination, with a dynamo-electric machine, of one of its main conductors forming a portion of coils of its field magnet, a circuit for primarily energizing such field magnet, and translating devices arranged in multiple arc or divided circuits whereby the addition of each individual translating device causes a corresponding increase in the energy of the field magnet, substantially as set forth.
>
> (3) The combination of a multiple-arc circuit containing a portion of the coils of the field magnet of a dynamo-electric machine, a multiple-arc circuit containing the armature of said machine, and multiple-arc circuits containing lamps or other translating devices, all such multiple arc circuits being derived from the same main conductors, and another field circuit whose resistance is varied by the addition and removal of translating devices, whereby the addition or removal of any translating device causes an instant and corresponding regulation of the current energizing the field magnet of the machine, substantially as set forth.

It will be seen at a glance that the claims of both the patents describe exactly the same device, although each inventor uses it for a different purpose. In the Brush claim the expression "in which the coils around the field-of-force electro-magnets are included in the main or operative circuits" includes very broadly the combination claim of Edison of a multiple arc circuit containing translating devices.

The only question of difference between the two patents is, then, the purpose for which the device is used, and an old invention applied to a new use is not a patentable novelty, as it is not invention to use an old thing or process for a new purpose.

The decisions of the Supreme Court on this point have been numerous and are unanimously in accord with the foregoing statement. An illustration of this is the case of Brown vs. Piper, in which the Court held that a patent for preserving articles in a close chamber by means of a freezing mixture having no contact with the atmosphere of the preserving chamber, described nothing but a double use of the ordinary ice-cream freezer, and was therefore not patentable. Also in the case of Tucker vs. Spaulding the patent covered the combination of a circular disk with removable saw teeth. There was a prior patent of the combination of a circular disk with removable cutters for the purpose of cutting tongues and grooves, and it was held that the latest patent was but a double use of the older one and was not an invention.

These cases appear analagous to the case of the Brush and Edison patents on compound winding of dynamos, and it is probable that if the latter were brought before the court Edison's patent would be declared only a double use of the older Brush winding on which the patent has expired.

In addition, however, to the evidence that Brush's patent anticipates that of Edison by more than two years, there are several other causes which should operate to invalidate the latter patent, and which are indicated in the bill of complaint in the case of the Edison Electric Light Company vs. the Mather Electric Company, now pending. This bill recites:

> "That heretofore, as your orator (the plaintiff) is informed and believes, and prior to the seventh day of August, 1882, Thomas Alva Edison, being then a citizen of the United States, residing at Menlo Park, in the County of Middlesex and State of New Jersey, was the true, original and first inventor or discoverer of a certain new and useful invention, to wit: An Improvement in Regulating the Generative Capacity of Dynamo-Electric Machines, and that the said invention was not known or used before his invention or discovery thereof, and had not been patented or been described in any printed publication in this or in any foreign country, and was not, and had not been at the time of the application for letters patent therefor, in public use or on sale in this country for more than two years, nor contrary to the provisions of the Statutes of the United States in such cases made and provided; and had not been abandoned to the public."

In view of the amount of prior use of this device and the number of publications in regard to it previous to Edison's application, the complainant's information seems to be peculiarly deficient, and it is incomprehensible how, if compound winding was not known or used prior to the date of the Edison patent, Mr. Edison had before that time put himself on record by publicly claiming that compound winding was of no value. This fact at least should have been within the knowledge of the plaintiff.

The use of this winding by Brush and Weston in 1878 and 1879, the descriptions of it by Sinisteden in 1871, already mentioned by Sir C. W. Siemens in *Philosophical Transactions*, March, 1880, and by Alexander Siemens in the *Jour. Soc. Telegr. Eng.*, April, 1880, besides the theoretical deductions of Marcel Deprez in *La Lumière Electrique* (1881), quoted above, in which he shows that this winding should act to effect self regulation, all are well known, and the printed publications have been frequently quoted in a number of scientific books.[*]

We have been asked why the Edison people had not laid claim to the patent earlier, over half the life of the patent already having elapsed. We are unable to answer this question, and shall await with some curiosity the answer which will be made to it by counsel of the General Electric Company when the case comes before the courts for argument.

We grant that the glamour which surrounds everything labelled "Edison" is such as to blind the eyes and deaden the perceptions of not only the public but of able jurists; but we do not believe that the managers of the General Electric's patent campaign have so far lost their wits as to believe in their case on this compound winding matter. We do not believe they will ever argue the case. We do believe that they will bring a number of suits against contractors who cannot defend them, and manufacturers who do not consider the idea essential for their machines, and in this way the General Electric Company may get decisions in its favor. Moreover, while suits are pending they can no doubt be used as effective arguments to persuade contractors and purchasers generally that Edison apparatus is the only safe apparatus to buy.

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[*] It is worthy of notice that the catalogue of this company for 1879 refers to a new type of dynamo machine, from the description of which it is manifest that Weston was far in advance of other American inventors in conceiving and successfully adopting the idea of automatic regulation.

[*] Letters refer to patent drawings.

[*] See Dynamo-Electric Machinery, S. P. Thompson, 4th edition, p. 61.

The injustice of such abuse of absurd patents which have by hook or crook come through the Patent Office is apparent and does not require comment. But this we believe to be the policy of the General Electric Company. It is a fact that those in control of the company at present have pinned their faith to these Edison patents, and believe that they can be so manipulated as to bring forth success from the jaws of disaster.

Will they win? The answer to this question lies in part with every manufacturer and contractor liable for suit on any of the patents at present under discussion.

The plan of economy and safety is the raising of a common fund for the defence of these suits under the direction of the only attorneys who have won important battles for the independent concerns in the trade.

The third and last article in this series will be devoted to the Edison three-wire patent.

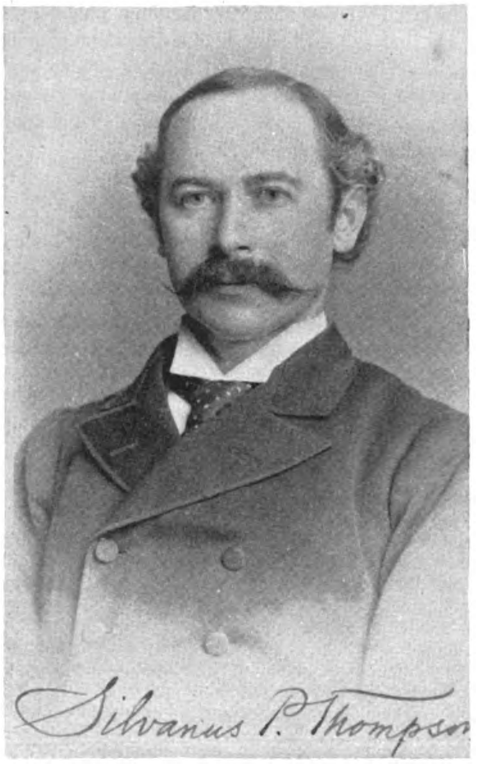
Technical Education in England and America.

Professor Silvanus Thompson's Views.

Professor Silvanus P. Thompson, who is the principal of the celebrated City and Guilds of London Technical College, Finsbury, is actively interested in the educational work that is being pushed by the wealthy old public bodies of the British metropolis with the object of enabling England to stand the strenuous competition of other European nations in the arts and sciences.

While in this country, Professor Thompson was interviewed by a representative of ELECTRICITY, and on being asked "What is being done in England in the matter of technical education?" Professor Thompson said:

"We have many schemes of technical education that are now developing both in London and in the provinces. There is much being done, but one cannot exactly say what it is, simply because it is growing so fast. Since the passing of the Technical Education Act, three years ago, which placed at the disposal of local bodies certain beer and spirit dues for the purpose of technical education, there has been much done and more begun. For example, in Birmingham the municipality has taken over the educational part of the Midland Institute, and is developing it into a large and important municipal technical school, which will have both day classes for students who give two or three years systematically to the work and the evening classes which were begun years ago by the Midland Institute. Again, in Manchester there is a magnificent technical school growing up under the municipality, partly from those beer and spirit dues, but having a large endowment from the bequest of the late Sir Joseph Whitworth. Also in Glasgow there is a splendid technical college for the West of Scotland. These three technical establishments are the best institutions in the provinces, and contain large laboratories, workshops and studios, and in fact all the appliances for a thoroughly practical education. One very important matter in connection with these movements is that they are taking their individual tone and strength from the industries of the places in which they are located. Until these funds were available locally, the only way of encouraging classes in applied science was from the funds administered from South Kensington by our Science and Art Department. These organizations did very good work for many years, but they are too often out of touch with the local industries. In London, the great work begun fifteen years ago by the City and Guilds' Institute has not extended as widely as some of its early supporters had hoped, but nevertheless it has two great colleges of applied science, the central institution at Kensington and the Technical College at Finsbury, both in a very flourishing condition. In these establishments, which have extensive laboratories and workshops, the courses are of a very high grade, and great pains are taken to secure as instructors men who, while having sufficient knowledge of theory, are thoroughly acquainted with the practical or workshop side of the subjects they teach. We look upon this as a prime requisite, and think it a great mistake for a schoolmaster to attempt to teach what he doesn't know. We prefer to take a man right out of the industry, who has the faculty of teaching, and pay him sufficiently well to make it worth his while to stay there. We have been particularly successful at both of these colleges in training young mechanical and electrical engineers. Of more recent growth in London are the polytechnic institutions, now some half dozen in number, which are more elementary, and include recreative work, which indeed in some of them takes the most prominent part. These institutions, which have been supported hitherto mainly by individuals or private corporations, are now aided by the funds diverted from the antiquated City Parochial Charities."



Silvanus P. Thompson

"Does your special educational experience lead you to think that for an electrical engineer the college training should precede, be combined with, or follow work in the shops?"

"Everything depends upon the temperament and previous training of the boy. In many cases it is undoubtedly best for him to go to the shops for a couple of years before his training at the technical college. Some of the best technical college pupils in my experience have been those who have had some previous experience of industrial life; but there are others for whom it is certainly better to defer entry into the factory until after they have had a year or two of technical training in the college. An intermediate system is possible, but only where the employers in the district are willing to co-operate with the technical college. This is the case among the engineers in the West of Scotland, and also in Bristol. The students of the Glasgow Technical College and of the technical department of the University College at Bristol can take a mixed course, spending the winter six months in the college and the summer six months in the factory. This system has been found to work admirably, for each kind of training helps the other.

"Until now it can hardly be said that the training given in any of the establishments in London I referred to replaces the old apprenticeship system, for the simple reason that employers are intensely conservative, and often sneer at efforts to teach in the schools anything that is of value from a practical point of view. But with the efforts to secure as teachers practical men who have had experience in the workshops, this feeling is dying away. There is another difficulty which technical education in the colleges has not yet met, namely, all the large firms receive pupils who pay large fees for the privilege of entering the profession or industry in a gentlemanly kind of way. In large engineering works, for example, there will often be a considerable number of idle young gentlemen who have paid their $1,500 to $3,000 for the privilege of going through the shops of that firm. Many of these learn little or nothing. It is difficult for the youth who has been trained in a technical college to find employment in such establishments unless he also is willing to pay the same fee as the young man who has had no training. This vicious system will die out, but at present it blocks the road to progress, for during a time of commercial depression there is a great temptation to managers to keep their works going by the fees from new articled pupils."

"How does the work done in English technical colleges compare with that done in American institutions?"

"It compares very favorably with that of such institutions as Cornell University and the Massachusetts Institute of Technology, but as a rule the day students do not stay long, but take a short course of two or three years. Indeed, we do not encourage them to stay longer, because no college can possibly give to a young man the same kind of training as he can get in the industry, where he is learning not only applied science but the art of managing men and of working to gain money. On the whole, I think the courses of instruction in England are a little less theoretical than those in this country. I have taken great interest in the Pratt Institute, Brooklyn. This compares closely with the polytechnic schools in London, and in many respects is superior to them. Those institutions which make so much of the recreative side cannot be as thoroughly in earnest as an establishment which devotes itself entirely to educational ends.

"You ask me about electrical engineering in our respective countries. Well, there are many points in which we can learn from you, and I think there are a good many also in which you can learn from us. We move very slowly, but for that very reason whenever we do anything we think it is done more perfectly and with more forethought than would be the case if the work had been rushed along. Our two electric railroads are, for example, much more solid and complete than anything you have on this side of the water, and they are *real* railroads, to which the nearest approach in this country is the intramural elevated road at the World's Fair. Electric car lines, of which you may have hundreds, are practically unknown with us, for the reason that with only two exceptions, so far as I am aware, our local authorities absolutely forbid the use of the trolley. I think we have only two trolley roads in the whole of England. It is not that we are opposed to electric locomotion, but our local authorities have set their faces against the use of overhead trolley lines. We have attempted to work two or three roads by means of accumulators, but these have not been a great success, owing to the difficulty of finding electric accumulators that will stand the racket of a jolting car. I have no doubt that accumulators can be made which will not deteriorate seriously with vibration, and which will not be too heavy for practical purposes. When once we have such accumulators, we shall have a great development of electric roads; but I do not think that trolley lines will ever become popular in England."

"Do you think there is any chance for the electric railroad conduit system in England?"

"I hardly think so, at all events judging from present indications. The conduit is too difficult to keep in order. Both its electrical and mechanical difficulties are very great and virtually prohibitive. They have a conduit road at Budapest which is working satisfactorily, but such a slot as they use would not be tolerated in England."

"Do you consider that England is abreast of us in electric lighting?"

"I am struck by the way in which electric lighting is used in this country, in the little outlying towns and villages as well as in the large cities. Our small towns and villages in England have hardly begun in electric lighting. They all have their little gasworks, which they cannot afford to change, or which they think they cannot. In our large towns electric lighting has progressed during the last four or five years considerably, and now it is the rule for the municipality to own its own electric station, just as it owns its gasworks or its waterworks. In London, however, the lighting is almost exclusively in the hands of stock companies. There is much less use of arc lamps for street lighting than is the case in America; but in the matter of domestic electric lighting I think we might give a good many points to American engineers. In one thing England is immensely ahead of the States, namely, that our industries, old-fashioned though they may be, are not cramped and torn to pieces by unscrupulous monopolies. The electric lighting companies in London are absolutely free from the tyranny of any monopoly holding rights on underground conduits."

"Do any other points of difference in electrical practice between England and America strike you?"

"I have been gratified at seeing the use that is being made in this country of electricity for motive power. This would be impossible if you had not for some years had a constant supply of current from central stations. I am struck by the very large use made of electric motors—for example, ventilating by means of fans. No doubt we should have the same in England if our climate required it. We have the motors and the fans, but when, once in a few years, we do have a spell of really sweltering weather, the Englishman buys a cheap palm leaf and cools himself."

Starting Multiphase Motors.

In starting multiphase motors having a closed circuited secondary member, it is found that the best starting torque is obtained when the resistance of the secondary element is considerably higher than would satisfy the best running conditions. This is because the resistance of the secondary best suited to efficient running is so low that the primary rush of current flowing through it on starting from rest is large enough to exercise a demagnetizing effect on the field so great as to materially decrease the starting torque. It has therefore been not unusual to connect with the secondary element a starting resistance, which later is removed from circuit. When the secondary element is the stationary part of the motor, this is very simply done by connecting properly in circuit with it an ordinary rheostat. In such case, however, collecting rings are required on the revolving member in order to supply it to the primary current. If on the other hand the secondary member is the revolving part of the motor and a fixed non-rotating rheostat is used, sliding connections are again necessary in the circuit of the rheostat. It is desirable to avoid the sliding contacts altogether, and this is the main object of a recent invention by Dr. Louis Bell, who makes the primary member the fixed part of the motor, and uses a starting resistance which revolves with the secondary member. The resistance is non-inductive in character, and a switch for short circuiting it is provided which also travels with the armature or revolving member, and which may be thrown while the motor is running, manually or automatically. —*Exchange.*

The failure is announced of the Railway Equipment Company, of Chicago.

A VAPOR LAMP.

The Star Electric Company Has Found Something New.

Mr. John Von de Kammer, electrician of the Star Electric Lamp Company of Chicago, who was one of the first to bring out a successful gas lamp, has perfected a Vapor Lamp which has created something of a sensation in Chicago.

The new lamps are now on exhibition at the rooms of the Ansonia Electric Company, and are attracting much attention. Some tests have been made with this lamp which are quite remarkable. One of the regular 16 C. P. lamps was over-run until the light produced measured on the photometer over 700 candles, and when afterward the filament was measured it was found that the resistance was no higher than at the start and the lamp had not been injured. It is well known that if the ordinary vacuum lamp is over-run but a few volts the lamp is practically ruined.

It is thought from these tests that the lamp will prove far more economical than either gas or vacuum lamps.

Another Large Scheme.

Electric Road Between New York and Philadelphia Proposed.

The United Press has the following:

The plans of the New Jersey Railway Company have been made public. The scheme is to build the longest electric road in the United States, connecting Philadelphia and New York.

Joseph H. Reall, of Bloomfield, is the projector of the enterprise, and associated with him are Charles E. W. Smith, of Morristown; J. H. Baldwin, of Orange; George S. Forbush, of Boston, and Major John Rurk.

Mr. Joseph H. Reall has always been a man of large ideas, and we are not surprised to find him in a new rôle. His tastes have always been of a pastoral nature, and he has owned, perhaps does yet, the finest herd of Jersey cattle in the State of New Jersey. He is also an expert judge of butter and cheese. So far as we know his schemes have always been profitable to himself.

We advise intending purchasers of stock in this new enterprise to hold a post-mortem on the Chicago-St. Louis Through-by-Lightning scheme before they invest, and to ask themselves a few questions as to the present conditions of traffic between New York and Philadelphia. Has the Reading's splendid service been properly patronized, and proved profitable? Is there any need for a new steam road between these two points. If not, what reason is there for supposing that an electric line would fill a long felt want?

The air-line-hundred-miles-an-hour theory will not work in the East.

Northwestern Electrical Association.

The Northwestern Electrical Association will hold its January meeting at the Hotel Pfister, Milwaukee, Wisconsin, on January 17th and 18th. The programme will open with an address by President Collins, of Green Bay. The papers are as follows: "New Things in Electricity," W. W. Low; "Essential Station Instruments," Prof. Jackson, Madison; "Corliss Compound Engines," E. L. Debell; "Advantages of Direct Connection," W. N. Stewart of the Siemens & Halske Electric Company, Chicago; "How Shall Members Buy Supplies?" H. C. Thom. Foreman Collins, Vice-President of the *Western Electrician* of Chicago, and J. McFadden of the General Electric Company of Chicago, will discuss the "Economical Use of Transformers."

A series of evening classes, with a very moderate rate of tuition, has been inaugurated in the department of Electricity and Electrical Engineering of the Armour Institute, Chicago.

Current Items.

An amateur electrician in the town of Dixville, Que., is operating a plant for supplying his residence with electric lights by wind power. This experimenting amateur has installed a small plant of storage batteries in his house, so connected to a dynamo and wind wheel that the whole arrangement works almost automatically. At a short distance from his dwelling he has erected a tower 58 feet high. Upon this tower is a 16-foot galvanized steel wind wheel, which is connected by a vertical shaft to the machinery below. In the base of the tower there is a room 14 feet square, in which are dynamo, regulators, automatic switches and other accessories. The dynamo is a 1,000-watt machine, with certain improvements which make it more suitable for work. Connected with the countershaft is a regulator which keeps the electric potential at a uniform voltage. There is, in addition to this, an electro-magnetic switch that opens and closes the circuit of the charging current whenever the potential of the dynamo, in stopping, falls below the voltage of the accumulators, or rises above it in starting. The storage batteries referred to are designed to lay up a supply of electricity sufficient to light the lamps for three or four evenings in case of a lack of wind for motive power.

M. Moison, a French electrician who has been experimenting with diamonds in the electric arc, says: By starting the arc slowly and placing a diamond in the crater, it is brought to incandescence and increases in size, covering itself with a black mass formed entirely of graphite. When the diamond is placed in an electric furnace it breaks into small fragments, each of which is changed into graphite; the stable form of carbon at the temperature of the arc is therefore graphite; in an oxy-hydrogen lamp at a temperature of 2,000 degrees, a diamond was covered with a black coating, but he never obtained any graphite.

D. H. Kent, of St. Paul, is the inventor of a telegraph typewriter, bearing his name, which, if successful, will eventually displace the Morse system entirely. The operator plays upon the keys of the instrument, as in any ordinary typewriter, but the resulting manuscript is produced at the telegraph office or station where it is to be delivered, which may be a thousand miles away. The main advantages to be gained by this over the Morse system are three in number—more words a minute can be sent, there is no receiving operator at the other end of the line to make blunders, the one to whom the message is addressed is not left in the dark by a blindly written message, every word being produced as it was ticked off by the transmitting operator.

A Connecticut paper mentions the peculiar origin of a fire which occurred recently in a dwelling house in Norwalk. An electric railway passes the place, and it appears that the return current, some of which escapes from the rails into the ground, followed an iron water pipe into the cellar of the house, then switched off to a gas pipe at a point where the two came in contact, and followed the latter to the meter, where it melted the lead connection and ignited the gas. The flames had caught the floor timbers when they were discovered, but the fire was extinguished with but trifling damage.

A new submarine torpedo boat built by Richard Radatz has been tested at Oshkosh, Wis., and found to work well. The boat is forty feet long and propelled and lighted by electricity, storage battery system. The boat carried three men and remained under water nearly an hour under perfect control. The inventor has several offers, but is waiting to hear from a proposition made to the Government.

The London, Brighton and South Coast Railway of England has thirty of its trains lighted by electricity, and is now about to equip a number of additional trains. It is said that about 15 per cent more work can be got out of an electrically lighted than of a gas lighted train, which makes a saving in first cost of about $225,000, as 85 electrically lighted trains can do the work of 100 gas lighted trains.

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Conduit Electric Railways. The discussion of the paper on "The Practicability of Electric Conduit Railways," read at the last meeting of the Institute of Electrical Engineers, supports the opinion which we have advanced before, that the success of such a system depends almost entirely upon the dimensions of the conduit and the adequacy of its drainage connections. The system under discussion was that employed in an experimental road at Coney Island, and was described in detail in ELECTRICITY, Vol. 4, No. 25.

It will be remembered that in this system contact is made at intervals of five or six feet by means of a long flexible shoe carried under the car which operates the contact switches placed at each side of the conduit. The idea of this construction is to avoid leakage or short circuits, not by draining the conduit, but by keeping the line entirely insulated except at a point directly under the car. To prove that the drainage was of no consequence in this system, the conduit was filled with mud and water, through which the car was run with but a very slight amount of leakage. Such a test is, however, not at all conclusive except for the special conditions under which it was made. With one car there would be but two or three points of contact at most between which leakage could occur, and the amount of current between them would naturally be small unless the mud was a very good conductor; but in an extensive system using as many cars as some of our street railways do at present, this same experiment would be a very risky one, and would mean a chance of short circuit wherever a car was situated, in many cases twenty or thirty times to the mile. This plan no doubt reduces the danger of short circuits, but it would be obviously unadvisable to build the conduit so small as to introduce the liability of its becoming filled with mud or water.

In regard to the various plans which have been evolved for underground trolley lines to avoid leakage, it can be said in general that their object is attained at the expense of simplicity, and a number of sometimes complicated working parts are introduced necessarily. The actual expense of these constructions would be difficult to estimate, as they have as yet been tried on but an experimental scale. The increase in the cost of running bare conductors in a conduit would apparently be considerable, and the difference would pay for a large increase in the size of a conduit. The latter also appears to be the most logical remedy for the difficulties inherent in trolley conduits, and constitutes to-day the only practical and extensive application of this system that has so far met with success. There is certainly no reason for introducing any complications into a system unless they result in some tangible benefit, and in case of electric railway conduits these special devices have not only proved of no advantage so far, but actually are behind the simple conduit as far as practical application is concerned.

The results of these special systems even in the small experimental lines which have been built are far from satisfactory in most cases, whether due to inherent defects in the system or the temporary character of the construction. A sample road which requires continual repairs and adjustment, sometimes several during a single trip, is not calculated to impress railway men favorably, as their prime requirement is reliability of service.

There has been for some time an accepted general admission that a perfectly simple conduit of sufficient size, carrying bare conductors at either side near the top, is a failure, but the fact exists that its failure still remains to be proved, as no fair trial of the plan has ever been made in this country. Investigation in this direction is perhaps less inviting than that in the line of special and patentable devices, as it does not involve invention but only practical engineering.

This plan, however, is worthy of consideration, as it constitutes the only method which has as yet proved a commercial success abroad or at home.

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We Scoop our Contemporaries. We will be pardoned for calling attention to the fact that ELECTRICITY was the only electrical paper to publish last week the news of the removal of the offices of the General Electric Company from 44 Broad street to Schenectady, and the transfer of a large portion of the staff from the Lynn works.

Thus those who depend upon any or all of our contemporaries for their news were kept in total ignorance of the most important happening in the electrical business world for the past three months.

We know not whether our contemporaries failed to get the news, or whether they were afraid to print it. Probably the latter would be the correct explanation, but for whatever reason, *they did not have the news.*

Even the United Press and the afternoon papers of Wednesday, the 3d, were solely dependent upon our information, and copied our news almost verbatim.

This is only one instance of many, and is merely alluded to because of its prominence.

Giving all due credit to our contemporaries for much excellent matter, we emphasize the fact that in order to get the NEWS you must subscribe for ELECTRICITY.

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WE ARE advised that Mr. F. W. Webster, the purchasing agent of the General Electric Company, to whom attention was recently called in these columns, will not move from Boston to Schenectady, for the reason that his resignation has been called for. This is as it should be. The scandals in his department have been notorious. The man who has ideas of business decency that will permit him to conduct a mica mining business in Canada under the name of "F. W. Webster & Company," shipping all its product to the "American Mica Company, 620 Atlantic avenue, Boston, F. W. Webster Treasurer," which latter company sells nearly all of its product to "F. W. Webster, purchasing agent of the General Electric Company,"—this man, we say, is entitled to a seat in the New York Board of Aldermen. He is wasting his talents in the business world, and is not adding to the purity of business methods. The itching palm is a disease to be eradicated.

A Commendable Progressive Movement. The trade union of workmen in the electrical field known as the Brotherhood of Electrical Workers has inaugurated a movement looking to the educational advancement of its members which cannot fail to commend itself to both employers and employees in this branch of engineering, and which should be emulated by every organization of this character. The plan alluded to, which was briefly outlined in the last issue of ELECTRICITY, has been adopted by the Local Union No. 3 of this order, and includes the organization of a club consisting of 400 members, under the name of the Electrical Workers' University Extension Club, by which, with the co-operation of President Low, of Columbia College, a course of study in electricity and its practical applications will be offered to its members. The fact that the Electrical Contractors' Association has contributed very generously to this project shows that the object of the organization is heartily endorsed by employers of this class of labor.

The officer of the Union quoted as saying, "It is the ambition of Local Union No. 3 to rise above strikes and boycotts, and to educate its members for their own good," has concisely defined the true province of a trade union, and any organization pursuing such an aim must command the favor of everyone concerned in its work.

The members of almost every trade to-day have learned the advantages of organization, and there is hardly any department of trade in which a union of its members does not exist now. The history of trade unions also proves that organization has been a great benefit to the workers in every trade as long as the reasonable and legitimate objects of such associations were not overstepped. The incentive to organization among the various trades becomes very apparent by looking back to the conditions existing a few years ago. The Bricklayers' Association has been for years one of the closest trade unions ever organized, the number of apprentices and new members being strictly limited. The trade was one which obviously demanded no special education or intelligence on the part of its members, nor any outlay for tools, yet solely by reason of organization its members were able to command a salary of from four dollars to four dollars and fifty cents per day, while the carpenter, whose work demanded a far greater degree of intelligence, as well as an investment of perhaps a hundred dollars for tools, could be hired for a dollar a day less. The practical benefit of a union was thus made so apparent that it is now found in every trade, and it wields considerable power in adjusting the relations between capital and labor, and in maintaining labor at a high standard. The power of such unions has, however, not always been wisely used, as the list of unjustifiable and unsuccessful strikes will show, but an effort like that of the Electrical Brotherhood's to educate and advance its members is highly commendable and deserves the coöperation of all interested in the electrical trade.

WE HAVE computed that there are 2,712 people in the United States who borrow a copy of ELECTRICITY every week from their neighbors. This is a serious injustice to the publisher. If you enjoy reading ELECTRICITY, we are entitled to your subscription. If you dance you must pay the fiddler, and we are not printing the liveliest paper in the field solely for fun. Send in your subscriptions; you will get your money's worth every week.

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LOST, strayed, stolen or suppressed—the issue of the *Electrical World* for the week ending January 6. As our contemporary has shown symptoms of mental weakness lately, we fear something serious has happened. A suitable reward is offered.

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WE WERE in error in stating last week that Mr. Charles T. Hughes was among those whose resignations have been called for. Mr. Hughes will remain in his present position, and moreover will still be located in New York. Our issue for the 3d was put to press on Saturday, the 30th December, and there were a great many people talking all at once over our private telephone.

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RESULTS of the move to Schenectady are the reported resignations of Messrs. A. S. Bevis, treasurer, and S. D. Greene, assistant general manager. These two gentlemen have held responsible positions which they have filled with credit. They will carry into new fields the best wishes of ELECTRICITY, and in fact of all who know them.

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WE ARE not able, as some of our contemporaries seem to be, to extract much satisfaction from the fact that prices for incandescent lamps have been materially reduced. The cost of lamps is but an insignificant portion of the cost of a plant, and we doubt if a thousand more lamps will be sold at 30 cents than at 40 cents.

SOLILOQUY OF THE DOOMED.

To go, or not to go: that is the question:
Whether 'tis better in the body to suffer
The chills and aches of Mohawk miasm,
Or to take arms against a score of troubles,
And by resigning end them? To lie awake o' nights
No more; and by a word to say we end
The heart-ache and our allegiance to
A knocked-out company; 'tis a consummation
Devoutly to be wished. To quit, to lose our jobs,
To surrender all our salaries,
Perchance to walk on our uppers: aye, there's the rub;
For in this stagnant trade, what jobs will come
When we have thrown away our boasted snap?
This gives us pause. There's the respect
Due to a regular stipend
Even in Schenectady.
But who would bear the gibes and jokes of friends,
The oppressor's wrong, banishment from the Tenderloin,
The pangs of love broken off short,
The insolence of Directors, and the
Prolonged society of the mosquito,
When he himself might all his shackles break
With an office pen? Who would these fardels bear,
To grunt and sweat i' the ooze of the Mohawk flats,
But that the dread of something worse
Befogs the brain, puzzles the will,
And makes us wonder where we are at.
Thus fat salaries make cowards of us all;
And thus the native hue of resolution,
Is sicklied o'er with the pale cast of thought,
And determinations of great bluff and bluster,
Resignations penned in the hot flush of disappointment,
Are quietly thrown in the waste basket.
We take our medicine,
And decide—to go.

GAS LAMPS NOT EXEMPT.

Temporary Injunction Granted Against the "Novak" People.

Judge Shipman, of the United States Circuit Court for the District of Connecticut, filed a decision on January 8, granting a preliminary injunction against the Waring Electric Company, manufacturers of the "Novak" incandescent lamp, holding that lamp an infringement of the Edison lamp patent, and restraining the Waring Company from continuing the manufacture of the lamps.

Mr. Twombly is Puzzled.

The Accumulated and Well-Planned Mysteries of Eight Years Can't be Fathomed in a Day.

(*"Holland" in Philadelphia Press.*)

"It has cost the General Electric Company and another rival company half a million dollars already to find out which one of them is Julius Cæsar, and they have not discovered it," said one of the keenest of our capitalists this morning; but when I asked him if he could furnish any hint which would explain this mystery, he said that the only one that he could give would be such as would not be flattering to the intelligence of some of the very able men who are associated with that corporation. I heard him mutter something about "hoodwinked" and "buncoed" and "over-reached." but he seemed to be talking to himself rather than to me.

Mr. Twombly, for instance, whose connection with it has caused it to be esteemed a Vanderbilt corporation, is as much mystified about it as any outsider. He says he went into it upon certain representations, and because certain strong men were already in it, but that he paid little attention to it until a few months ago, when he found something was going wrong. Then, quite as much to save his business repute as his money, he gave much attention to it, and yet the more he investigated the less he seemed to know, a condition which he thought could be truthfully suspected of some of the other eminent capitalists who are with him there.

There is a feeling that we are on the eve of important developments in connection with that corporation.

Engaging Board at the Edison.

(*Schenectady Correspondence Albany Argus.*)

The following officials of the Lynn branch of the General Electric Company were in the city yesterday and were registered at the Edison Hotel: E. W. Rice, general superintendent and director of the technical department; W. C. Fish, of the lighting department; F. O. Blackwell, of the mining department; W. H. Knight, of the electric railway department, and H. G. Reist.

Well Informed? Well, Rather!

(*From the Financial Record.*)

"ELECTRICITY, a paper which has been hostile in its criticism of the General Electric Company, but also very well informed, states that steps are now taken to separate the Thomson-Houston from the Edison interests."

Legal Complications Arise.

(*From the N. Y. Press.*)

It is believed that an effort is being made to separate the Thomson-Houston Company from the General Electric, and it is reported that a conference was recently held in Boston, in which Judge Cobb took part, in which the legal possibilities of a syndicate taking control of the Thomson-Houston Company was discussed.

Personal.

Mr. Morgan Brooks, President of the Electrical Engineering Company of Minneapolis, was in town last week.

Mr. R. M. Jones, of Salt Lake City, an old-time hustler for the Sprague Company, has been a New York visitor.

Mr. Geo. W. Conover, for several years the buyer for the Ansonia Electric Company, has resigned his position and accepted the Western agency for the Perkins Switch Manufacturing Company. Mr. Conover is well known throughout the West in electrical circles and the Perkins Company are to be congratulated in securing him as their agent.

A Swindler Abroad.

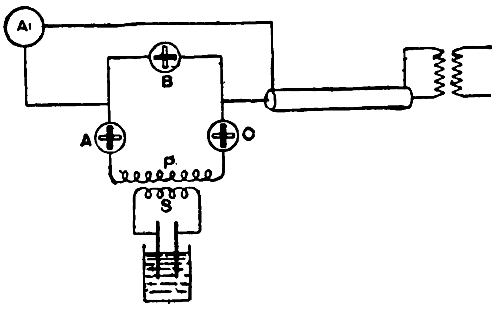
Walter Campbell, who bought the rights for Illinois under the patents of the Electrical Forging Company of Boston, is missing, along with $215,000 which he had collected from sales of stock in the Illinois Electrical Forging Company.

The Electrical Transmission of Power from Niagara Falls.

BY PROF. GEO. FORBES.

ABSTRACT OF DISCUSSION.

Dr. Fleming, in opening the discussion, said it was not always that engineers were to be found who were able or willing to take them into their confidence during the constructive stage of their work, and to tell them not merely what they had done, but what they were proposing to do. He would confine his remarks to two points, and the first was the difficulties which might be expected to appear in all cases where electrical transmission of power was conducted over long lines having capacity and self-induction. These difficulties were not merely hypothetical things which were discussed by Professors, and might, therefore, be safely neglected when coming to practice, but were exceedingly real, and capable of giving rise to very disagreeable and dangerous effects. One of the great risks which had to be avoided in the construction of these lines was the presence of pressure effects, which occurred when the lines were suddenly connected to, or disconnected from, the machines. Prof. Forbes was quite right in saying that under those circumstances surgings were set up in the cables and in the machines, and that the pressure might become almost anything they pleased; it might become scores if not many more times greater than the working pressure; in fact, it was impossible to say under some circumstances what the pressure actually did become, and under those circumstances it was of no use to say anything of failure of insulation, for no insulation would be sufficient to withstand the pressures that were brought against them. The methods by which they could be controlled had only to be known to be adopted. As Prof. Forbes had mentioned that those difficulties had been got over at Deptford, there could be no objection to his telling them the method adopted by his colleague, Mr. d'Alton, in consultation with himself and others. The way in which it was done now was this: The cable was never suddenly connected, but a transformer was placed in the main, and had on its secondary circuit an arrangement by which it could be gradually short-circuited. A water resistance was generally employed, but it might be carbon resistance. The first process of connecting the trunk mains was to keep the switch B open and close A and C, the transformer being open-circuited on the secondary side. Under these circumstances the transformer offered a considerable impedance to the flow of current, and that nullified the capacity effect in the main. The next step was to gradually short-circuit the secondary circuit of the transformer, reducing the impedance of the transformer. When completely short-circuited the switch B was closed, and then the switches A and C were opened, and the transformer was disconnected from the main. In switching off exactly the reverse took place. When dealing with long concentric cables the capacity might reach a very high value—one-third of a microfarad a mile. It was almost impossible to get a cable, if it was concentric, that had not a capacity effect. If they were to adopt a pressure of 20,000 volts, and a frequency of 100, which was probably what they would have done had they started this enterprise in England, and a capacity of one-third of a microfarad with 18 miles of cable, the capacity current in that cable would be 72 amperes when nothing was connected at the other end. That could be easily calculated from the formulae he gave some time ago. The capacity of that capacity current to do work, or rather mischief, was proportional to the square of the current and to the frequency. Hence the advantage of low frequencies, for the capacity was something enormous when they came to long lines. Concentric cables were therefore inadmissible for long lines. He thought there was great safety in using an artificial load in putting machines into and out of parallel. In all Continental stations they did so. When he (Dr. Fleming) was at Rome last Easter he spent a long day with Prof. Mengarini at Tivoli, and the latter allowed him to experiment with the machines there as much as he pleased. They had an artificial load which took up 300 H. P., and this artificial load was made to resemble as closely as possible the real external line. The process of putting the machines in was this: First of all they put them on the artificial line, and adjusted the incoming machines so as to give exactly the required current and volts. They then put on two machines and divided the current without any difficulty; then a third was put into parallel, and then a fourth, and a fifth. They were taken out one by one by reversing the process. That artificial line was used in all the Ganz stations, and he thought Prof. Forbes was very wise in making provision for it in dealing with his machines. It was curious that he had not adopted it much in England. He did not know any place where it was used; yet at the same time he hardly knew any large alternating stations on the Continent where it was not done. In the next place he would say one word on the question of pressure. He was very glad to hear Prof. Forbes say he never intended the primary circuit to be opened. But the question naturally occurred, would not the primary circuit sometimes open itself? In other words, what was going to be done in the way of main fuses? That was really a serious question in dealing with these pressures. What kind of main fuses did Prof. Forbes intend to adopt? In his paper he mentioned a transformer, the secondary of which had a working arrangement which would gradually introduce impedance if the current rose above a certain value. He trusted that the arrangement would be found to work well; but at the present moment one great want in connection with large distribution of alternating currents was an arrangement of main fuses which would not interrupt the circuit, but if the main current went above a certain value would put impedance into the circuit gradually but quickly, and then take it out again as required, but never allowing the main circuit to be broken. The great difficulty at present was that it *did* become broken, and a great rise of pressure took place, with disastrous results to the insulation. The question of pressure was one to which Prof. Forbes and his colleagues had doubtless given very serious consideration before deciding to adopt 20,000 volts. The difficulty which might be encountered with this high pressure was not the difficulty of working with the stock pressure of 20,000 volts, but the tremendous arcs which might be produced if they were started between the conductors. Prof. Forbes did not tell them, he believed, how far apart those cables were going to be in the conduits. He described a conduit in which copper strip was to be used as the conductor, but did not mention what distance they were to be apart. That was a very important matter. It might be impossible under some circumstances to prevent such rises of pressure that an arc would start, and what would be the state of affairs with naked conductors in those conduits if they were only, say, a foot apart? The question was sometimes asked, what is the best frequency to work at? It was very much like asking, what is the best speed to walk at? It depended upon where you were going and what you wanted to do. Continental engineers had not been at work at the matter at haphazard when they adopted a frequency of between 40 and 50. Our adoption of 80 to 100 was necessitated by the circumstances under which we had to start alternate current working; and the same in America. But there was no doubt, he thought, about the wisdom of selecting this low frequency at Niagara, where the utilization of power by motors was an important matter, and there were enormous advantages to be gained by the reduction of these capacity effects and other effects of the same kind by the employment of a reduced frequency.



Mr. W. M. Mordey said they were called upon to discuss a paper on a subject of world-wide importance, and he believed a sense of responsibility would be felt by all speakers. What made the paper so interesting was that Prof. Forbes not merely described the scheme and the works, but went pretty fully into reasons and principles. It was a very important matter that after so much work had been done on alternate current distribution of all sorts Prof. Forbes should come there and throw the gauntlet down to the whole industry on two or three points of primary importance in connection with distribution. Those of them, for instance, who had been working at comparatively high periods had to justify their continued existence and to prove that Prof. Forbes was wrong. Prof. Forbes stated in the paper that "it is a matter of common knowledge that parallel working is assisted by lowering the frequency." With all respect, he (Mr. Mordey) would deny that. He thought there was no evidence whatever to show, with any good plant now running, that lowering the frequency had any connection with parallel working. If there was no difficulty whatever in working at 100 periods there could be no improvement in working at a lower rate. It might be that, with certain types of machines, there were advantages in working at lower rates, but he believed that a machine that was incapable of working at 100 periods would work worse at 16 or 40 periods than a machine that would work at 100 periods successfully. The only definite argument Prof. Forbes put forward was a letter from Messrs. Ganz, who had written him "that their reason in adopting the frequency of 42 periods per second was that it is the lowest frequency that is available with arc lights so as not to produce any serious flickering, and their desire was to lower the frequency as far as practicable in order to ensure parallel working." Now, Messrs. Ganz were very important people; they had large experience all over the Continent, but it was very necessary to examine and sift statements of this sort, and not to accept them as facts. He thought they ought to ask if Messrs. Ganz had not been a little forgetful in making such a statement as that. In his paper on "Alternate Current Working" in 1889 he made a similar statement; he quoted a letter by Mr. Zipernowski to the *Electrician* of May 10, 1889, stating that their low periodicity was "chosen on principle," "that we by this means are enabled to couple our dynamos in parallel is not a secondary result, but just the end we are aiming at." His (Mr. Mordey's) surprise was, therefore, very great when during the discussion Mr. Zipernowski wrote: "We state that we have not reduced the periodicity because of the coupling in parallel," and adding that they had always kept to 85 alternations with only slight variations. He happened to know that this last statement was correct. For a considerable time before parallel working Messrs. Ganz had been making alternators of 42 periods per second; when parallel working was recognized to be a necessity they made experiments and adhered to 42 periods and gave out that they adopted it because it gave the best results in parallel working. I am not aware of any other support than that of Messrs. Ganz to Prof. Forbes's statement, and these words taken from Mr. Zipernowski's own writing showed that his last published statement contradicted his first, and acknowledged that they had made these machines for low periods for years before parallel working was thought of. The question of artificial loading in putting machines on to mains in parallel had also been dealt with by Prof. Forbes, and had been approved very strongly by Dr. Fleming. Now, that was an old, primitive, and he thought an obsolete method. He explained a plan was got out some years ago by Mr. Raworth and himself, and published in his Paper "On Testing and Working Alternators," by which the regulation of each alternator was entirely controlled by controlling the steam supplied to its engine.

(To be continued.)

Legal Notes.

The attachment of the Thomson Houston and General Electric companies against the Little Rock (Ark.) City Electric Street Railway Company having been sustained by Judge Hill releasing the sureties on the forthcoming bond, the attorneys immediately filed an answer, denying the debt, which also contains several counter claims.

Prof. Henry A. Rowland, of Johns Hopkins University, has brought suit in the United States Circuit Court against the Cataract Construction Company for $30,000 for his services as an electrical expert in planning a system to utilize the water power of Niagara for the generation of electricity. Prof. Rowland says he devoted six months to the work and then sent in his bill for $10,000. The company sent him a check for $3,500, which it considered sufficient. This angered Prof. Rowland, and he has brought suit for $30,000, declaring that he charged too little in the first instance.

On application of creditors, George W. Hoadly, cashier of the National Bank of Arizona, has been appointed by the District Court to be Receiver for the Phœnix (Ariz.) Electric Light and Power Company. The company was intimately connected with the defunct Hartford Bank. Reorganization is expected to bring the company around all right, as the franchise is valuable.

The American Bell Telephone Company has begun suit in the United States Circuit Court against the Grand Rapids (Mich.) Electric Light and Power Company to recover damages for an alleged infringement of certain telephone patents which the plaintiff claims to control.

D. E. Connor, ex-city engineer of Covington, Ky., has, it is said, perfected and patented a system of underground trolley for electric cars that is thought to be absolutely perfect. When Professor Clark, of the Patent Office, saw the device, says the Cincinnati *Times-Star*, he advised that it be patented in all foreign countries before being placed in the market, and this has been done. The Cleveland syndicate, controlling all the lines in Covington and Newport and in Cleveland, O., have engaged Mr. Connor to go to Cleveland and change one of their cable roads in the Forest City to an underground trolley line. The system uses a slot the same as a cable road, and a carrier similar to that which grasps the cable. The wire lies dead in the slot except a few feet each side of where it is picked up by the carrier as it rolls along. The system is continuous and does not have to be charged at intervals as is the case with other conduit systems.

G. E. GREEN GOODS.

A Very Tough Man Expresses His Opinion in a Very Tough Manner.

The following is a portion of a circular which was passed around Wall and State streets a couple of weeks ago. It is reprinted here for the benefit of our out-of-town friends who did not receive a copy:

"De undersigned is prepared ter offer ter de public big er little lots uv G. E. at figgers dat'll make de enamel drop off de teeth er de fakirs dat has been workin' de public on Red, N. P., U. P., Atch., N. E. er N. C.

"Dey ain't been no time in de history uv Wall St. dat er more convenient class er Goods hev been shown up et easy prices.

"De Goods we offer'll nail er sucker every time, an' fer de N. E. an' N. Y. trade dere simply out er sight.

"Dese G. E. Goods ain't no chump stuff dat yer got ter work off down er cellar or under der wharf. Dey has backers, dese Goods has, an' nobody ain't got no license ter kick if he gets nabbed in de act.

"Dese Goods has been shoved by de swellest mob dat ever worked de public an' dere names sells de Goods every time.

"Dis ain't no case er Pullhard, Ringheart, BarkLeod er Watchbury, dat just trow up der hands an' turn de stuff over ter er Receiver when der chips is all blown in, and de suckers whats lost der boodle appeals to der feelins. Yer can bet yer life dese Goods ain't no case er feelins uv any kind.

"De backers er dese Goods has got de sand ter play de game plum to de limit, and keep on playing it when de whole outfit is blown in—chips, cards and de box—and when er chump puts up any squeal 'bout Receivers dey just looks im in de eye and dey say 'Yer er d—— liar, and if yer don't close yer trap and git, we'll put de coppers onter yer,' and den dey gets de papers ter print dat he's er d—— liar, and dat he orter be sent up. Dat's de kind er goods we'se offering yer, an yer can just go broke er dealin' in 'em.

"Ter give yer an idee uv de sand dats behind dese Goods, so thet yer kin figger whedder it's plum safe ter handle 'em, git onter what de backers uv dese Goods has done. Dey sold 'em by de barrel at 120 sluggers apiece, an swore on er stack er Bibles dat in er couple er moons dey'd be sellin' at 150, and when dey got de suckers' stuff dey plunked er down ter 80, an when de chumps squealed for dere mun dey just give 'em de laugh, and told 'em ter be dead game an even up by buying more, an dey did. Den dey swinged er down ter 50, and when dey squealed agen dey asked wha' te 'ell dey was goin' ter do about it, and dey been asking 'em ever since, an yer kin gamble all de dividends that G. E. pays in '94 agin de '93 dividends on dat Western Whiskey Fake dat dey'll ask 'em de same question when de Goods sells at 20 an 10, an when dey is finally deposited in de sewer.

"In closin' dis offer de undersign calls yer attention to dis big advantage day ain't offered wid any oder line uv Green Goods in de market:

"Wid every lot we gives er printed denial uv any story dat any one kin tell about de Goods, an dey'll be signed by de President or de Vice-President or any er de Directors. or by prominent officials or strong friends uv de Goods.

"Den we furnish printed statements er profits ter fit any case dat may come up. We don't give er d—— what yer call fer yer kin have, er dat de Goods is earnin' a thousand er day, or more dan enough in er minit ter pay off de National Debt. and wid every lot goes er big red poster dat day ain't no Court in de land dat cares to monkey wid dis game, an in er few monts dividends 'll be resumed.

"Den again we calls particular attention ter de fact dat de backers er dese Goods don't allow no one ter monkey wid 'em—de minit any bloke interferes wid de game dey get de papers to prove dat he's er d— - lyin, thievin scoundrel uv er bear, who don't know better dan ter tell de public dere is er difference between er National Bank an er Faro Bank.

"Don't forget when yer write fer dese Goods ter give yer right name, fer der ain't no law can tackle dis game, an' keep yer eye on de fact dat we sell assorted lots, an dat de quicker yer buy de higher de price'll be an' de more boodle yer can scoop.

"Holy Gee, if yer only got aboard when de stuff was up ter 120 yer'n had money ter burn. Yours, out fer de stuff.

"LOADEM, SHORTEM & GRINATEM."

Boston Notes.

The Interstate and other local electric stree railways which take their power from the central station located at Farmers, near Attleboro, Mass., had hard luck last Tuesday morning when the station took fire and before it could be extinguished $75,000 worth of engines, dynamos, generators, etc., were destroyed. This serious conflagration completely demoralized about 24 miles of electric railway and throws out of work for the time being over 100 men. The power and light station was not very conveniently situated, so the fire, while a very serious loss, will undoubtedly lead to the building and equipping of a far finer station in the town of Attleboro.

The movement in favor of municipal ownership of gas, electric light and similar enterprises appears to be finding increasing favor in Massachusetts. The placing of all electric wires, too, underground is extending, so that at the present time in four cities, viz., Newton, Salem, Worcester and Holyoke, the telephone companies are placing their wires in conduits of their own. Cambridge made a move in the same direction and with practical results, although the order compelling the change has been passed but a few months. For the benefit of our readers we here insert the order as passed and now being acted upon: "That the mayor be requested to petition the next General Court for such legislation as will enable cities and towns in this commonwealth to construct and maintain conduits and manholes in their respective streets. And that the various companies now maintaining overhead wires be required to place their wires and cables in the conduits of the city, and that such company shall pay to the city or town constructing said conduits such rental as will ensure the return of not less than 10 per cent. upon the money invested in such conduits." Those who supported this order claim that it will hasten the placing of wires underground, and will alleviate all those difficulties that would be likely to occur if the various electrical companies were allowed to construct their own subways. The general opinion is that the order will pass the Legislature and the municipal authorities secure the power they ask and proceed with the undertaking forthwith.

The directors of the New England Street Railway Company, it is reported, have finally decided to declare a quarterly dividend of 1 per cent., payable January 15th, as against 1½ per cent. as heretofore. The question has been a good deal debated whether to declare or pass the dividend. The books show that the dividend has been earned, but the floating debt of the subsidiary companies rather embarrassed the directors until they determined to capitalize it.

The Worcester Consolidated Railway Company's directors have voted to fund the floating debt by the issue of $500,000 five per cent. mortgage bonds.

Although 1894 is only a week old, there is a prosperous electric manufacturing company in this city—the W. S. Hill Electric Company—that has been asked to furnish estimates for no less than six large switchboards; and what is satisfactory to note, so fine a reputation does this firm enjoy for high grade work of the kind that it has already secured several of the contracts and expects to close the rest in a few days.

There is trouble and dissatisfaction between the directors and employees of the West End Railway of Boston. For the present year an elaborate schedule of time and wages had been prepared after full discussion between the directors and the men. The very first day the new order of things took effect the men claimed that the company had taken advantage of them and were not carrying out their part of the contract. The men soon got worked up into a state of excitement, and at one time it looked as though they might refuse to run the cars. They were, however, conciliated for the time being under promise that what they complained of should be set right, and it has been done.

There is weeping and wailing in Lynn among the vast army of unemployed workmen who formerly were engaged in the factories of the General Electric Company, while there is much gnashing of teeth among the stockholders of the now cadaverous Trust against the gross mismanagement of the prevaricating incompetents who have wrecked what was intended once to be a good paying business. There are now something over 400 hands at work in the extensive factories at West Lynn, and according to most men's calculations it is only a short time ere the above force will be materially reduced. To what purposes, after the last car of machinery has been shipped to Schenectady, these extensive buildings will be put is at present uncertain. Rumor has it that a new rubber company, at present in process of organization, will occupy part; another part may be utilized for shoe manufacturing, while a large portion may be utilized by the Boston and Maine Railroad for freight sheds and repair shops. These suppositions are simply in the air and may never assume any more tangible form than airy nothings. May it not be that these huge factories with their splendid equipment will take on life and activity once more and be an integral factor in the future development of electrical science when they have come into the hands of the Siemens & Halske Company, of Berlin, Germany, the enterprising corporation whose advent in this country it was once sought to prevent by sending Mr. C. A. Coffin to Berlin to buy them off? Such is the latest rumor as to the future of the Lynn factory. The whirligig of time brings many changes, and they who live longest will see the most. Meantime the exodus from Lynn to Schenectady continues, and what few of the boys there are remaining are assuming a lively gait in acting on that kindly suggestion made by the Great Mogul, Mr. Coffin, at the time of the formation of the Trust, that the rest of the electric crowd might just as well strike their tents and get out, for he and his friends were going to monopolize the entire business. Yes, in faith, the boys are getting out as fast as they can; but it's the General Electric crowd that's "gitting," while the rest of the electrical fraternity looks on, snickers, and winks the other eye.

General News.

What is Going on in the Electrical World.

Paterson, N. J.—Mayor Braun is in favor of the city owning and operating an electric plant for city service.

Dowagiac, Mich.—Fred E. Lee has purchased the Commercial Electric Light system from the city for $6,000, and has begun operating the plant.

Hoboken, N. J.—The North Hudson Railroad Company has asked council for permission to change its motive power from horse to electricity.

Denver, Col.—The Electrical Specialty Company, capitalized at $50,000, has filed with the Secretary of State a certificate of full paid up stock.

Parkersburg, W. Va.—The *Journal* advocates the building of an electric street railway, and says it would be of great benefit to the city and the suburbs.

Newton, Mass.—The mayor recommends the earnest consideration of the plan proposed by the street light committee for securing a municipal gas and electric light plant.

Attleboro, Mass.—Fire on the 2d inst. completely destroyed the plant of the Attleboro and North Attleboro Electric Company at Farmers Village. The loss will probably exceed $70,000.

Utica, N. Y.—The Utica Electric Light and Power Company has renewed its lighting contract with the city, and will add three new dynamos, with an aggregate of 100 horse power, to its plant.

Hollidaysburg, Pa.—The Logan Valley Electric Railway Company's power house, together with a large amount of rolling stock and machinery, was burned last week. The loss is put at $50,000; the insurance on the property was $40,-000.

Lockport, N. Y.—The Cowles Electric Smelting and Aluminum Company of Lockport and the Pittsburg Aluminum Company have, it is rumored, ended their legal disputes by consolidating, and the local plant will be removed to Niagara Falls by the consolidated company.

Savannah, Ga.—The Board of Directors of the Electric Railway Company as reconstructed is as follows: J. S. Collins, president; T. W. Wrenne, Jacob Paulsen, W. J. Lindsay, W. K. Wilkinson, R. M. Hicks, T. Nugent, H. Logan, H. H. Hull, H. C. Cunningham, W. G. Cooper.

Wyoming, Pa.—Electricity is to be introduced into the Mount Lookout colliery. It is to be for hauling coal inside the workings from the breast to the foot of the shaft. The trolley system will be used. The plant will be located outside, and will be used also to light the workings with incandescent lamps.

Leavenworth, Kan.—The committee having charge of the electric railway ordinance, including the mayor, have reported it unanimously to the city council, recommending its passage. The indications, therefore, are favorable for the early construction and operation of an electric road within the city and to the Fort and the Soldiers' Home.

Omaha, Neb.—The Nebraska Telephone Company expended $240,000 during the past year in the way of extensions and improvements, two-thirds of which was invested in this city. Outside of the city $90,000 was expended in the extension of new lines and the changing of grounded lines to complete metallic circuits.

Kansas City, Mo.—The Kansas City Electrical Works are to engage in the manufacture of the new "Midland" dynamos, which, says a local paper, "will necessitate the employment of a large number of men in the near future and will result in building up an industry in Kansas City equal to any of the great electrical machine shops in the East."

Newark, N. J.—The Consolidated Traction Company has, it is reported, secured practically all the stock of the New Jersey Traction Company, and will therefore have control of all the lines in Newark except the South Orange, the new line from Jersey City to Newark, all the Jersey City and Bergen and Elizabeth lines except the North Hudson and Union County.

San Francisco.—Among the electrical fixtures of the Mid-Winter Fair are a great electrical fountain, a tower nearly 300 feet high studded in all its outlines and crosspieces with incandescent lights to the number of nearly 5,000, a cyclorama showing in eruption the Hawaiian volcano Kilauea and a scenic theatre with grand electrical effects. In addition to these the exterior and interior lighting by arc and incandescent lamps will be on a most elaborate scale.

New York.—The secretary of the Board of Electrical Control reports that during the past year the two subway companies have built in the city 100½ miles of telegraph and telephone subways, and 43¾ miles of electric light and power subways. The city now has 847 miles of telegraph and telephone subways, and 820 miles of the electric kind. In the former there are 32,600 miles of wire, and in the latter 1,300 miles. There are now in New York 6,790 arc lamps for commercial and city lighting, 268,000 incandescent lamps and nearly 10,000 telephones, most of them operated through the subways.

Philadelphia.—The Maritime Exchange of this city has been notified that the telephone line connecting Lewes, Del., with Cape Charles, Va., has been completed, placing Lewes in direct communication with the life-saving stations at Ocean City, Assateague, Watchapwreague and Cape Charles. News of maritime disasters and other information important to shipping interests will by means of this wire be at once communicated to the station at Lewes and from there telegraphed to the Maritime Exchanges in this city, New York and Baltimore.

Baltimore.—Work has begun on the long-talked-of boulevard between this city and Washington, of which an electric railway is to be an important feature. The boulevard will be thirty-two miles long and 100 feet wide. It will be nearly an air line between the two cities. The trolley system is to be used on the cars, and a speed of thirty miles an hour is expected. The work will cost about $3,000,000. The Baltimore and Washington Tramway Company, the corporation undertaking the enterprise, intends to push the work so as to complete the boulevard and the railway in a year's time.

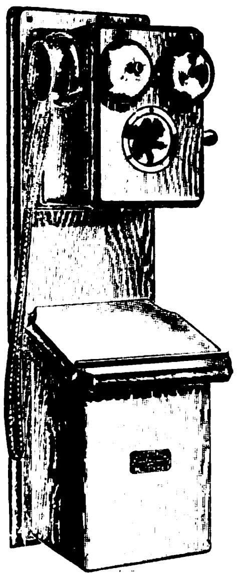
Brooklyn, N. Y.—At the annual meeting of the stockholders of the Citizens' Electric Illuminating Company for the election of trustees for the ensuing year, held on the 3d inst., the present board of trustees was re-elected, as follows: Hugh McLaughlin, John Delmar, James Shevlin, Thomas F. Nevis and Anthony Barrett. —The Railroad Commissioners announce that they have granted permission to the Nassau Railway Company, the Kings County Electric Railway Company, and the Coney Island, Fort Hamilton and Brooklyn Railway Company, none of which has yet been built, to use the electric trolley system on their respective roads, when constructed. — A franchise has been granted to the Thirty-ninth Street and Suburban Railroad Company to run a trolley line through Flatlands and Flatbush to Jamaica Bay.

Hartford, Conn.—The *Courant* states that a large electric railway scheme is being gradually unfolded, including the operation by a syndicate with abundant capital, not local, of the Hartford Suburban Railway Company and the Hartford Light and Power Company. Other companies recently chartered which the Suburban will acquire or control are: The Hartford and West Hartford Horse Railway Company, the Hartford and Middletown Railway Company, the Enfield and Somers Tramway Company and the Windsor and Suffield Tramway Company. The directors of the Hartford Suburban Railway Company are: David Henney, of Unionville, Conn.; Wilbur E. Goodwin, of Elmwood; William F. Henney, W. R. Hurd, William H. Goodrich, Samuel Frisbie, of Farmington; C. M. Henney, F. C. Rockwell, of West Hartford; H. B. Goodwin, J. B. Henney and P. H. Quinn. David Henney was elected president, W. R. Hurd vice-president, Wilbur E. Goodwin treasurer and William H. Goodrich secretary.

Another Boston Telephone.

Well nigh two decades have passed since Professor Alexander Graham Bell, in and of Boston at that time, astounded the world with his wonderful invention, the telephone.

Since the invention was made, patented, sold and placed on the market, along the passing years during which the whole civilized globe has been receiving its equipment, or enjoying the benefits and advantages of the telephone service, the chief offices of the Bell Telephone Company have been retained at the Hub of the Universe. The colossal dimensions and proportions assumed by the parent company have borne unmistakable testimony to the skill and shrewdness of the early exploiters and later the managers of this gigantic business.

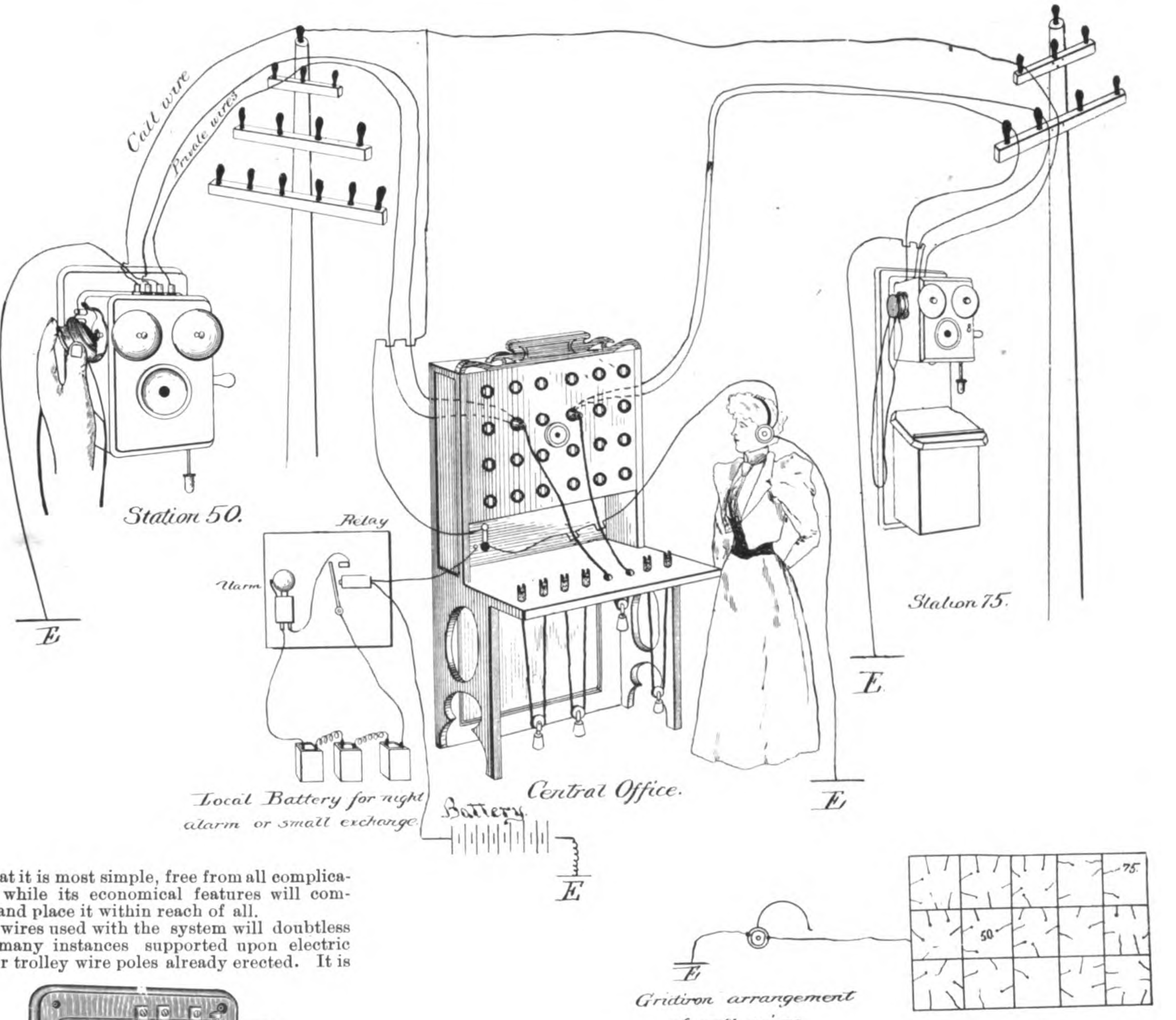


But the seventeen years which constitute the allotted life of an American patent have well nigh run the course, and the 31st day of this current month of January, 1894, will witness the expiration of a fundamental telephone patent which throws open the entire field for the advent of other inventions of a telephonic character which, with the added knowledge, experience and skill of these seventeen years, it is honestly believed will show most marked improvement on the Bell invention and allied auxiliaries.

And again Boston is to the fore in improved telephony, with a sure and certain prospect of more widely popularizing the use of the telephone both in the matter of efficient service and, what is of supreme importance these times, less cost than ever.

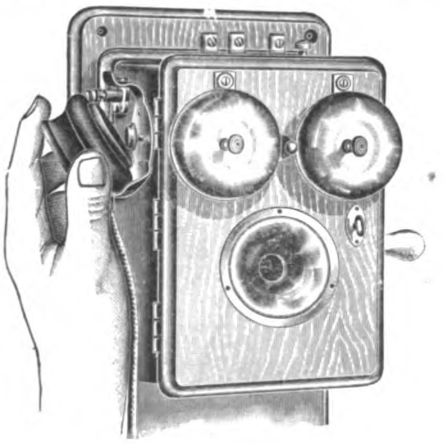
This statement is borne out by the present article and accompanying cuts, which illustrate a new system, the merits and advantages of which are vouched for by more than one of the foremost legal and scientific experts in the country, who have examined, tested and used the same, pronouncing it to be the very thing now needed to fill the bill and give satisfaction to all.

ELECTRICITY has from the first striven to keep its readers posted in each successive stage of development in every department of the art and science of electricity, and has pleasure in publishing exclusively an article descriptive of this latest candidate for telephonic honors, with the assurance that the promoters of this enterprise cannot fail to speedily reap rich rewards for its system. It may be stated, then, that the accompanying sketch exhibits an exchange system decidedly new, for which a patent has been applied. One of the leading patent lawyers in the country assures the owners that they avoid all existing patents; therefore they are prepared to protect their customers from any damages arising from alleged infringement. It is claimed for this system that it is most simple, free from all complications, while its economical features will commend and place it within reach of all.



Gridiron arrangement of call wires.

The wires used with the system will doubtless be in many instances supported upon electric light or trolley wire poles already erected. It is imperatively necessary in such cases that metallic circuits should be used in preference to ground connections, to prevent induction. Two wires are carried from central station to each subscriber. When these wires are connected by operator at central station with any subscriber, the said operator is prevented from listening to the conversation.



A third wire, which is grounded through the head receiver of the operator at central station, "gridirons" the territory operated by the "exchange" and is tapped at each subscriber's station, as shown in cut. This is always an open circuit until the subscriber pulls down the cord at bottom of bell box, which grounds his call wire, enabling him to call "central" for desired connection. For example, telephone number 50 desires to talk with telephone 75. Number 50 takes the receiver from its holder, places it to his ear, and pulls down the cord at bottom of bell box; this connects him with the third or general signal wire running to central station; he then calls into his transmitter "75 on 50," immediately releasing said cord after calling, always giving his own number last, to enable the operator to know who he is. When cord has been released a sharp click will be heard, which assures him that his call has been received; if the click is not heard, he should again pull down the cord and call "75 on 50," releasing the cord as before. When the click is heard, he replaces the receiver in its holder and rings up 75 direct—the party called for.

If upon turning the crank of bell his own bell refuses to ring, it is evidence that telephone 75 is busy talking with some other subscriber, and number 50 will have to call again later on, unless the operator should ring him up, having connected the line in the meantime. After the conversation is completed, before replacing the receiver in its holder, number 50 should again pull down the cord from bottom of bell box and call into his transmitter, "Disconnect number 50"; this must always be done, for should another subscriber desire to talk with number 50, the operator would think his line still in use.

In small exchanges or central stations that may be located in a postoffice or store, or at any place where the continuous services of an operator are not warranted on the score of economy, a clerk or any other party may serve. The operator's instrument can be switched on to an alarm to sound a call when a subscriber desires to be connected, the subscriber pulling down his cord below the bell box and listening until his call is answered by "central," who will connect as requested. To avoid the maintenance of battery at "central" the call wire relay, shown in switchboard diagram, can be operated by the subscriber, who, without removing the receiver, pulls down the bell cord at bottom of bell box and holds it while turning his generator handle; this notifies attendant at "central" that "central" is wanted. He then places receiver to his ear and upon hearing the operator or attendant at "central" calls for number or subscriber wanted.

The above applies only to small "exchanges" or "central offices" where a *permanent* operator is not required.

The subscriber, when connected by "central," is enabled to do his own ringing up, as a call is not always promptly replied to. This feature alone permits the permanent operator to attend to answering calls, making connections without losing time in ringing bells and waiting for delinquents. This will also apply to a clerk or other party acting as operator; they will simply connect the wires, leaving the subscriber to do his own ringing up. The subscriber is also assured of the fact that if he cannot ring up the party wanted it is by no means the fault of central office.

As above stated, metallic circuits must be used in connection with an exchange system if electric light or trolley wire poles are to be utilized. The wire used should be of 14 or 16 gauge hard drawn copper, which is the cheapest wire in the end.

How to Earn Dividends.

It is an axiom that has been demonstrated time and time again since electricity was first used on a commercial scale for light and power purposes that if profits were to be earned upon the capital invested in these new enterprises the coal bin must be considered of primary importance and treated accordingly. Engines, dynamos, generators, indeed every piece of apparatus, whether team or electrical, of the most improved and efficient type might be installed, but if the fuel used under the boilers was not carefully attended to there could be no possibility of ever earning dividends on capital invested. The experience of innumerable lighting and power companies throughout the world proves the truthfulness of this fact, hence it is that companies, presidents, superintendents and managers have tried their best to solve the problem, to overcome the difficulty, and to avoid the loss, with but varying and not very encouraging success. At last, however, many have discovered how to end their troubles and to put their companies on a sound dividend-earning basis. A process has been formulated by means of which most astounding results have been attained, thanks to the enterprise, energy and scientific skill of a corporation known as the Northwestern Land and Coal Company, whose chief offices are in the Ames Building, Boston, with branch offices in the leading cities of the United States.

This company owns and is selling in immense quantities "394," a preparation which combines and utilizes the gases that are ordinarily thrown off in the burning of coal, thereby increasing its heating power. It has been found by practical demonstration to be of great commercial value. It can be used successfully on anthracite, bituminous or lignite, and can be easily applied under the simple instructions furnished for users. It promotes and quickens the combustion of the coal, reinforces the fires, produces a higher temperature, and generates more steam than when coal is burned in its natural state. It prevents the escape of smoke or free carbon, thereby causing complete combustion. It increases the horse power of boilers, prevents the formation of clinkers, makes one-third less ashes, and effects a net economy in the consumption of coal of from 10 to 20 per cent. It saves the grate bars, keeps the flues clean, and displaces blowers, which are expensive to keep in running order. It reduces the labor of firemen. No alterations are required for burning coal when thus treated.

The "394" is being successfully used as a steam producer, fuel saver and smoke destroyer by Electric Light Companies, Water Companies, Manufactories, Cable Roads and in domestic service.

This compound has been tested, experimented with and used by many of the foremost scientific men in the country, and the company is in receipt of most flattering letters of commendation and tabulated analyses of comparative tests all alike testifying to the merits of this preparation. Not only so, but managers of electric light and power plants, water works, textile factories, engine factories and others who now use it regularly are unanimous in their praise of it. They assert that they are effecting a saving in their coal bills of as much as 33 1-3 per cent.

Such a matter as this is deserving the prompt attention of all steam users, and from the substantial recognition already won by it, and the increasing volume of business the company is enjoying, it is clear that this is the sure and certain way at last discovered to earning good annual dividends.

Columbia Lamps at Lower Prices.

The Columbia Incandescent Lamp Company of St. Louis, the only one of the outside lamp companies which defeated the claims of the General Electric Company for the Edison patent, have issued the following announcement:

We beg to advise you that on and after the 10th day of January the price of Columbia lamps will be as follows:

10, 16 and 20 c. p. lamps, - - - -	$.32½ net.
25 " " - - - - -	35 "
32 " " - - - -	50 "
50 " " - - - - - -	75 "
Special railway and anchored filament,	37½ "

The above prices are for barrel lots and over. For less quantities than barrel lots, 2½ cents each will be added.

The same high grade of the Columbia Lamp will be maintained. We are enabled to make this reduction by reason of the magnificent support which has been given us by the users of incandescent lamps throughout the United States during the past year, which has enabled us to largely increase our manufacturing facilities and add additional machinery which has reduced the cost.

The development of electric railroads in Canadian cities has been altogether subsequent to our last tariff revision, and a duty of $6 a ton on steel rails tends to check that development. This duty is not imposed on steam road rails. Delegations have waited on the Government to ask the removal of the duty, which was intended only for horse car lines. The matter is under consideration, but it is expected the duty will be removed. --*Iron Age Canadian Correspondent.*

Reduced Prices for Beacon Lamps.

The Beacon Vacuum Pump and Electrical Company, under date of January 1, announces a new price list, as follows:

16 c. p. in lots of 1,000 or over, - - - -	30 cts.
" " " " 500 - - - - - -	31 "
" " in barrel lots (bbls. containing 200),	32 "
" " in smaller quantities, - - - - -	35 "

They also call attention to the following:

The lamp, which is the invention of Messrs. Nickerson and Cary, to whom over twenty fundamental patents have been granted, was first put on the market last summer.

Since then these experts have been working constantly to reach the high quality which characterized the old Beacon lamp and made it a standard of perfection. This standard has been attained and at the same time the cost of manufacture has been reduced.

The company is now prepared to guarantee satisfaction and prompt shipments, and solicits correspondence from manufacturers desirous of making lamps under N. & C. licenses.

"Acme" Portable Testing Set.

Queen & Company, Incorporated, Philadelphia, are making a renewed push of their "Acme" Portable Testing Set, which was temporarily withdrawn from the market because of certain small defects which have now been overcome in a thoroughly satisfactory manner.

Commercial Note.

Heubel & Mauger, manufacturers of electrical and brass goods, 286-290 Graham street, Brooklyn, have issued a new catalogue calling the attention of purchasers to their numerous electrical specialties. Among these may be mentioned their bells, switches, push-buttons and other accessories for house wiring, all of which are to be commended for their superior quality and reasonable price.

INCORPORATIONS.

The Fuller Incandescent Heat and Light Company, Chicago, Ill.—to purchase, sell, use and operate and license others to use and operate patents, patent rights, generators, motors for generating electricity, etc. Capital stock, $1,000,000. Promoters: J. T. Kretzinger, C. E. V. Akerberg, M. F. Gallagher.

The Universal Electric Heat and Light Company, Chicago, Ill.—to purchase, sell, use and operate and license others to use and operate patents, patent rights, generators, motors for generating electricity, etc. Capital stock, $100,000. Promoters: J. T. Kretzinger, C. E. V. Akerberg, M. F. Gallagher.

The Sidney Power Company, Salem, Oregon—to construct and operate a plant for manufacturing, generating and transmitting electricity. Capital stock, $50,000. Promoters: J. M. Wallace, J. M. Kyle, H. T. Wallace, all of Salem.

The New Decatur (Ala.) Natural Gas, Petroleum and Mining Company, Freehold, N. J.—to manufacture, buy, sell, lease and use machinery, generators, motors, pipes, pumps, apparatus, devices, supplies and articles of every kind appertaining to or in any wise connected with the production, use, distribution, etc., of electricity, natural gas, petroleum, etc. Capital stock, $100,000. Promoters: Thos. Rutter, James Swann, Chas. Y. Kent, New York City; Acton Hartshorne, Freehold, N. J.; John D. Probst, Englewood, N. J.

The United States Wenstrom Electric Company, Jersey City, N. J.—to manufacture, buy, sell and lease electrical dynamos, motors, electrical machines. Capital stock, $80,000. Promoters: Benjamin Blum, Chas. S. Cowan, New York City; Joseph B. de Lery, South Lakewood, N. J.

The Electric Land and Improvement Company, of Orleans, N. Y. Capital stock, $40,000. Directors: Louis Fobes, John Fobes and A. J. Schlager, of Binghamton.

The Toledo and Maumee Valley Railway Company, Toledo, Ohio—to build and operate by electricity or other motive power a railway having Toledo and Perrysburg as its termini, etc. Capital stock, $300,000. Incorporators: Wm. B. Taylor, Josiah D. Cook, George G. Metzger, Parks Foster and Grant Williams.

The Inter-Urban Electric Railway Company, La Salle, Ill. Capital stock, $250,000. Incorporators: C. W. Palmer, R. M. Gardner, M. C. Vanfleet.

Subjacent Electric Wires Traction Company, Chicago. Capital stock, $1,000,000. Incorporators: Charles M. Hill, Charles Rose, Thomas N. McCauley.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED DECEMBER 26, 1893.

ELECTRIC RAILWAYS AND APPLIANCES.

511,342. Conduit Railway Trolley. John C. Love, Chicago, Ill., assignor to the Love Electric Traction Company, same place. Filed May 17, 1892.

511,343. Trolley for Conduit Railways. John C. Love, Chicago, Ill., assignor to the Love Electric Traction Company, same place. Filed May 17, 1892.

511,346. Trolley Bar Carrier for Cars. John C. Love, Philadelphia, Pa., assignor to the Love Electric Traction Company, Chicago, Ill. Filed Jan. 21, 1893. Renewed Nov. 11, 1893.

511,419. Trolley Wire Crossing. Henry Geise, Philadelphia, Pa., assignor of one-half to Edwin Jaquett Sellers and Horace Pettit, same place. Filed June 26, 1893.

511,452. Conduit for Electric Railways. Henry D. Oler, Paterson, N. J. Filed Aug. 23, 1892.

511,524. Converter System for Electric Railways. Gustaf E. Hesso, Brooklyn, N. Y., assignor of five-eighths to William W. Share and Valdemar F. Lassoe, same place. Filed Nov. 21, 1892.

511,627. Electric Railway Switching Mechanism. Charles J. Kintner, New York, N. Y. Filed June 24, 1893.

511,634. Trolley Base. James L. Mauldin, Cleveland, Ohio, assignor of one-half to Frank J. Lewis, same place. Filed March 20, 1893.

ELECTRIC LIGHTS AND APPLIANCES.

511,495. Electric Arc Lamp. Reginald Belfield, London, England, assignor to George Westinghouse, Jr., Pittsburg, Pa. Filed April 5, 1893.

511,527. Automatic Electric Light Extinguisher. Geo. M. Hughes and George T. Reed, Baltimore, Md., assignors to the Automatic Electric Light Extinguisher Company of Baltimore City. Filed March 17, 1893.

511,613. Rosette for Electric Lights. Charles N. Hammond, Boston, Mass., assignor to the Hammond Cleat and Insulator Company, same place. Filed June 30, 1893.

MOTORS, DYNAMOS, ETC.

511,347. Governor for Electric Motors. John Marty, Jr., Cleveland, Ohio. Filed Oct. 10, 1892.

511,375. Method of and Means for Compounding Dynamo-Electric Machines. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company of New York. Filed Nov. 23, 1892.

511,448. Electric Locomotive. John G. McCormick, Louisville, Ky. Filed April 1, 1892.

511,523. Current Regulator for Dynamo-Electric Machines. Charles D. Haskins, Brooklyn, N. Y., assignor to the Western Electric Company, Chicago, Ill. Filed Nov. 12, 1892.

511,559. Electrical Transmission of Power. Nikola Tesla, New York, N. Y., assignor to the Tesla Electric Company, same place. Filed Dec. 8, 1888.

511,560. System of Electrical Power Transmission. Nikola Tesla, New York, N. Y., assignor to the Tesla Electric Company, same place. Filed Dec. 8, 1888.

511,570. Rotary Electro-Magnetic Engine. Henry P. White, Kalamazoo, Mich. Filed Feb. 15, 1893.

511,621. Electric Motor Apparatus. William A. Johnston, Arthur W. Browne and John C. Davidson, Prince's Bay, N. Y., assignors to the S. S. White Dental Manufacturing Company, Philadelphia, Pa. Filed April 25, 1893.

TELEPHONE AND TELEGRAPH APPARATUS.

511,358. Telephone. Barton Pickering, Dayton, Ohio. Filed Jan. 29, 1881.

511,456. Telephonic Instrument. Parnell Rabbidge, Sydney, New South Wales. Filed April 22, 1893.

511,462. Fire Alarm Telegraph. Charles H. Rudd, Chicago, Ill., assignor to the Western Electric Company, same place. Filed May 19, 1892. Renewed May 15, 1893.

511,464. Multiple Switchboard System for Telephone Exchanges. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed April 26, 1893.

511,589. Telephone System. Frank R. Colvin, New York, N. Y. Filed June 26, 1893.

511,739. Telephone System. John J. McNally, California, Mo. Filed Aug. 31, 1893.

ELECTRICAL MEASURING INSTRUMENTS.

511,376. Electrical Measuring Instrument. Elihu Thomson, Swampscott, assignor to the General Electric Company, Boston, Mass. Filed March 2, 1893.

511,401. Electric Meter. Lucien Brillie, Paris, France. Filed Nov. 22, 1893.

511,508. Electric Measuring Apparatus. Theodor Bruger, Bockenheim, near Frankfort-on-the-Main, Germany, assignor to Hartmann & Braun, same place, Filed Aug. 19, 1893.

511,647. Electric Grain-Weighing Scale. John Outcalt and David De P. A. Outcalt, Spotswood, N, J. Filed July 8, 1893.

INSULATORS.

511,611. Insulator. Charles N. Hammond, Boston, Mass., assignor, by direct and mesne assignments, to the Hammond Cleat and Insulator Company, same place. Filed Sept. 1, 1892.

511,612. Insulator. Charles N. Hammond, Boston, Mass., assignor to the Hammond Cleat and Insulator Company, same place. Filed April 12, 1893.

CONDUCTORS.

511,344. Support for Electrical Conductors. John C. Love, Philadelphia, Pa., assignor to the Love Electric Traction Company, Chicago, Ill. Filed Jan. 21, 1893.

511,345. Tension Device for Electric Conductors. John C. Love, Philadelphia, Pa., assignor to the Love Electric Traction Company, Chicago, Ill. Filed Jan. 21, 1893.

MISCELLANEOUS.

511,328. Method of Electric Commutation and a Fluid Electric Commutator. Charles E. Emery, Brooklyn, N. Y. Filed Dec. 28, 1892.

511,434. Galvanic Battery. Harry T. Johnson, New York, N. Y. Filed April 21, 1893.

511,451. Electric Bell. Augustus J. Oehring, Chicago, Ill., assignor to the Western Electric Company, same place. Filed April 25, 1891.

511,461. Safety Device for Electric Circuits. Charles H. Rudd, Evanston, assignor to the Western Electric Company, Chicago, Ill. Filed Dec. 10, 1888.

511,512. Machine for Separating Magnetic from Non-Magnetic Substances. George G. Crosby, New York, N. Y., assignor to the Magnetic Iron Milling Company of Tennessee. Filed Jan. 11, 1893.

511,514. Process of and Composition for the Manufacture of Porous Cups for Electrical Batteries. Frank G. Curtis, Philadelphia, Pa. Filed Feb. 13, 1893.

511,547. Electric Wire Covering. Franklin S. Randall, Philadelphia, Pa. Filed June 2, 1893.

511,574. Electric Transformer. James J. Wood, Fort Wayne, Ind. Filed May 19, 1893.

511,682. Electrolyzing Apparatus. Antoine J. O. Chalandre, Paris, France, assignor to the Society Outhenin Chalandre Fils et Cie, same place. Filed Sept. 13, 1893.

511,731. Electric Signaling Apparatus. Thomas B. Doolittle, Bridgeport, Conn. Filed Feb. 13, 1893.

511,742. Electric Cautery Apparatus. James A. Wotten and Earnest A. Bostrom, Atlanta, Ga. Filed June 26, 1893.

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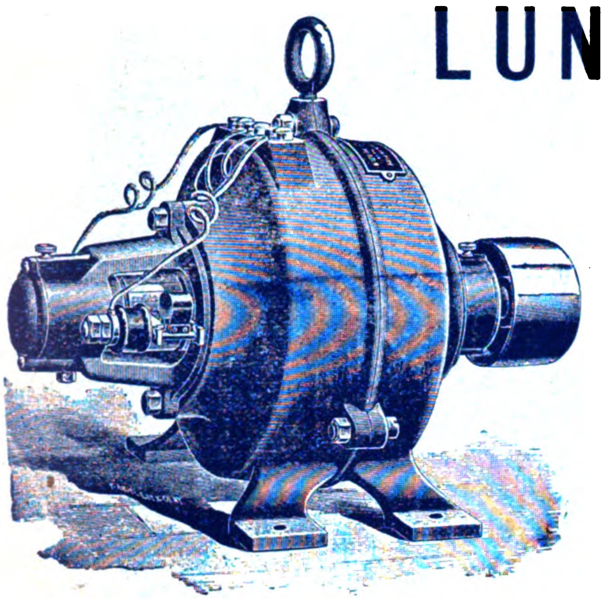

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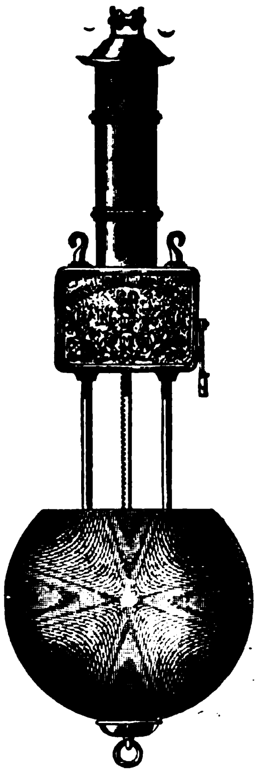

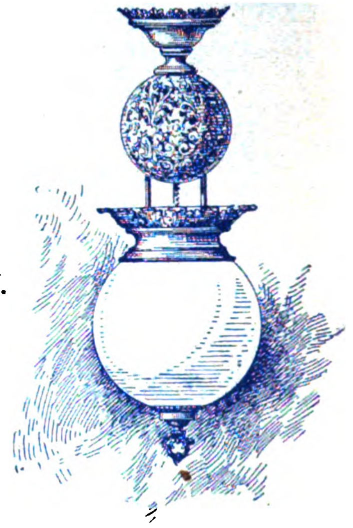

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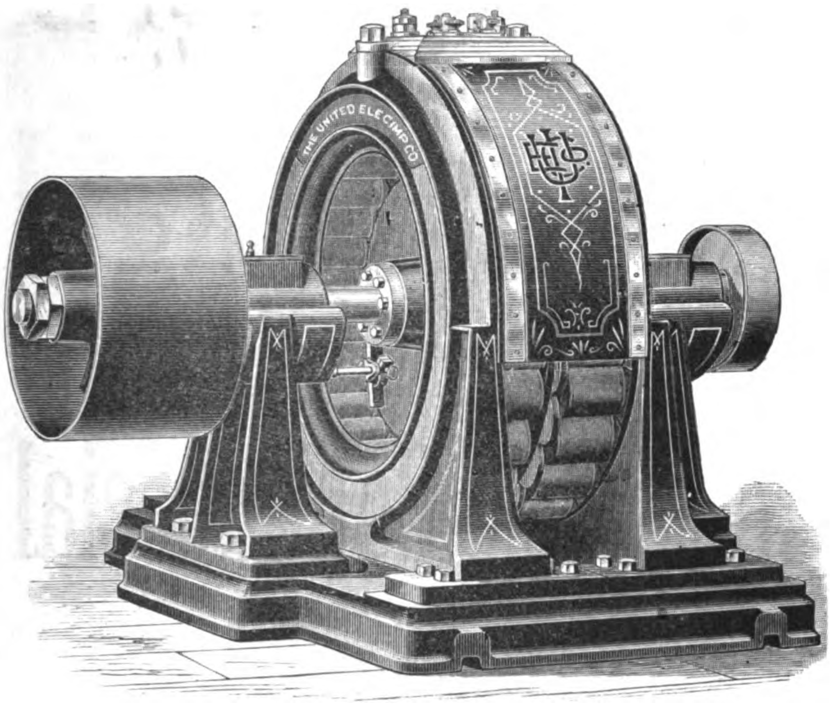

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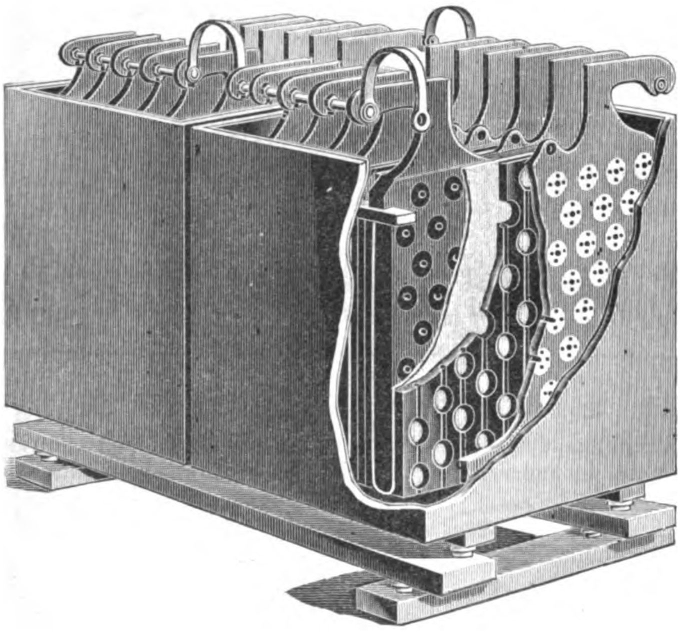

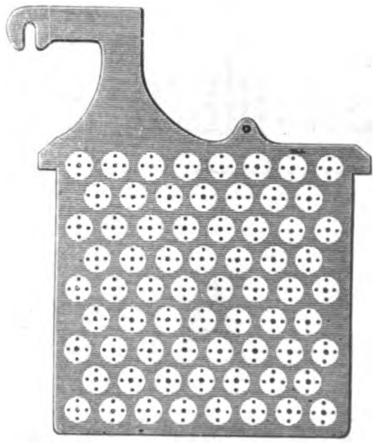

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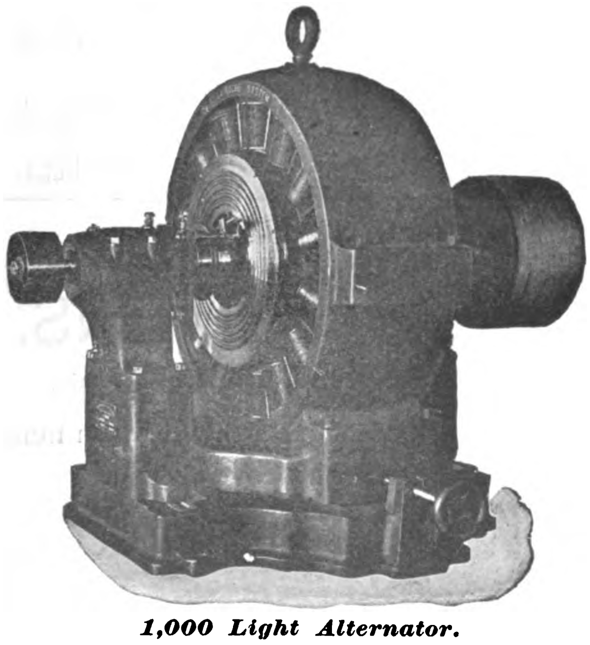

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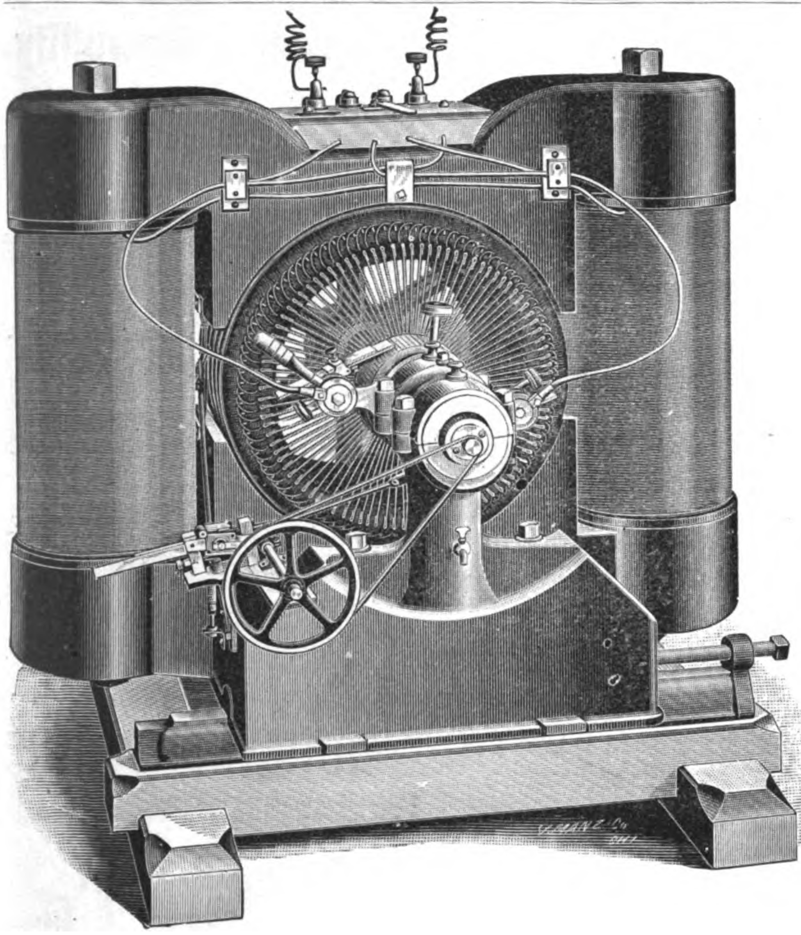

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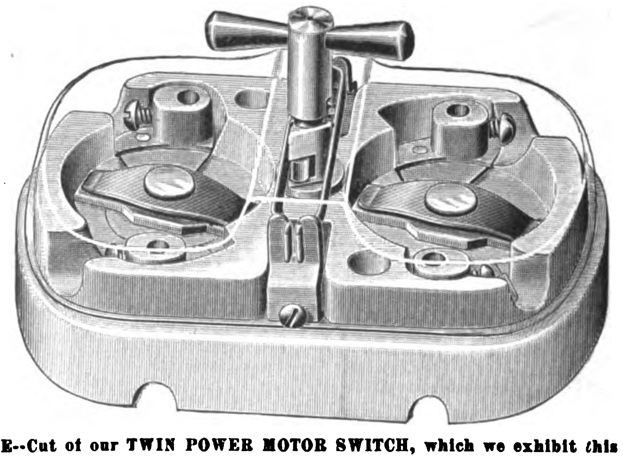

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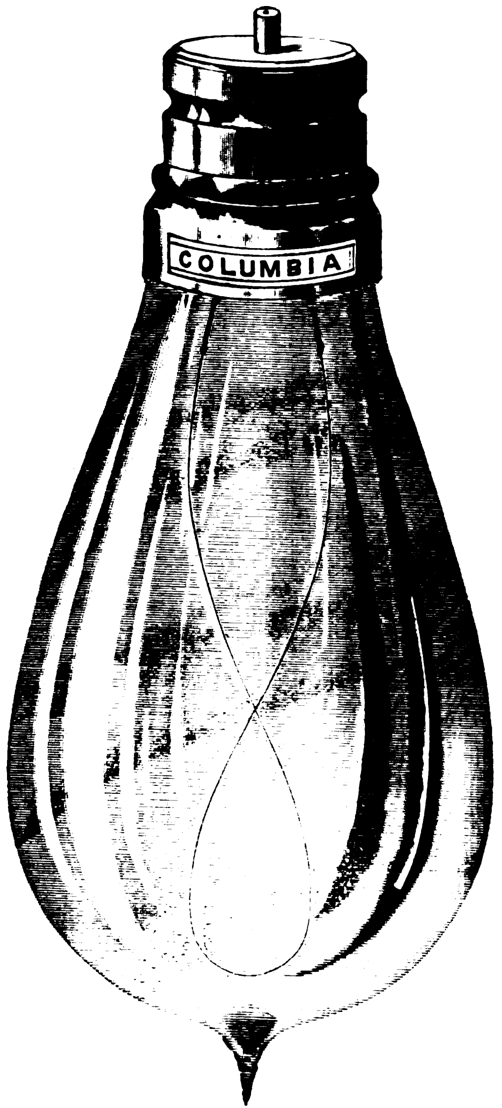

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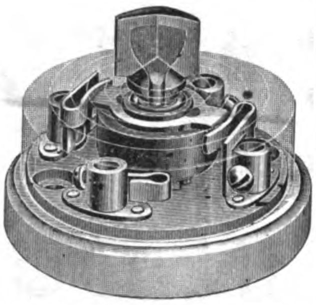

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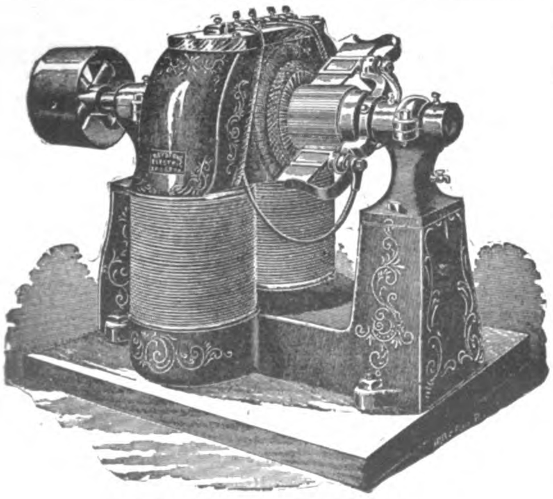

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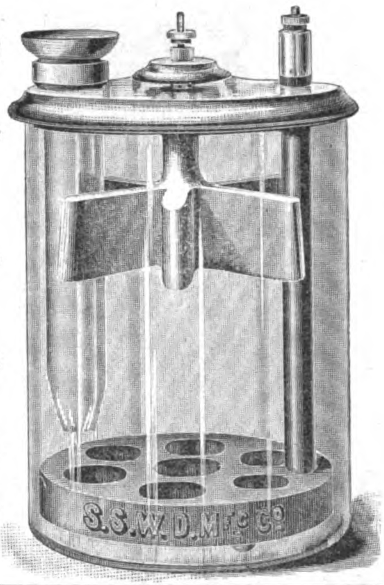

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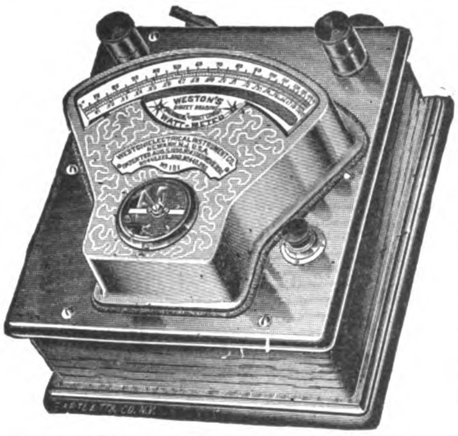

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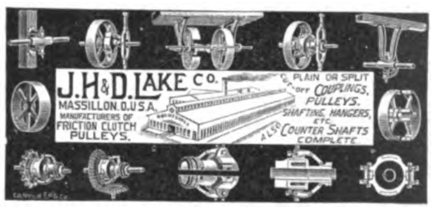

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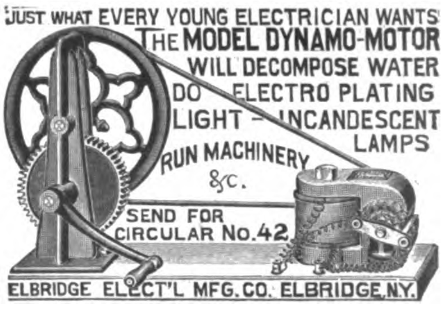

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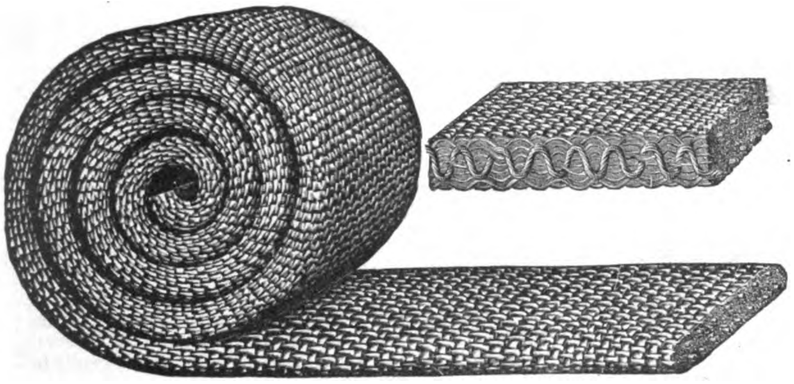

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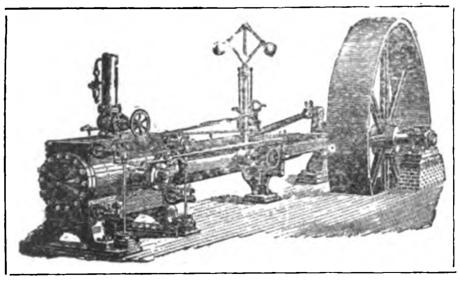

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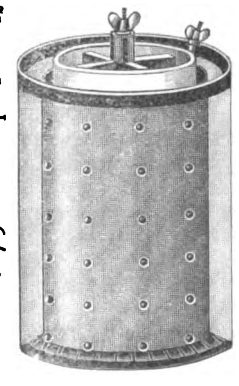

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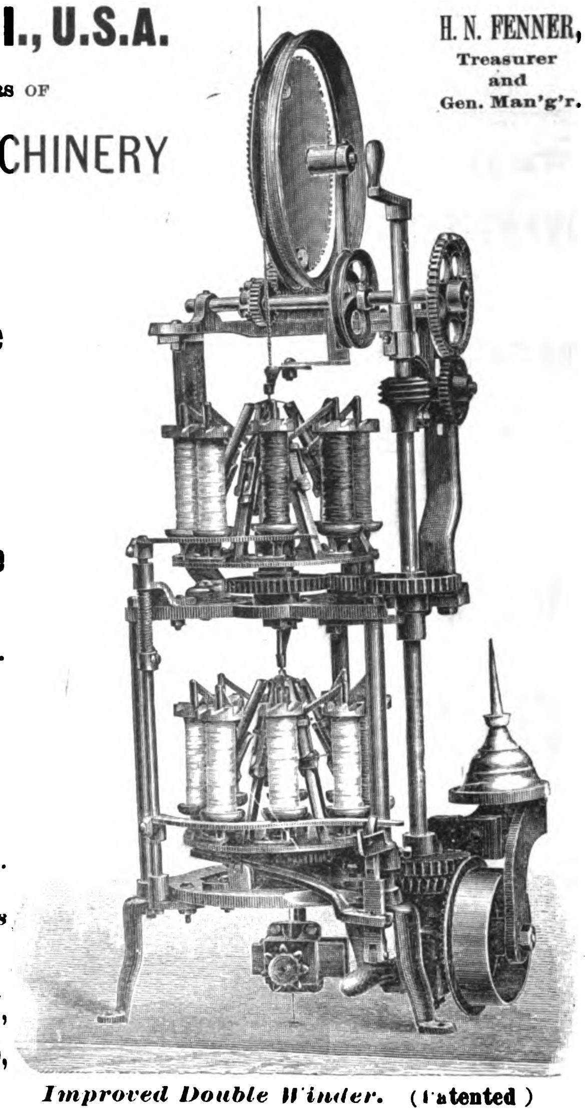

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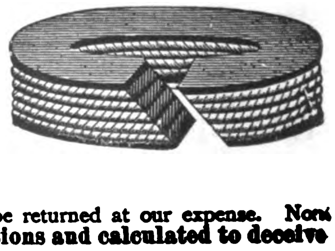

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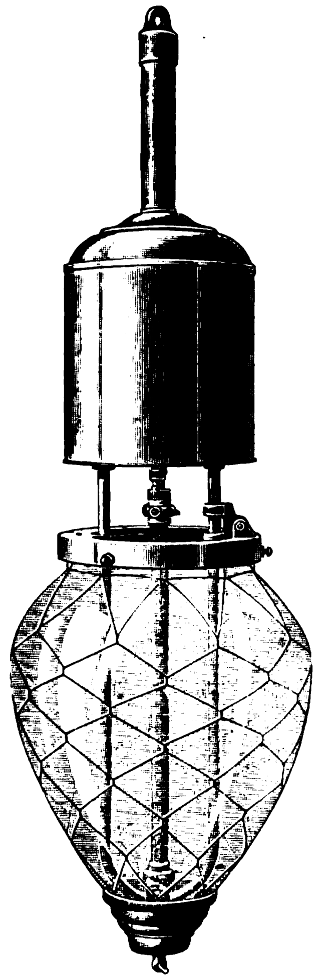

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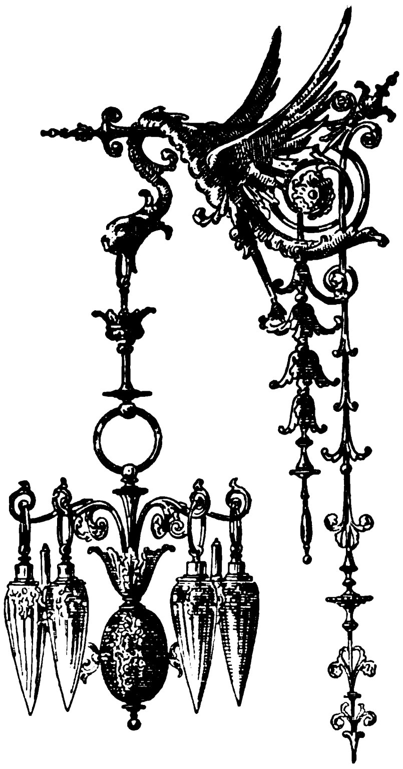

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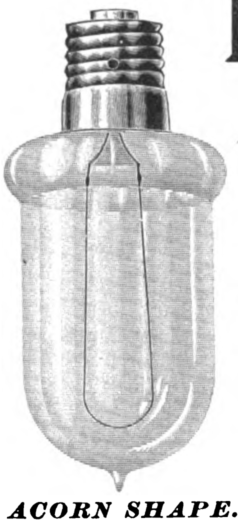

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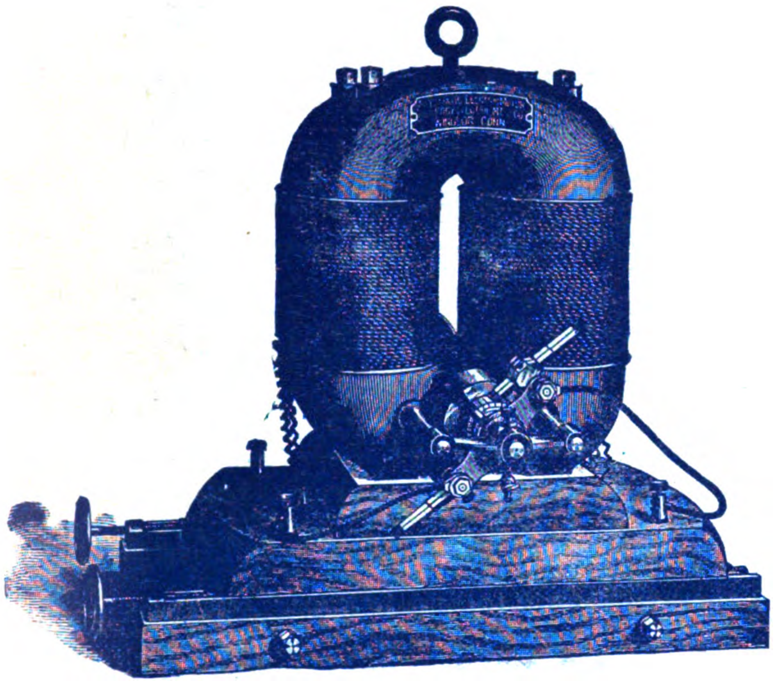

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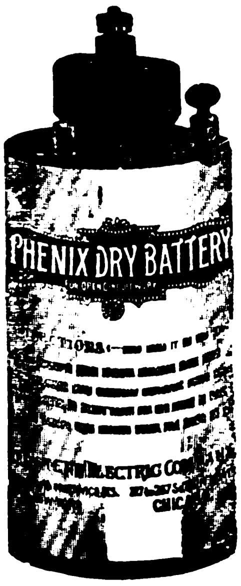

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